



# **Jawaharlal Nehru Technological University Anantapur**

*(Established by Govt. of A.P., Act. No. 30 of 2008)*

**Ananthapuramu-515 002 (A.P) India**

## **B.Tech. in Electronics & Communication Engineering Course Structure and Syllabi under R19 Regulations**

<b>JNTUA Curriculum</b>
<b>Electronics and Communication Engineering B. Tech Course Structure</b>

<b>S.No.</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P-C</b>
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counselling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

<b>Semester - I (Theory - 4, Lab - 4)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A54101	Algebra & Calculus	BS	3-1-0	4
2.	19A56101T	Applied Physics	BS	3-0-0	3
3.	19A05101T	Problem Solving & Programming	ES	3-1-0	4
4.	19A52101T	Communicative English 1	HS	2-0-0	2
5.	19A04101	Electronics & Communication Engineering Workshop	LC	0-0-2	1
6.	19A56101P	Applied Physics Lab	BS	0-0-3	1.5
7.	19A05101P	Problem Solving & Programming Lab	ES	0-0-3	1.5
8.	19A52101P	Communicative English 1 Lab	HS	0-0-2	1
<b>Total</b>					<b>18</b>

<b>Semester - II (Theory - 4, Lab - 5)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A04201T	Network Theory	ES	3-0-0	3
2.	19A54201	Differential Equations and Vector Calculus	BS	3-1-0	4
3.	19A51102T	Chemistry	BS	3-0-0	3
4.	19A05201T	Data Structures	ES	3-0-0	3
5.	19A03101	Engineering Workshop	LC	0-0-2	1
6.	19A03102	Engineering Graphics Lab	ES	1-0-4	3
7.	19A04201P	Network Theory Lab	ES	0-0-3	1.5
8.	19A51102P	Chemistry Lab	BS	0-0-3	1.5
9.	19A05201P	Data Structures Lab	ES	0-0-3	1.5
<b>Total</b>					<b>21.5</b>

<b>Semester – III (Theory - 6, Lab –3, MC-1)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A54302	Complex Variables and Transforms	BS	3-0-0	3
2.	19A04301	Signals & Systems	PC	3-0-0	3
3.	19A04302T	Electronic Devices and Circuits	PC	3-0-0	3
4.	19A04303	Probability Theory and Stochastic Processes	PC	3-0-0	3
5.	19A04304	Digital Electronics and Logic Design	PC	3-0-0	3
6.	19A02304T	Electrical Technology	ES	3-0-0	3
7.	19A04302P	Electronic Devices and Circuits Lab	PC	0-0-3	1.5
8.	19A04305	Basic Simulation Lab	PC	0-0-2	1
9.	19A02304P	Electrical Technology Lab	ES	0-0-2	1
10.	19A99302	Biology For Engineers	HS	3-0-0	0
<b>Total</b>					<b>21.5</b>

<b>Semester – IV (Theory - 7, Lab –2, MC-1)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A04401	Electromagnetic Waves and Transmission lines	PC	3-0-0	3
2.	19A04402T	Electronic Circuits – Analysis and Design	PC	3-0-0	3
3.	19A02404	Control Systems	ES	3-0-0	3
4.	19A04403T	Analog Communications	PC	3-0-0	3
5.	19A05304T	Python Programming	ES	2-1-0	3
6.	19A04404	Computer Architecture and Organization	PC	3-0-0	3
7.	19A52301	Universal Human Values	HS	2-0-0	2
8.	19A04402P	Electronic Circuits – Analysis and Design Lab	PC	0-0-3	1.5
9.	19A04403P	Analog Communications Lab	PC	0-0-3	1.5
10.	19A99301	Environmental Science	BS	3-0-0	0
<b>Total</b>					<b>23</b>

<b>Semester - V (Theory - 6, Lab - 3)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
1.	19A04501T	Integrated Circuits and Applications	PC	2-0-0	2
2.	19A04502	Antennas and Wave Propagation	PC	3-0-0	3
3.	19A52601T	English Language Skills	HS	3-0-0	3
4.	19A04503T	Digital Communications	PC	3-0-0	3
5.	19A05403T 19A02403 19A05303T 19A04504a 19A04504b	Professional Elective-I Operating Systems Power Electronics Object Oriented Programming Data Communications and Networks Nano Electronics	PC	3-0-0	3
6.	19A01506a 19A01506b 19A02506a 19A03506a  19A03506b 19A05506a 19A05506b  19A27506a 19A27506b  19A54506a 19A52506a  19A51506a	Open Elective-I Experimental stress analysis. Building Technology Electrical Engineering Materials Introduction to Hybrid and Electric Vehicles Rapid Prototyping Free and Open Sources Systems Computer Graphics and Multimedia Animation Brewing Technology Computer Applications in Food Technology Optimization Techniques Technical Communication and Presentation Skills Chemistry of Energy Materials	OE	3-0-0	3
7.	19A04501P	Integrated Circuits and Applications Lab	PC	0-0-3	1.5
8.	19A52601P	English Language Skills Lab	HS	0-0-3	1.5
9.	19A04503P	Digital Communications Lab	PC	0-0-2	1
10.	19A04507	Socially Relevant Project		0-0-1	0.5
11.	19A99601	Research Methodology (Mandatory course)		3-0-0	0
				<b>Total</b>	<b>21.5</b>

Semester – VI (Theory - 6, Lab –2, MC-1)					
S.No	Course No	Course Name	Category	L-T-P	Credits
1.	19A04601T	Microprocessors and Microcontrollers	PC	3-0-0	3
2.	19A04602T	Digital Signal Processing	PC	3-0-0	3
3.	19A04603	Digital System Design through VHDL	PC	3-0-0	3
4.	19A04605a	Professional Elective-II (MOOC) Introduction to Wireless and Cellular Communications (IITMadras)	PC	3-0-0	3
	19A04605b	Fabrication Techniques for MEMs-based sensors (IISc, Bangalore)			
	19A04605c	Advances in UHV Transmission and Distribution (IISc Bangalore)			
	19A04605d	Electrical Measurement and Electronic Instruments (IIT KGP)			
	19A04605e	Principles and Techniques of Modern Radar Systems (offered by IIT KGP)			
5.	19A01604a	Open Elective-II Industrial waste and wastewater management.	OE	3-0-0	3
	19A01604b	Building Services & Maintenance			
	19A02604a	Industrial Automation			
	19A02604b	System Reliability Concepts			
	19A03604a	Introduction to Mechatronics			
	19A03604b	Optimization techniques through MATLAB			
	19A05604a	Fundamentals of VR/AR/MR			
	19A05604b	Data Science			
	19A27604a	Food Toxicology			
	19A27604b	Food Plant Equipment Design			
	19A54604a	Wavelet Transforms & its applications			
	19A52604a	Soft Skills			
	19A51604a	Chemistry of Polymers and Its Applications			
6.	19A52602a	Humanities Elective-I Entrepreneurship & Incubation	HS	3-0-0	3
	19A52602b	Managerial Economics and Financial Analysis Business Ethics and Corporate Governance			
	19A52602c	Enterprise Resource Planning Supply Chain Management			
	19A52602d				
	19A52602e				
7.	19A04602P	Digital Signal Processing Lab	PC	0-0-3	1.5
8.	19A04601P	Microprocessors and Microcontrollers Lab	PC	0-0-3	1.5
9.	19A04606	Socially Relevant Project		0-0-1	0.5
10.	19A99501	Constitution of India (Mandatory Course)		3-0-0	0
11.	19A04607	Industrial Training/Skill Development/Research Project*	PR	-----	-----
				<b>Total</b>	<b>21.5</b>

<b>Semester – VII (Theory - 5, Lab -2 )</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
<b>1.</b>	19A04701T	Microwave Engineering and Optical Communications	PC	3-0-0	3
<b>2.</b>	19A04702T	VLSI Design	PC	3-0-0	3
<b>3.</b>	19A04703a 19A04703b 19A04703c 19A04703d 19A04703e	Professional Elective-III Satellite Communications Digital TV Engineering Embedded Systems Image Processing Advanced Digital Signal Processing	PE	3-0-0	3
<b>4.</b>	19A01704a 19A01704b 19A02704a 19A02704b 19A03704a 19A03704b 19A05704a 19A05704b 19A27704a 19A27704b 19A54704a 19A51704a	Open Elective-III Air pollution and control. Basics of civil Engineering Renewable Energy Systems Electric Vehicle Engineering Finite element methods Product Marketing Fundamentals of Game Development Cyber Security Corporate Governance in Food Industries Process Technology for Convenience & RTE Foods Numerical Methods for Engineers (ECE , CSE, IT &CE ) Chemistry of Nanomaterials and Applications	OE	3-0-0	3
<b>5.</b>	19A52701a 19A52701b 19A52701c 19A52701d 19A52701e	Humanities Elective-II Organizational Behavior Management Science Business Environment Strategic Management E-Business	HS	3-0-0	3
<b>6.</b>	19A04701P	Microwave and Optical Communications Lab	PC	0-0-3	1.5
<b>7.</b>	19A04702P	VLSI Design Lab	PC	0-0-3	1.5
<b>8.</b>	19A04705	Industrial Training/Skill Development/Research Project	PR	-----	2
				<b>Total</b>	<b>20</b>

<b>Semester – VIII (Theory - 2)</b>					
<b>S.No</b>	<b>Course No</b>	<b>Course Name</b>	<b>Category</b>	<b>L-T-P</b>	<b>Credits</b>
<b>1.</b>	19A04801a	Professional Elective-IV Advanced 3G and 4G Wireless Mobile Communications	PE	3-0-0	3
	19A04801b	Introduction to Internet of Things			
	19A04801c	Fuzzy sets, logic and systems and Applications			
	19A04801d	Biomedical Signal Processing			
	19A04801e	Analog IC design			
<b>2.</b>	19A01802a	Open Elective-IV Disaster Management.	OE	3-0-0	3
	19A01802b	Global Warming and climate changes			
	19A02802a	IoT Applications in Electrical Engineering			
	19A02802b	Smart Electric Grid			
	19A03802a	Energy conservation and management			
	19A03802b	Non destructive testing			
	19A05802a	Block Chain Technology and Applications			
	19A05802b	MEAN Stack Technology			
	19A27802a	Food Plants Utilities & Services			
	19A27802b	Nutraceuticals & Functional Foods			
	19A54802a	Mathematical Modeling & Simulation			
	19A51802a	Green Chemistry and Catalysis for Sustainable Environment			
	<b>3.</b>	19A04803			
				<b>Total</b>	<b>13</b>



## Honours Degree in ECE

S.No.	Course No.	Course Name	L	T	P	Credits
1.	19A04H01	Automotive Electronics	3	1	0	4
2.	19A04H02	Low power VLSI Design.	3	1	0	4
3.	19A04H03	Pattern Recognition	3	1	0	4
4.	19A04H04	Micro Electromechanical Systems	3	1	0	4
5.	19A04H05	VLSI Testing and Testability	3	1	0	4
<b>Total</b>						<b>20</b>

## Minor Degree in ECE

S.No.	Course No.	Course Name	L	T	P	Credits
1.	19A04301	Signals and Systems	3	0	0	3
2.	19A04302T	Electronics Devices and Circuits	3	0	0	3
3.	19A04304	Digital Electronics and Logic Design	3	0	0	3
4.	19A04503T	Digital Communications	3	0	0	3
5.	19A04602T	Digital Signal Processing	3	0	0	3
6.	19A04M01	Minor Discipline Project	-	-	-	5
<b>Total</b>						<b>20</b>

**(19A54101) ALGEBRA & CALCULUS**  
(Common to all branches of Engineering)

**Course Objectives:**

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

**Bridge Course:** Limits, continuity, Types of matrices

**Unit 1:Matrices**

**10 hrs**

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- solving systems of linear equations, using technology to facilitate row reduction determine the rank, eigenvalues and eigenvectors, diagonal form and different factorizations of a matrix; (L3)
- identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics; (L3)

**Unit 2: Mean Value Theorems**

**6 hrs**

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof);

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Translate the given function as series of Taylor's and Maclaurin's with remainders (L3)
- analyze the behaviour of functions by using mean value theorems (L3)

**Unit 3: Multivariable calculus**

**8 hrs**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies. (L3)
- Acquire the Knowledge maxima and minima of functions of several variable (L1)
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables (L3)

### **Unit 4:Multiple Integrals**

**10hrs**

Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves. Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates.

### **Learning Outcomes:**

- At the end of this unit, the student will be able to
- Evaluate double integrals of functions of several variables in two dimensions using Cartesian and polar coordinates (L5)
- Apply double integration techniques in evaluating areas bounded by region (L4)
- Evaluate multiple integrals in Cartesian, cylindrical and spherical geometries (L5)

### **Unit 5:Special Functions**

**6 hrs**

Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- understand beta and gamma functions and its relations (L2)
- Conclude the use of special function in evaluating definite integrals (L4)

### **Text Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

### **Reference Books:**

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 201.
4. Micheael Greenberg, Advanced Engineering Mathematics, 9<sup>th</sup> edition, Pearson edn
5. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
6. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.

7. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
8. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education
9. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
10. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

**Course Outcomes:**

At the end of the course, the student will be able to

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- Utilize mean value theorems to real life problems (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional coordinate systems (L5)
- Students will become familiar with 3- dimensional coordinate systems and also learn the utilization of special functions

**(19A56101T) APPLIED PHYSICS**  
**(ECE, CSE, EEE & IT Branches)**

**Course Objectives:**

- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications.
- To explain the significant concepts of dielectric and magnetic materials this leads to potential applications in the emerging micro devices.
- To impart knowledge in basic concepts of electromagnetic waves and its propagation in optical fibers along with its Engineering applications.
- To identify the importance of semiconductors in the functioning of electronic devices.
- To teach the concepts related to superconductivity which lead to their fascinating applications.
- To familiarize the applications of nanomaterials relevant to engineering branches.

**Unit-I : Wave Optics**

**8hrs**

Interference-Principle of Superposition-Interference of light-Conditions for sustained Interference -Interference in thin films (reflected light)-Newton's Rings-Determination of Wavelength- Engineering applications of Interference

Diffraction-Fraunhofer Diffraction-Single and Double slits - Diffraction Grating – Grating Spectrum -Determination of Wavelength - Engineering applications of diffraction

Polarization-Polarization by double refraction-Nicol's Prism--Half wave and Quarter wave plate- Engineering applications of Polarization.

**Unit Outcomes:**

**The students will be able to**

- **explain** the need of coherent sources and the conditions for sustained interference (L2)
- **identify** engineering applications of interference including homodyne and heterodyne detection (L3)
- **analyze** the differences between interference and diffraction with applications (L4)
- **illustrate** the concept of polarization of light and its applications (L2)
- **classify** ordinary polarized light and extraordinary polarized light (L2)

**Unit-II : Dielectric and Magnetic Materials**

**(8hrs)**

Introduction--Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations: Electronic and Ionic, (Quantitative), Orientation Polarizations (Qualitative) - Frequency dependence of polarization-Lorentz (internal) field-Claussius - Mosotti equation-Applications of Dielectrics: Ferroelectricity.

Introduction-Magnetic dipole moment-Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment -Classification of Magnetic materials-Weiss theory of ferromagnetism (qualitative)-Hysteresis-soft and hard magnetic materials-Magnetic device applications (Magnetic bubble memory).

#### **Unit Outcomes:**

##### **The students will be able to**

- **explain** the concept of dielectric constant and polarization in dielectric materials (L2)
- **summarize** various types of polarization of dielectrics (L2)
- **interpret** Lorentz field and Clausius- Mosotti relation in dielectrics (L2)
- **classify** the magnetic materials based on susceptibility and their temperature dependence (L2)
- **explain** the applications of dielectric and magnetic materials (L2)
- **Apply** the concept of magnetism to magnetic devices (L3)

#### **Unit – III: Electromagnetic Waves and Fiber Optics**

**10hrs**

Divergence and Curl of Electric and Magnetic Fields- Gauss' theorem for divergence and Stokes' theorem for curl- Maxwell's Equations (Quantitative)- Electromagnetic wave propagation (Non-conducting medium) -Poynting's Theorem.

Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation-Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile –Propagation of electromagnetic wave through optical fiber – modes -importance of V-number-Attenuation, Block Diagram of Fiber optic Communication -Medical Applications-Fiber optic Sensors.

#### **Unit Outcomes:**

##### **The students will be able to**

- **apply** the Gauss' theorem for divergence and Stokes' theorem for curl (L3)
- **evaluate** the Maxwell's equations, Maxwell's displacement current and correction in Ampere's law (L5)
- **asses** the electromagnetic wave propagation and its power in non-conducting medium (L5)
- **explain** the working principle of optical fibers (L2)
- **classify** optical fibers based on refractive index profile and mode of propagation (L2)
- **identify** the applications of optical fibers in medical, communication and other fields (L2)
- **Apply** the fiber optic concepts in various fields (L3).

#### **Unit – IV: Semiconductors**

**8 hrs**

Origin of energy bands - Classification of solids based on energy bands – Intrinsic semiconductors - density of charge carriers-Fermi energy – Electrical conductivity - extrinsic semiconductors - P-type & N-type - Density of charge carriers - Dependence of Fermi energy on carrier concentration and temperature- Direct and Indirect band gap semiconductors-Hall

effect- Hall coefficient - Applications of Hall effect - Drift and Diffusion currents - Continuity equation - Applications of Semiconductors.

### **Unit Outcomes:**

The students will be able to

- **classify** the energy bands of semiconductors (L2)
- **outline** the properties of n-type and p-type semiconductors and charge carriers (L2)
- **interpret** the direct and indirect band gap semiconductors (L2)
- **identify** the type of semiconductor using Hall effect (L2)
- **identify** applications of semiconductors in electronic devices (L2)

### **Unit – V: Superconductors and Nanomaterials**

**8 hrs**

Superconductors-Properties- Meissner's effect-BCS Theory-Josephson effect (AC &DC)-Types of Super conductors-Applications of superconductors.

Nano materials – Significance of nanoscale – Properties of nanomaterials: Physical, Mechanical, Magnetic, Optical – Synthesis of nanomaterials: Top-down-Ball Milling, Bottom-up -Chemical vapour deposition – characterization of nanomaterials: X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM) - Applications of Nano materials.

### **Unit Outcomes:**

The students will be able to

- **explain** how electrical resistivity of solids changes with temperature (L2)
- **classify** superconductors based on Meissner's effect (L2)
- **explain** Meissner's effect, BCS theory & Josephson effect in superconductors (L2)
- **identify** the nano size dependent properties of nanomaterials (L2)
- **illustrate** the methods for the synthesis and characterization of nanomaterials (L2)
- **Apply** the basic properties of nanomaterials in various Engineering branches (L3).

### **Text Books:**

1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy” A Text book of Engineering Physics”- S. Chand Publications, 11<sup>th</sup> Edition 2019.
2. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2012.

### **Reference Books:**

1. Shatendra Sharma, Jyotsna Sharma, “ Engineering Physics”, Pearson Education,2018
2. David J.Griffiths, “Introduction to Electrodynamics”- 4/e, Pearson Education,2014
3. T Pradeep “A Text book of Nano Science and Nano Technology”- Tata Mc GrawHill 2013

### **Course Outcomes:**

The students will be able to

- **identify** the wave properties of light and the interaction of energy with the matter (L3)
- **apply** electromagnetic wave propagation in different guided media (L2)
- **asses** the electromagnetic wave propagation and its power in different media (L5)
- **calculate** conductivity of semiconductors (L3)
- **interpret** the difference between normal conductor and superconductor (L2)
- **demonstrate** the application of nanomaterials (L2)



**(19A05101T) PROBLEM SOLVING AND PROGRAMMING**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

1. Introduce the internal parts of a computer, and peripherals.
2. Introduce the Concept of Algorithm and use it to solve computational problems
3. Identify the computational and non-computational problems
4. Teach the syntax and semantics of a C Programming language
5. Demonstrate the use of Control structures of C Programming language
6. Illustrate the methodology for solving Computational problems

**Unit 1:**

**Computer Fundamentals: What is a Computer, Evolution of Computers, Generations of Computers, Classification of Computers, Anatomy of a Computer, Memory revisited, Introduction to Operating systems, Operational overview of a CPU.**

**Introduction to Programming, Algorithms and Flowcharts:** Programs and Programming, Programming languages, Compiler, Interpreter, Loader, Linker, Program execution, Fourth generation languages, Fifth generation languages, Classification of Programming languages, Structured programming concept, Algorithms, Pseudo-code, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.

**Unit Outcomes:**

Student should be able to

1. Identify the different peripherals, ports and connecting cables in a PC (L2)
2. Illustrate the working of a Computer (L3)
3. Select the components of a Computer in the market and assemble a computer (L4)
4. Solve complex problems using language independent notations (L3)

**Unit 2:**

**Introduction to computer problem solving:** Introduction, the problem-solving aspect, top-down design, implementation of algorithms, the efficiency of algorithms, the analysis of algorithms.

**Fundamental algorithms:** Exchanging the values of two variables, counting, summation of a set of numbers, factorial computation, sine function computation, generation of the Fibonacci sequence, reversing the digits of an integer.

**Learning Outcomes:** Student should be able to

1. Solve Computational problems (L3)
2. Apply Algorithmic approach to solving problems (L3)
3. Analyze the algorithms (L4)

### **Unit 3:**

**Types, Operators, and Expressions:** Variable names, data types and sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

**Input and output:** standard input and output, formatted output-Printf, formatted input-Scanf.

**Control Flow:** Statements and blocks, if-else, else-if, switch, Loops-while and for, Loops-Do-while, break and continue, Goto and labels.

**Functions and Program Structure:** Basics of functions, functions returning non-integers, external variables, scope variables, header variables, register variables, block structure, initialization, recursion, the C processor.

**Learning Outcomes:** Student should be able to

1. Recognize the programming elements of C Programming language (L1)
2. Select the control structure for solving the problem (L4)
3. Apply modular approach for solving the problem (L3)

### **Unit 4:**

**Factoring methods:** Finding the square root of a number, the smallest divisor of a number, the greatest common divisor of two integers, generating prime numbers.

**Pointers and arrays:** Pointers and addresses, pointers and function arguments, pointers and arrays, address arithmetic, character pointers and functions, pointer array; pointers to pointers, Multi-dimensional arrays, initialization of arrays, pointer vs. multi-dimensional arrays, command line arguments, pointers to functions, complicated declarations.

**Array Techniques:** Array order reversal, finding the maximum number in a set, removal of duplicates from an order array, finding the  $k^{\text{th}}$  smallest element

**Learning Outcomes:** Student should be able to

1. Solve mathematical problems using C Programming language (L3)
2. Structure the individual data elements to simplify the solutions (L6)
3. Facilitate efficient memory utilization (L6)

### **Unit 5:**

**Sorting and Searching:** Sorting by selection, sorting by exchange, sorting by insertion, sorting by partitioning, binary search.

**Structures:** Basics of structures, structures and functions, arrays of structures, pointers to structures, self-referential structures, table lookup, typedef, unions, bit-fields.

**Some other Features:** Variable-length argument lists, formatted input-Scanf, file access, Error handling-stderr and exit, Line Input and Output, Miscellaneous Functions.

**Learning Outcomes:** Student should be able to

1. Select sorting algorithm based on the type of the data (L4)
2. Organize heterogeneous data (L6)
3. Design a sorting algorithm (L6)

**Text Books:**

1. Pradip Dey, and Manas Ghosh, “Programming in C”, 2018, Oxford University Press.
2. R.G. Dromey, “How to Solve it by Computer”. 2014, Pearson.
3. Brian W. Kernighan, and Dennis M. Ritchie, “The C Programming Language”, 2<sup>nd</sup> Edition, Pearson.

**Reference Books:**

1. RS Bichkar “Programming with C”, 2012, Universities Press.
2. Pelin Aksoy, and Laura Denardis, “Information Technology in Theory”, 2017, Cengage Learning.
3. Byron Gottfried and Jitender Kumar Chhabra, “Programming with C”, 4<sup>th</sup> Edition, 2019, McGraw Hill Education.

**Course Outcomes:**

1. Construct his own computer using parts (L6).
2. Recognize the importance of programming language independent constructs (L2)
3. Solve computational problems (L3)
4. Select the features of C language appropriate for solving a problem (L4)
5. Design computer programs for real world problems (L6)
6. Organize the data which is more appropriated for solving a problem (L6)

(19A52101T) COMMUNICATIVE ENGLISH I  
(Common to All Branches of Engineering)

### Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

### Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

### Unit 1

**Listening:** Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information. **Reading for Writing:** Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.

### Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

## Unit 2

**Listening:** Answering a series of questions about main idea and supporting ideas after listening to audio texts. **Speaking:** Discussion in pairs/ small groups on specific topics followed by short structured talks. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

### Learning Outcomes

At the end of the module, the learners will be able to

- comprehend short talks on general topics
- participate in informal discussions and speak clearly on a specific topic using suitable discourse markers
- understand the use of cohesive devices for better reading comprehension
- write well structured paragraphs on specific topics
- identify basic errors of grammar/ usage and make necessary corrections in short texts

## Unit 3

**Listening:** Listening for global comprehension and summarizing what is listened to. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed **Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

### Learning Outcomes

At the end of the module, the learners will be able to

- comprehend short talks and summarize the content with clarity and precision
- participate in informal discussions and report what is discussed
- infer meanings of unfamiliar words using contextual clues
- write summaries based on global comprehension of reading/listening texts
- use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing

## Unit4

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

### Learning Outcomes

At the end of the module, the learners will be able to

- infer and predict about content of spoken discourse
- understand verbal and non-verbal features of communication and hold formal/informal conversations
- interpret graphic elements used in academic texts
- produce a coherent paragraph interpreting a figure/graph/chart/table
- use language appropriate for description and interpretation of graphical elements

### Unit 5

**Listening:** Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. **Speaking:** Formal oral presentations on topics from academic contexts - without the use of PPT slides. **Reading:** Reading for comprehension. **Writing:** Writing structured essays on specific topics using suitable claims and evidences. **Grammar and Vocabulary:** Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

### Learning Outcomes

At the end of the module, the learners will be able to

- take notes while listening to a talk/lecture and make use of them to answer questions
- make formal oral presentations using effective strategies
- comprehend, discuss and respond to academic texts orally and in writing
- produce a well-organized essay with adequate support and detail
- edit short texts by correcting common errors

### Text Book

- **English all round: Communication Skills for Undergraduate Learners Vol. I,** Orient BlackSwan Publishers, First Edition 2019.

## Reference Books

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking*. Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

## Sample Web Resources

Grammar/Listening/Writing

[1-language.com](http://1-language.com)

<http://www.5minuteenglish.com/>

<https://www.englishpractice.com/>

Grammar/Vocabulary

[English Language Learning Online](http://www.bbc.co.uk/learningenglish/)

<http://www.bbc.co.uk/learningenglish/>

<http://www.better-english.com/>

<http://www.nonstopenglish.com/>

<https://www.vocabulary.com/>

[BBC Vocabulary Games](#)

[Free Rice Vocabulary Game](#)

Reading

<https://www.usingenglish.com/comprehension/>

<https://www.englishclub.com/reading/short-stories.htm>

<https://www.english-online.at/>

Listening

<https://learningenglish.voanews.com/z/3613>

<http://www.englishmedialab.com/listening.html>

Speaking

<https://www.talkenglish.com/>

[BBC Learning English – Pronunciation tips](#)

[Merriam-Webster – Perfect pronunciation Exercises](#)

All Skills

<https://www.englishclub.com/>

<http://www.world-english.org/>

<http://learnenglish.britishcouncil.org/>

Online Dictionaries

[Cambridge dictionary online](#)

[MacMillan dictionary](#)

[Oxford learner's dictionaries](#)

## **Course Outcomes:**

At the end of the course, the learners will be able to

- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table



**(19A04101) ELECTRONICS & COMMUNICATION ENGINEERING WORKSHOP**

**Course Objectives:**

- To introduce electronic components, measuring instruments and tools used in electronic workshop.
- To equip with the knowledge of understanding data sheets of electronic components
- To give practical experience on soldering the electronic components on a PCB
- To introduce EDA tools
- To know about the internal parts of a computer, assembling a computer from the parts, preparing a computer for use by installing the operating system
- To provide training on Productivity tools like word processors, spreadsheets, presentations
- To provide knowledge in understanding working of various communication systems

**List of Exercises / Experiments:**

1. Familiarization of commonly used Electronic Workshop Tools : Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
  - Provide some exercises so that electronics hardware tools and instruments are learned to be used by the students
2. Familiarization of Electronic Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
  - Provide some exercises so that electronic measuring instruments are learned to be used by the students
3. Electronic Components:  
Familiarization/Identification of electronic components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, color coding, package, symbol, cost etc.
4. Testing of electronic components like Resistor, Capacitor, Diode, Transistor, ICs etc.
  - Compare values of components like resistors, inductors, capacitors etc with the measured values by using electronic instruments
5. Study of Cathode Ray Oscilloscope (CRO)
  - Find the Amplitude and Frequency of a signal
  - Measure the Unknown Frequency & Phase difference of signals using Lissajous figures

6. Interpret data sheets of discrete components and IC's.
  - Write important specifications/ratings of components & ICs and submit it in the form of a report
7. Introduction to EDA Tools: MULTISIM/PSPICE/TINA schematic capture tool, Learning of basic functions of creating a new project, getting and placing parts, connecting placed parts, simulating the schematic, plotting and analyzing the results.
  - Provide some exercises so that students are familiarized in using EDA tools
8. Assembling and Testing of simple electronic circuits on breadboards; identifying the components and its location on the PCB, soldering of the components, testing the assembled circuit for correct functionality.
9. Familiarization with Computer Hardware & Operating System:
  - Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.
  - Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods available (eg: beeps). Students should record the process of assembling and trouble shooting a computer.
  - Install Operating system on the computer. Students should record the entire installation process.
10. Familiarization with Office Tools
  - Word Processor: Able to create documents using the word processor tool. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied.
  - Spreadsheet: Able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells.
  - Presentations: creating, opening, saving and running the presentations, Selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyper-linking, running the slide show, setting the timing for slide show.
11. Familiarization of PA system with different microphones, loud speakers, mixer etc. Represent the same in the form of diagrams, write specifications and submit it in the form of a report.

12. Understand working of various Communication Systems like Television, Satellite Transmitter & Receiver, Radio Receiver, Mobile Phone. Prepare demo boards/charts of various communication systems.

**Course Outcomes:**

- Identify discrete components and ICs (L3)
- Assemble simple electronic circuits over a PCB (L3)
- Testing of various components (L4)
- Interpret specifications (ratings) of the component (L5)
- Demonstrate disassembling and assembling a Personal Computer and make the computer ready to use (L2)
- Make use of Office tools for preparing documents, spread sheets and presentations (L3)
- Demonstrate working of various communication systems (L2)

(19A56101P) APPLIED PHYSICS LAB  
(ECE, CSE, CSSE, EEE, EIE & IT Branches)

**Course Objectives:**

- Understands the concepts of interference and diffraction and their applications.
- Understand the role of optical fiber parameters in communication.
- Recognize the importance of energy gap in the study of conductivity and hall effect in a semiconductor.
- Illustrates the magnetic and dielectric materials applications.
- Apply the principles of semiconductors in various electronic devices.

**Note: In the following list, out of 15 experiments, any 12 experiments must be performed in a semester**

**List of Physics Experiments**

1. Determine the thickness of the wire using wedge shape method  
Experimental outcomes:  
operates optical instrument like travelling microscope. (L2)  
estimate the thickness of the wire using wedge shape method (L2)  
Identifies the formation of interference fringes due to reflected light from non uniform thin film. (L2)
2. Determination of the radius of curvature of the lens by Newton's ring method  
Experimental outcomes:  
operates optical instrument like travelling microscope. (L2)  
estimate the radius of curvature of the lens (L2)  
Identifies the formation of interference fringes due to reflected light from non uniform thin film. (L2)  
plots the square of the diameter of a ring with no. of rings (L3)
3. Determination of wavelength by plane diffraction grating method  
Experimental outcomes:  
operates optical instrument like spectrometer. (L2)  
estimate the wavelength of the given source (L2)  
Identifies the formation of grating spectrum due diffraction. (L2)
4. Dispersive power of a diffraction grating  
Experimental outcomes:  
operates optical instrument like spectrometer. (L2)  
estimate the wavelength of the given source (L2)  
Identifies the formation of grating spectrum due diffraction. (L2)
5. Resolving power of a grating  
Experimental outcomes:  
operates optical instrument like spectrometer. (L2)  
estimate the resolving power of the grating (L2)  
Illustrates the role of resolving power in various optical instruments. (L3)
6. Determination of dielectric constant by charging and discharging method.

- Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the dielectric constant of the given substance. (L2)  
Identifies the significance of dielectric constant in various devices. (L2)
7. Magnetic field along the axis of a circular coil carrying current.  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the magnetic field along the axis of a circular coil carrying current. (L2)  
plots the intensity of the magnetic field of circular coil carrying current with distance (L3)
8. To determine the self inductance of the coil (L) using Anderson's bridge.  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the self inductance of the coil using Anderson's bridge. (L2)  
Identifies the significance of self inductance of the coil in electric devices. (L2)
9. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the hysteresis loss, coercivity and retentivity of the ferromagnetic material.. (L2)  
classifies the soft and hard magnetic material based on B-H curve. (L2)  
plots the magnetic field H and flux density B (L3)
10. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the numerical aperture and acceptance angle of a given optical fiber. (L2)  
Identifies the significance of numerical aperture and acceptance angle of a optical fiber in various engineering applications. (L2)
11. Measurement of magnetic susceptibility by Gouy's method  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the magnetic susceptibility of the given material. (L2)  
Identifies the significance of magnetic susceptibility in various engineering applications. (L2)
12. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.  
Experimental outcomes:  
operates various instruments and connect them as per the circuit. (L2)  
estimate the charge carrier concentration and mobility in a semiconductor. (L2)  
Illustrates the applications of hall effect. (L3)  
plots the voltage with current and voltage with magnetic field (L3)
13. To determine the resistivity of semiconductor by Four probe method  
Experimental outcomes:

- operates various instruments and connect them as per the circuit. (L2)  
 estimate the resistivity of a semiconductor. (L2)  
 Identifies the importance of Four probe method in finding the resistivity of semiconductor. (L3)
14. To determine the energy gap of a semiconductor  
 Experimental outcomes:  
 operates various instruments and connect them as per the circuit. (L2)  
 estimate the energy gap of a semiconductor. (L2)  
 Illustrates the engineering applications of energy gap . (L3)  
 plots  $1/T$  with  $\log R$  (L3)
15. Measurement of resistance with varying temperature.  
 Experimental outcomes:  
 operates various instruments and connect them as per the circuit. (L2)  
 estimate the resistance with varying temperature. (L2)  
 plots **resistance**  $R$  with temperature  $T$  (L3)

### Course Outcomes:

The students will be able to

- **operate** optical instruments like microscope and spectrometer (L2)
- **determine** thickness of a hair/paper with the concept of interference (L2)
- **estimate** the wavelength of different colors using diffraction grating and resolving power (L2)
- **plot** the intensity of the magnetic field of circular coil carrying current with distance (L3)
- **evaluate** the acceptance angle of an optical fiber and numerical aperture (L3)
- **determine** magnetic susceptibility of the material and its losses by B-H curve (L3)
- **determine** the resistivity of the given semiconductor using four probe method (L3)
- **identify** the type of semiconductor i.e., n-type or p-type using hall effect (L3)
- **calculate** the band gap of a given semiconductor (L3)

### References Books:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.
2. <http://vlab.amrita.edu/index.php> -Virtual Labs, Amrita University

**(19A05101P) PROBLEM SOLVING AND PROGRAMMING LAB**  
**(Common to All Branches of Engineering)**

**Laboratory Experiments #**

1. Assemble and disassemble parts of a Computer
2. Design a C program which reverses the number
3. Design a C program which finds the second maximum number among the given list of numbers.
4. Construct a program which finds the kth smallest number among the given list of numbers.
5. Design an algorithm and implement using C language the following exchanges  
$$a \leftarrow b \leftarrow c \leftarrow d$$
6. Develop a C Program which counts the number of positive and negative numbers separately and also compute the sum of them.
7. Implement the C program which computes the sum of the first n terms of the series  
$$\text{Sum} = 1 - 3 + 5 - 7 + 9$$
8. Design a C program which determines the numbers whose factorial values are between 5000 and 32565.
9. Design an algorithm and implement using a C program which finds the sum of the infinite series  
$$1 - x^2/2! + x^4/4! - x^6/6! + \dots$$
10. Design a C program to print the sequence of numbers in which each number is the sum of the three most recent predecessors. Assume first three numbers as 0, 1, and 1.
11. Implement a C program which converts a hexadecimal, octal and binary number to decimal number and vice versa.
12. Develop an algorithm which computes the all the factors between 1 to 100 for a given number and implement it using C.
13. Construct an algorithm which computes the sum of the factorials of numbers between m and n.
14. Design a C program which reverses the elements of the array.
15. Given a list of n numbers, Design an algorithm which prints the number of stars equivalent to the value of the number. The stars for each number should be printed horizontally.
16. Implement the sorting algorithms a. Insertion sort b. Exchange sort c. Selection sort

d.. Partitioning sort.

17. Illustrate the use of auto, static, register and external variables.

18. Design algorithm and implement the operations creation, insertion, deletion, traversing on a singly linked list.

19. Develop a C program which takes two numbers as command line arguments and finds all the common factors of those two numbers.

20. Design a C program which sorts the strings using array of pointers.

# The above list is not exhaustive. Instructors may add some experiments to the above list. Moreover, 50% of the experiments are to be changed every academic year. Instructors can choose the experiments, provided those experiments are not repetitions.

**Course outcomes:** Student should be able to

1. Construct a Computer given its parts (L6)
2. Select the right control structure for solving the problem (L6)
3. Analyze different sorting algorithms (L4)
4. Design solutions for computational problems (L6)
5. Develop C programs which utilize the memory efficiently using programming constructs like pointers.

**References:**

1. B. Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance", Tata McGraw-Hill, 2<sup>nd</sup> edition, 2002.
2. R.G. Dromey, "How to Solve it by Computer". 2014, Pearson.



**(19A52101P) COMMUNICATIVE ENGLISH I LAB**  
**(Common to All Branches of Engineering)**

### **Introduction**

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

### **Course Objectives**

- To expose the students to variety of self instructional, learner friendly modes of language learning
- To help the students cultivate the habit of reading passages from the computer monitor. Thus providing them with the required facility to face computer based competitive exams like GRE, TOEFL, and GMAT etc.
- To enable them to learn better pronunciation through stress, intonation and rhythm
- To train them to use language effectively to face interviews, group discussions, public speaking
- To initiate them into greater use of the computer in resume preparation, report writing, format making etc

### **Course Outcomes**

- CO1: To remember and understand the different aspects of the English language proficiency with emphasis on LSRW skills
- CO2: To apply communication skills through various language learning activities
- CO3: To analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- CO4: To evaluate and exhibit acceptable etiquette essential in social and professional settings
- CO5: To create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

## **Unit 1**

1. Phonetics for listening comprehension of various accents
2. Reading comprehension
3. Describing objects/places/persons

### **Learning Outcomes**

At the end of the module, the learners will be able to

- understand different accents spoken by native speakers of English
- employ suitable strategies for skimming and scanning on monitor to get the general idea of a text and locate specific information
- learn different professional registers and specific vocabulary to describe different persons, places and objects

## **Unit 2**

1. JAM
2. Small talks on general topics
3. Debates

### **Learning Outcomes**

At the end of the module, the learners will be able to

- produce a structured talk extemporarily
- comprehend and produce short talks on general topics
- participate in debates and speak clearly on a specific topic using suitable discourse markers

## **Unit 3**

1. Situational dialogues – Greeting and Introduction
2. Summarizing and Note making
3. Vocabulary Building

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Learn different ways of greeting and introducing oneself/others
- summarize the content with clarity and precision and take notes while listening to a talk/lecture and make use of them to answer questions
- replenish vocabulary with one word substitutes, homonyms, homophones, homographs to reduce errors in speech and writing

## **Unit4**

1. Asking for Information and Giving Directions
2. Information Transfer
3. Non-verbal Communication – Dumb Charade

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Learn different ways of asking information and giving directions
- Able to transfer information effectively
- understand non-verbal features of communication

## Unit 5

1. Oral Presentations
2. Précis Writing and Paraphrasing
3. Reading Comprehension and spotting errors

## Learning Outcomes

At the end of the module, the learners will be able to

- make formal oral presentations using effective strategies
- learn different techniques of précis writing and paraphrasing strategies
- comprehend while reading different texts and edit short texts by correcting common errors

## Reference Books

- English in Action, 1st Edition, 2019, Maruthi Publications.
- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking*. Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

## Sample Web Resources

Grammar/Listening/Writing

[1-language.com](http://1-language.com)

<http://www.5minuteenglish.com/>

<https://www.englishpractice.com/>

Grammar/Vocabulary

[English Language Learning Online](http://www.bbc.co.uk/learningenglish/)

<http://www.bbc.co.uk/learningenglish/>

<http://www.better-english.com/>

<http://www.nonstopenglish.com/>

<https://www.vocabulary.com/>

[BBC Vocabulary Games](#)

[Free Rice Vocabulary Game](#)

Reading

<https://www.usingenglish.com/comprehension/>

<https://www.englishclub.com/reading/short-stories.htm>

<https://www.english-online.at/>

## Listening

<https://learningenglish.voanews.com/z/3613>

<http://www.englishmedialab.com/listening.html>

## Speaking

<https://www.talkenglish.com/>

[BBC Learning English – Pronunciation tips](#)

[Merriam-Webster – Perfect pronunciation Exercises](#)

## All Skills

<https://www.englishclub.com/>

<http://www.world-english.org/>

<http://learnenglish.britishcouncil.org/>

## Online Dictionaries

[Cambridge dictionary online](#)

[MacMillan dictionary](#)

[Oxford learner's dictionaries](#)

**(19A04201T) NETWORK THEORY**  
**(ECE)**

**Course Objectives:**

- To introduce basic laws, mesh & nodal analysis techniques for solving electrical circuits
- To impart knowledge on applying appropriate theorem for electrical circuit analysis
- To explain transient behavior of circuits in time and frequency domains
- To teach concepts of resonance
- To introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship.

**UNIT 1 Introduction to Electrical Circuits**

Passive components and their V-I relations, Energy sources - Ideal, Non-ideal, Independent and dependent sources, Source transformation Kirchoff's laws, Star-to-Delta or Delta-to-Star Transformations, Mesh analysis and Nodal analysis problem solving, Super node and Super mesh for DC Excitations.

**Unit Outcomes**

- Gain knowledge on basic network elements, voltage and current laws (L1)
- Apply Kirchoff's laws, network reduction techniques on simple electrical circuits with dependent & independent sources (L3)
- Solve complex circuits using mesh and nodal analysis techniques (L3)

**UNIT 2 Network Theorems**

Superposition theorem, Thevenin & Norton theorems, Maximum power transfer theorem, Reciprocity theorem, Millman theorem, Miller Theorem, Tellegan's Theorem, Compensation theorem - problem solving using dependent sources also, Duality and dual networks.

**Unit Outcomes:**

- Understand significance of duality and dual networks (L2)
- Select appropriate theorem for network simplification (L5)
- Determine maximum power transfer to the load (L5)

**UNIT 3 Transients**

First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, Evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem solving using R-L-C elements with DC excitation and AC (sinusoidal) excitation, Response as related to s-plane rotation of roots. Solutions using Laplace transform method.

**Unit Outcomes:**

- Understand behavior of circuit elements under switching conditions (L1)

- Analyze response of RL, RC & RLC circuits in time & frequency domains (L4)
- Evaluate initial conditions in RL, RC & RLC circuits (L5)

#### **UNIT 4                      Resonance and Coupled Circuits**

Self inductance, Mutual inductance, dot rule, coefficient of coupling, Analysis of multi-winding coupled circuits, series & parallel connection of coupled inductors.

Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, Condition for maximum impedance, current in anti resonance, Bandwidth of parallel resonance, general case resistance present in both branches, anti resonance at all frequencies.

##### **Unit Outcomes:**

- Understand magnetically coupled circuits (L1)
- Determine resonant frequency and bandwidth of a simple series or parallel RLC circuit (L5)
- Determine voltages and currents in a resonant circuit (L5)

#### **UNIT 5                      Two Port Networks & Network Functions**

Two Port Networks, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters, hybrid and inverse hybrid parameters, relationship between parameters, interconnection of two port networks.

Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function

##### **Unit Outcomes:**

- Determine network parameters for given two port network (L5)
- Relate different two port network parameters (L4)
- Represent transfer function for the given network (L4)

##### **Text Books:**

1. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
2. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.

##### **References Books:**

1. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
2. Network lines and Fields by John. D. Ryder 2nd edition, Asia publishing house.
3. Bhise, Chadda, Kulshreshtha, “Engineering network analysis and filter design” Umesh Publication, 2000.
4. Joseph Edminister and Mahmood Nahvi, “Electric Circuits”, Schaum’s Outline Series, Fourth Edition, Tata McGraw Hill Publishing Company, New Delhi, 2003.

**Course Outcomes:**

- Solve network problems using mesh and nodal analysis techniques (L3)
- Analyze networks using Thevenin, Norton, Maximum power transfer, Superposition, Miller and Millman theorems (L4)
- Compute responses of first order and second order networks using time & frequency domain analysis (L5)
- Design resonant circuits for given bandwidth (L6)
- Utilize z, y, ABCD and h parameters for analyzing two port circuit behavior (L3)

**(19A54201) DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**  
**(Civil, Mechanical, EEE, ECE and EIE)**

**Course Objectives:**

- 1) To enlighten the learners in the concept of differential equations and multivariable calculus.
- 2) To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

**UNIT 1: Linear differential equations of higher order** **8hrs**

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- identify the essential characteristics of linear differential equations with constant coefficients (L3)
- solve the linear differential equations with constant coefficients by appropriate method (L3)

**UNIT 2: Equations reducible to Linear Differential Equations** **8hrs**

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications to L-C-R Circuit problems and Mass spring system.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- classify and interpret the solutions of linear differential equations (L3)
- formulate and solve the higher order differential equation by analyzing physical situations (L3)

**UNIT 3: Partial Differential Equations** **8 hrs**

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solutions to homogenous and non-homogenous higher order linear partial differential equations.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- apply a range of techniques to find solutions of standard PDEs (L3)
- outline the basic properties of standard PDEs (L2)

**UNIT4: Vector differentiation**

**8hrs**



Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- apply del to Scalar and vector point functions (L3)
- illustrate the physical interpretation of Gradient, Divergence and Curl (L3)

### **UNIT 5: Vector integration**

**8hrs**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field (L4)
- evaluate the rates of fluid flow along and across curves (L4)
- apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals (L3)

### **Text Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

### **Reference Books:**

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
6. Micheael Greenberg, Advanced Engineering Mathematics, 9<sup>th</sup> edition, Pearson edn
7. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
8. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
9. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
10. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.
11. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
12. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

### **Course Outcomes:**

At the end of the course, the student will be able to

- solve the differential equations related to various engineering fields (L6)
- Identify solution methods for partial differential equations that model physical processes (L3)
- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- estimate the work done against a field, circulation and flux using vector calculus (L6)

(19A51102T) CHEMISTRY  
(CSE, CSSE, ECE, EIE, EEE and IT)

**Course Objectives:**

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- To introduce instrumental methods, molecular machines and switches

**Unit 1: Structure and Bonding Models:**

(10 hrs)

Planck's quantum theory, dual nature of matter, Schrodinger equation, significance of  $\Psi$  and  $\Psi^2$ , applications to hydrogen, particle in a box and their applications for conjugated molecules, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of  $O_2$  and  $CO$ , etc.  $\pi$ -molecular orbitals of butadiene and benzene, calculation of bond order, crystal field theory – salient features – splitting in octahedral and tetrahedral geometry, magnetic properties and colour, band theory of solids – band diagrams for conductors, semiconductors and insulators, role of doping on band structures.

**Learning Outcomes:**

*At the end of this unit, the students will be able to*

- **apply** Schrodinger wave equation to hydrogen and particle in a box (L3)
- **illustrate** the molecular orbital energy level diagram of different molecular species (L2)
- **explain** the band theory of solids for conductors, semiconductors and insulators (L2)
- **discuss** the magnetic behaviour and colour of complexes (L3)

**Unit 2: Electrochemistry and Applications:**

(10 hrs)

Electrodes – concepts, reference electrodes (Calomel electrode,  $Ag/AgCl$  electrode and glass electrode) electrochemical cell, Nernst equation, cell potential calculations, numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), photovoltaic cell – working and applications, photogalvanic cells with specific examples. Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Secondary cells – lead acid, and lithium ion batteries- working of the batteries including cell reactions.

**Learning Outcomes:**

*At the end of this unit, the students will be able to*

- **apply** Nernst equation for calculating electrode and cell potentials (L3)
- **differentiate** between pH metry, potentiometric and conductometric titrations (L2)

- **explain** the theory of construction of battery and fuel cells (L2)
- **solve** problems based on cell potential (L3)

### Unit 3: Polymer Chemistry:

(10 hrs)

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation.

Plastics - Thermoplastics and Thermosettings, Preparation, properties and applications of – Bakelite, urea-formaldehyde, Nylon-66, carbon fibres, Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, polypyrroles – mechanism of conduction and applications.

#### Learning Outcomes:

*At the end of this unit, the students will be able to*

- **explain** the different types of polymers and their applications (L2)
- **explain** the preparation, properties and applications of Bakelite, Nylon-66, and carbon fibres (L2)
- **describe** the mechanism of conduction in conducting polymers (L2)
- **discuss** Buna-S and Buna-N elastomers and their applications (L2)

### Unit 4: Instrumental Methods and Applications

(10 hrs)

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, UV-Visible, IR and NMR Spectroscopies. Principles of Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC), separation of gaseous mixtures and liquid mixtures

#### Learning outcomes:

After completion of Module IV, students will be able to

- **explain** the different types of spectral series in electromagnetic spectrum (L2)
- **understand** the principles of different analytical instruments (L2)
- **explain** the different applications of analytical instruments (L2)

### Unit 5: Molecular Machines and Molecular Switches:

(10 hrs)

Concepts and terms of supra molecular chemistry, complementarity, Basic Lock and Key principle, examples of Supramolecules, Molecular recognition- cation binding, anion binding, simultaneous cation and anion binding, supramolecular reactivity and catalysis

Self assembly in biological systems, Synthetic systems- catenanes, rotaxanes, metal ion assisted assemblies, template synthesis of macrocyclic ligands

Applications of Supramolecular Devices- Ionic devices, Electronic devices, Switching devices

#### Learning Outcomes:

*At the end of this unit, the students will be able to*

- **explain** the band theory of solids for conductors, semiconductors and insulators (L2)
- **explains** supramolecular chemistry and self assembly (L2)
- **demonstrate** the application of Rotaxanes and Catenanes as artificial molecular machines (L2)

#### **Text Books:**

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

#### **Reference Books:**

1. J. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. J.M. Lehn, Supra Molecular Chemistry, VCH Publications

#### **Course Outcomes:**

At the end of the course, the students will be able to

- **compare** the materials of construction for battery and electrochemical sensors (L2)
- **explain** the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers. (L2)
- **explain** the principles of spectrometry, GC and HPLC in separation of gaseous and liquid mixtures (L2)
- **apply** the principle of supramolecular chemistry in application of molecular machines and switches (L3)

**(19A05201T) DATA STRUCTURES**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

1. To teach the representation of solution to the problem using algorithm
2. To explain the approach to algorithm analysis
3. To introduce different data structures for solving the problems
4. To demonstrate modeling of the given problem as a graph
5. To elucidate the existing hashing techniques

**Unit – 1: Introduction**

Algorithm Specification, Performance analysis, Performance Measurement. Arrays: Arrays, Dynamically Allocated Arrays. Structures and Unions. Sorting: Motivation, Quick sort, How fast can we sort, Merge sort, Heap sort

**Learning Outcomes :**

Student should be able to

1. Analyze the given algorithm to find the time and space complexities.(L4)
2. Select appropriate sorting algorithm (L4)
3. Design a sorting algorithm (L6)

**Unit – 2: Stack, Queue and Linked lists**

Stacks, Stacks using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues. Linked lists: Singly Linked Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Additional List Operations, Doubly Linked Lists.

**Learning outcomes:** Student should be able to

1. Evaluate expressions (L5)
2. Develop the applications using stacks and queues (L3)
3. Construct the linked lists for various applications (L6)

**Unit – 3 :Trees**

Introduction, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Binary Search Trees, Counting Binary Trees, Optimal Binary search Trees, AVL Trees. B-Trees: B-Trees, B + Trees.

**Learning outcomes**

1. Explain the concept of a tree (L2)
2. Compare different tree structures (L4)
3. Apply trees for indexing (L3)

#### **Unit – 4 : Graphs and Hashing**

The Graph Abstract Data Type, Elementary Graph Operations, Minimum Cost Spanning Trees, Shortest Paths and Transitive Closure

Hashing: Introduction to Hash Table, Static Hashing, Dynamic Hashing.

#### **Learning outcomes:**

Student should be able to

1. Recognize the importance of Graphs in solving real world problems (L2)
2. Apply various graph traversal methods to applications (L3)
3. Design a minimum cost solution for a problem using spanning trees (L6)
4. Select the appropriate hashing technique for a given application (L5)
5. Design a hashing technique (L6)

#### **Unit – 5: Files and Advanced sorting**

File Organization: Sequential File Organization, Direct File Organization, Indexed Sequential File Organization.

Advanced sorting: Sorting on Several keys, List and Table sorts, Summary of Internal sorting, External sorting.

#### **Learning outcomes:** Student should be able to

1. Organize data in the form of Files (L6)
2. Apply sorting on large amount of data (L3)

#### **Text Books:**

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed “Fundamentals of Data Structures in C”, 2<sup>nd</sup> Edition, University Press, 2007.
2. Alan L. Tharp, “File Organization and Processing”, Wiley and Sons, 1988.

#### **Reference Books:**

1. D. Samanta, “Classic Data Structures”, 2<sup>nd</sup> Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012.
2. Peter Bras, “Advanced Data Structures”, Cambridge University Press, 2016
3. Richard F. Gilberg, Behrouz A. Forouzan, “Data Structures A Pseudo code Approach with C”, Second Edition, Cengage Learning 2005.

#### **Course Outcomes:**

Students should be able to

1. Select Appropriate Data Structure for solving a real world problem (L4)
2. Select appropriate file organization technique depending on the processing to be done (L4)
3. Construct Indexes for Databases (L6)
4. Analyse the Algorithms (L4)
5. Develop Algorithm for Sorting large files of data (L3)

**(19A03101) ENGINEERING WORKSHOP**  
**(Common to all branches)**

**Course Objective:**

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

**Wood Working:**

Familiarity with different types of woods and tools used in wood working and make following joints

- a) Half – Lap joint
- b) Mortise and Tenon joint
- c) Corner Dovetail joint or Bridle joint

**Sheet Metal Working:**

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

- a) Tapered tray
- b) Conical funnel
- c) Elbow pipe
- d) Brazing

**Fitting:**

Familiarity with different types of tools used in fitting and do the following fitting exercises

- a) V-fit
- b) Dovetail fit
- c) Semi-circular fit
- d) Bicycle tire puncture and change of two wheeler tyre

**Electrical Wiring:**

Familiarities with different types of basic electrical circuits and make the following connections

- a) Parallel and series
- b) Two way switch
- c) Godown lighting
- d) Tube light
- e) Three phase motor
- f) Soldering of wires

**Course Outcomes:**

After completion of this lab the student will be able to

1. apply wood working skills in real world applications. (L3)
2. build different parts with metal sheets in real world applications. (L3)
3. apply fitting operations in various applications. (L3)
4. apply different types of basic electric circuit connections. (L3)
5. demonstrate soldering and brazing. (L2)



**(19A03102) ENGINEERING GRAPHICS LAB**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modeling.
- Instruct graphical representation of machine components.

**Part A: Manual Drawing: (7 Classes)**

**Introduction to Engineering graphics:** Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions.

a) Conic sections including the rectangular hyperbola- general method only,

b) Cycloid, epicycloids and hypocycloid

c) Involute

**(2L + 6P hrs)**

**Projection of points, lines and planes:** Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces. **(2L + 6P hrs)**

**Projections of solids:** Projections of regular solids inclined to one or both planes by rotational or auxiliary views method. **(1L + 3P hrs)**

**Sections of solids:** Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections. **(1L + 3P hrs)**

**Development of surfaces:** Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts. **(1L + 6P hrs)**

**Part B: Computer Aided Drafting: (6 Classes)**

**Introduction to AutoCAD:** Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. **(1L + 3P hrs)**

Dimensioning principles and conventional representations.

**Orthographic Projections:** Systems of projections, conventions and application to orthographic projections. (3L + 9P hrs)

**Isometric Projections:** Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids. (2L + 6P hrs)

**Text Books:**

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000

**Reference Books:**

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2009
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.
3. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009
4. K.C.John, Engineering Graphics, 2/e, PHI, 2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

**Course Outcomes:**

After completing the course, the student will be able to

- draw various curves applied in engineering. (L2)
- show projections of solids and sections graphically. (L2)
- draw the development of surfaces of solids. (L3)
- use computers as a drafting tool. (L2)
- draw isometric and orthographic drawings using CAD packages. (L3)

**Note:**

1. Manual (part A) and Computer Aided Drafting (part B) classes can be held in alternative weeks for optimal utilization of computer facilities.
2. External examinations to be conducted both manual and computer mode with equal weight of marks.

**Additional Sources**

1. Youtube: [http://sewor,Carleton.ca/gkardos/88403/drawings.html](http://sewor.Carleton.ca/gkardos/88403/drawings.html) conic sections-online, red woods.edu

(19A04201P) NETWORK THEORY LAB  
(ECE)

**Course Objectives:**

- To gain hands on experience in verifying Kirchoff's laws and network theorems
- To analyze transient behavior of circuits
- To study resonance characteristics
- To determine 2-port network parameters

**List of Experiments:**

Any 10 of the following experiments are to be conducted in Hardware & Simulation (Multisim/Open source software):

1. Verification of Kirchoff's Laws
2. Apply Mesh & Nodal Analysis techniques for solving electrical circuits (problems with dependent sources also)
3. Verification of Superposition & Reciprocity Theorem
4. Verification of Thevenin's and Norton's Theorem
5. Verification of Maximum Power Transfer Theorem
6. Verification of Millman and Miller Theorem
7. Measure and calculate RC time constant for a given RC circuit
8. Measure and calculate RL time constant for a given RL circuit
9. Measure and analyze (settling time, overshoot, undershoot, etc.) step response of for a given series RLC circuit for following cases:
  - (i)  $\zeta = 1$  (critically damped system)
  - (ii)  $\zeta > 1$  (over damped system)
  - (iii)  $\zeta < 1$  (under damped system)Choose appropriate values of R, L, and C to obtain each of above cases one at a time.
10. Design a series RLC resonance circuit. Plot frequency response and find resonance frequency, Bandwidth, Q – factor.
11. Design a parallel RLC resonance circuit. Plot frequency response and find resonance frequency, Bandwidth, Q – factor.
12. Measure and calculate Z, Y parameters of two-port network.
13. Measure and calculate ABCD & h parameters of two-port network.

**Course Outcomes:**

- Verify Kirchoff's laws and network theorems (L4)
- Measure time constants of RL & RC circuits (L3)
- Analyze behavior of RLC circuit for different cases (L4)
- Design resonant circuit for given specifications (L6)

Characterize and model the network in terms of all network parameters (L3)

(19A51102P) CHEMISTRY LAB  
(CSE, CSSE, ECE, EIE, EEE and IT)

**Course Objectives:**

- Verify the fundamental concepts with experiments

**List of Experiments:**

1. Measurement of  $\lambda_{Dq}$  by spectrophotometric method
2. Models of potential energy surfaces
3. Conductometric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base
4. Determination of cell constant and conductance of solutions
5. Potentiometry - determination of redox potentials and emfs
6. Determination of Strength of an acid in Pb-Acid battery
7. Preparation of a polymer
8. Verify Lambert-Beer's law
9. Thin layer chromatography
10. Identification of simple organic compounds by IR and NMR
11. HPLC method in separation of gaseous and liquid mixtures
12. Estimation of Ferrous Iron by Dichrometry.

**Course Outcomes:**

At the end of the course, the students will be able to

- **determine** the cell constant and conductance of solutions (L3)
- **prepare** advanced polymer materials (L2)
- **measure** the strength of an acid present in secondary batteries (L3)
- **analyse** the IR and NMR of some organic compounds (L3)

**(19A05201P) DATA STRUCTURES LAB**  
**(Common to All Branches of Engineering)**

**Course Objectives:**

1. To introduce to the different data structures
2. To elucidate how the data structure selection influences the algorithm complexity
3. To explain the different operations that can be performed on different data structures
4. To introduce to the different search and sorting algorithms.

**Laboratory Experiments**

1. String operations using array of pointers
2. Searching Algorithms (With the Number of Key Comparisons) Sequential, Binary and Fibonacci Search Algorithms.
3. Sorting Algorithms: Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Heap Sort, Merge Sort, and Radix Sort. Using the system clock, compute the time taken for sorting of elements. The time for other operations like I/O etc should not be considered while computing time.
4. Implementation of Singly Linked List, Doubly Linked List, Circular Linked List
5. Stack implementation using arrays
6. Stack implementation using linked lists
7. Queue implementation using arrays. Implement different forms of queue. While implementing you should be able to store elements equal to the size of the queue. No positions should be left blank.
8. Queue implementation using linked lists
9. Creation of binary search tree, performing operations insertion, deletion, and traversal.
10. Breadth first search
11. Depth first search
12. Travelling sales man problem
13. File operations
14. Indexing of a file
15. Reversing the links (not just displaying) of a linked list.
16. Consider a linked list consisting of name of a person and gender as a node. Arrange the linked list using 'Ladies first' principle. You may create new linked lists if necessary.
17. An expression can be represented in three ways: infix, prefix and postfix. All the forms are necessary in different contexts. Write modules to convert from one form to another form.

18. A table can be defined as a collection of rows and columns. Each row and column may have a label. Different values are stored in the cells of the table. The values can be of different data types. Numerical operations like summation, average etc can be performed on rows/columns which contain numerical data. Such operations are to be prevented on data which is not numeric. User may like to insert row/columns in the already existing table. User may like to remove row/column. Create table datatype and support different operations on it.

**Course Outcomes:**

At the end of the course students should be able to

1. Select the data structure appropriate for solving the problem (L5)
2. Implement searching and sorting algorithms (L3)
3. Design new data types (L6)
4. Illustrate the working of stack and queue (L4)
5. Organize the data in the form of files (L6)

**(19A54302) COMPLEX VARIABLES AND TRANSFORMS**

(Common to ECE & EEE)

**Course Objective:**

This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The student develops the idea of using continuous/discrete transforms.

**Unit-I: Complex Variable – Differentiation:**

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method-Conformal mappings-standard and special transformations ( $\sin z$ ,  $e^z$ ,  $\cos z$ ,  $z^2$ ) Mobius transformations (bilinear) and their properties.

**Unit Outcomes:**

Students will be able to

- Understand functions of Complex variable and its properties.
- Find derivatives of complex functions.
- Understand the analyticity of complex functions .
- Understand the conformal mappings of complex functions.

**Unit-II: Complex Variable – Integration:**

Line integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof);power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi circle with  $f(z)$  not having poles on real axis).

**Unit Outcomes:**

Students will be able to

- Understand the integration of complex functions.
- Apply Cauchy's integral theorem and Cauchy's integral formula.
- Understand singularities of complex functions.
- Evaluate improper integrals of complex functions using Residue theorem.

### **Unit-III: Laplace Transforms**

Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac’s delta function – Convolution theorem – Laplace transform of Periodic function. Differentiation and integration of transform – solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.

#### **Unit Outcomes:**

Students will be able to

- Understand the concept of Laplace transforms and find the Laplace transforms of elementary functions.
- Find the Laplace transforms of general functions using its properties.
- Understand Laplace transforms of special functions(Unit step function, Unit Impulse & Periodic).
- Apply Laplace transforms to solve Differential Equations.

### **Unit-IV: Fourier series**

Determination of Fourier coefficients (Euler’s) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms - Parseval’s formula- Complex form of Fourier series.

#### **Unit Outcomes:**

Students will be able to

- Understand finding Fourier series expression of the given function.
- Determine Fourier coefficients (Euler’s) and identify existence of fourier series of the given function.
- Expand the given function in Fourier series given in Half range interval.
- Apply Fourier series to establish Identities among Euler coefficients.
- Find Fourier series of wave forms.

### **Unit-V: Fourier transforms & Z Transforms:**

Fourier integral theorem (without proof) – Fourier sine and cosine integrals-complex form of Fourier integral. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – convolution theorem .

Z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by z-transforms.

#### **Unit Outcomes:**

Students will be able to

- Find Fourier Sine and cosine integrals.



- Understand Fourier transforms.
- Apply properties of Fourier transforms.
- Understand Z transforms.
- Apply properties of Z transforms.
- Apply Z transforms to solve difference equations.

**Course Outcomes:**

After the completion of course, students will be able to

- Understand the analyticity of complex functions and conformal mappings.
- Apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
- Understand the usage of Laplace Transforms, Fourier Transforms and Z transforms.
- Evaluate the Fourier series expansion of periodic functions.

**Text Books:**

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India

**Reference Books:**

1. B.V.Ramana, Higher, "Engineering Mathematics", Mc Graw Hill publishers.
2. Alan Jeffrey, "Advanced Engineering Mathematics", Elsevier.

(19A04301) SIGNALS AND SYSTEMS

**Course Objectives:**

- To introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domains.
- To present Fourier tools through the analogy between vectors and signals.
- To teach concept of sampling and reconstruction of signals.
- To analyze characteristics of linear systems in time and frequency domains.
- To understand Laplace and z-transforms as mathematical tool to analyze continuous and discrete-time signals and systems.

**Unit I**

**Signals & Systems:** Basic definitions and classification of Signals and Systems (Continuous time and discrete time), operations on signals, Concepts of Convolution and Correlation of signals, Analogy between vectors and signals-Orthogonality, mean square error, Fourier series: Trigonometric & Exponential, Properties of Fourier series, concept of discrete spectrum, Illustrative Problems.

**Unit Outcomes:**

- Understand different types of signals and systems. (L1)
- State principles of vector spaces and concept of Orthogonality. (L2)
- Describe continuous time signal and discrete time signal. (L2)
- Analyze the periodic signals by applying Fourier series. (L3)

**Unit II**

**Continuous Time Fourier Transform:** Definition, Computation and properties of Fourier transform for different types of signals and systems, Inverse Fourier transform. Statement and proof of sampling theorem of low pass signals, Illustrative Problems.

**Unit Outcomes:**

- Identify system properties based on impulse response and Fourier analysis. (L1)
- Analyze the spectral characteristics of signals. (L3)
- Illustrate signal sampling and its reconstruction. (L2)
- Apply Fourier transform to solve problems. (L2)

### Unit III

**Discrete Time Fourier Transform:** Definition, Computation and properties of Discrete Time Fourier transform for different types of signals and systems, Illustrative Problems.

#### Unit Outcomes:

- Understand the properties of the discrete-time Fourier transform. (L1)
- Analyse the spectral characteristics of signals using Fourier transform. (L3)
- Evaluate the Fourier transform of Discrete-time signals. (L2)

### Unit IV

**Signal Transmission Through Linear Systems:** Linear system, impulse response, Response of a linear system for different input signals, linear time-invariant (LTI) system, linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time, Energy and Power spectral densities, Illustrative Problems.

#### Unit Outcomes:

- Understand the impulse response, transfer characteristics of LTI system and various filters. (L1)
- Analyse filter characteristics and physical realisation of LTI system. (L3)
- Apply the relation between bandwidth and rise time & energy and power spectral densities in various applications. (L2)

### Unit V

**Laplace Transform:** Definition, ROC, Properties, Inverse Laplace transforms, the S-plane and BIBO stability, Transfer functions, System Response to standard signals, Solution of differential equations with initial conditions.

**Z-Transform:** Definition, ROC, Properties, Poles and Zeros in Z-plane, The inverse Z-Transform, System analysis, Transfer function, BIBO stability, System Response to standard signals, Solution of difference equations with initial conditions, Illustrative Problems.

#### Unit Outcomes:

- Understand the limitations of Fourier transform and need for Laplace transform and develop. (L1)
- Apply transform techniques to analyse discrete-time signals and systems. (L2)

- Evaluate response of linear systems to known inputs by using Laplace transforms. (L2)
- Analyze the continuous-time and discrete-time signals and systems using Laplace and Z- transforms.(L3)

**Course Outcomes:**

After completion of the course, student will be able to

**CO1:**Understand the mathematical description and representation of continuous-time and discrete-time signals and systems. Also understand the concepts of various transform techniques. (L1)

**CO2:**Apply sampling theorem to convert continuous-time signals to discrete-time signals and reconstruct back, different transform techniques to solve signals and system related problems. (L2)

**CO3:**Analyze the frequency spectra of various continuous-time and discrete-time signals using different transform methods. (L3)

**CO4:** Classify the systems based on their properties and determine the response of them. (L4)

**Text Books:**

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, 2<sup>nd</sup> Edition, PHI, 2009.
2. Simon Haykin and Van Veen, “Signals & Systems”, 2<sup>nd</sup> Edition, Wiley, 2005.

**References:**

1. BP Lathi, “Principles of Linear Systems and Signals”, 2<sup>nd</sup> Edition, Oxford University Press, 015.
2. Matthew Sadiku and Warsame H. Ali, “Signals and Systems A primer with MATLAB”, CRC Press, 2016.
3. Hwei Hsu, “Schaum's Outline of Signals and Systems”, 4<sup>th</sup> Edition, TMH, 2019.

**(19A04302T) ELECTRONIC DEVICES AND CIRCUITS**

**Course Objectives:**

- To acquire fundamental knowledge and expose to the field of semiconductor theory and devices and their applications.
- To introduce different types of semiconductor devices, viz., diodes and special diodes.
- To explain application of diodes as rectifiers, clippers, clampers and regulators.
- To describe operation and characteristics of Bipolar Junction Transistor & Field Effect Transistor.
- To analyze the various biasing circuits using BJTs & FETs.

**Unit I:**

**Semiconductor Diode:** Open circuited PN junction, PN junction as a rectifier, Current components in a PN diode, Diode Equation and its mathematical derivation, Volt-Ampere Characteristics, Energy band diagram of PN diode, Temperature dependence of Volt-Ampere Characteristics, Diode resistance (Static and Dynamic resistance), Transition capacitance, Diffusion capacitance, Step graded junction.

**Unit Outcomes:**

- Study the characteristics and operation of p-n junction diode. (L1)
- Explain the energy band diagram & effect of temperature on the characteristics of diode. (L2)
- Derive the expression for transition capacitance and diffusion capacitance. (L2)

**Unit II:**

**Special Devices:** Avalanche breakdown, V-I Characteristics of Zener diode, Zener breakdown, Principle of operation and characteristics of Tunnel diode with the help of Energy band diagram, Photo diode, LED, PIN diode and Varactor diode, Silicon Controlled Rectifier (SCR) and its V-I characteristics, DIAC, TRIAC, Schottky Barrier diode, solar cell, Uni-Junction Transistor (UJT) and its V-I Characteristics, Problem solving.

**Unit Outcomes:**

- Study the characteristics operation and applications of Zener diode. (L1)
- Explain V-I Characteristics of Tunnel diode, Photo diode, SCR, UJT and other special diodes. (L2)
- Apply concepts of semiconductor devices and solve problems. (L2).

### Unit III:

**Diode Applications:** Diode as switch, Rectifier – Half wave and Full wave rectifier, Bridge rectifier, Ripple factor, PIV, Filters – Inductor and Capacitor Filter, L-section filter, pi-Filter, Zener as voltage regulator, Clipping and Clamping circuits, Detector, Voltage doubler, Problem solving related to diode applications.

### Unit Outcomes:

- Understand the circuit operation involving p-n junction and Zener diodes. (L1)
- Analyze the performance of rectifiers with and without filters. (L3)
- Design half wave and full wave rectifier circuits, clippers, clampers and voltage regulator. (L4)
- Compare the various rectifier circuits in terms of their parameter metrics. (L5)

### Unit IV:

#### **Bipolar Junction Transistor (BJT):**

Transistor – Structure, current components and their relationship, PNP and NPN transistors- Active mode of operation, symbols and conventions, Transistor equations, Transistor as an amplifier, input and output characteristics of Common Base, Common Emitter and Common collector configurations. DC analyses of Common Base, Common Emitter and Common collector circuits.

**BJT Biasing:** Load line and modes of operations, operating point, Bias stability, fixed bias, self bias, stabilization against variations in  $I_{co}$ ,  $V_{BE}$ ,  $\beta$ , Bias compensation, Thermal runaway, condition for Thermal stability, Problem solving.

**Applications:** As a switch, as an amplifier.

### Unit Outcomes:

- Understand the current components and their relationships in BJT. (L1)
- Explain principle, operation and applications of Bipolar Junction Transistor. (L2)
- Describe input and output Characteristics of Bipolar Junction Transistor. (L2)
- Derive the expression for stability factor of various biasing circuits. (L3)
- Analyse the different configurations (CB,CC,CE).(L3)

### Unit V:

**Field-Effect Transistors (FET) :** Metal Oxide Semiconductor Field-effect Transistor (MOSFET) - structures and V-I characteristics of n-channel Enhancement mode MOSFET, p-channel Enhancement mode MOSFET, n-channel depletion mode MOSFET, p-channel depletion mode MOSFET, symbols and conventions, Complementary MOSFETs (CMOSFETs) - structure, V-I characteristics, symbols and conventions, structure and V-I characteristics of n-channel and p-channel Junction Field Effect Transistors (JFET), Problem solving.

**Biassing Circuits Using MOSFETs and JFETs:** Different configurations using MOSFETs and JFET, load line and modes of operation, different biasing circuits (self-bias, voltage divider bias) using MOSFETs and JFETs, DC Analysis of n-channel and p-channel MOSFETs (both Enhancement and Depletion modes), DC analysis of n-channel and p-channel JFETs, Problem solving.

**Applications:** MOSFETs, JFET as switch and small signal amplifier, CMOS as a switch.

**Unit Outcomes:**

- Understand the current components and their relationships in Field effect transistors (JFET, MOSFETs). (L1)
- Explain principle, operation and applications of Field effect transistors. (L2)
- Describe input and output Characteristics of Field effect transistors. (L2)
- Analyse the different configurations (CS,CG,CD) and biasing circuits.(L3)

**Course Outcomes:**

After the completion of the course students will able to

**CO1:** Understand principle, operation, characteristics and applications of Bipolar Junction Transistor and Field Effect Transistor (L1)

**CO2:** Describe basic operation and characteristics of various semiconductor devices. (L2)

**CO3:** Analyze diode circuits for different applications such as rectifiers, clippers and clampers also analyze low frequency and high frequency models of BJT and FET. (L3)

**CO4:** Design various biasing circuits for BJT and FET. (L4)

**CO5:** Compare the performance of various semiconductor devices. (L5)

**TEXT BOOKS:**

1. Donald A Neamen, “Electronic Circuits – analysis and design”, 3<sup>rd</sup> Edition, McGraw Hill (India), 2019.
2. J. Milliman and C Halkias, “Integrated electronics”, 2<sup>nd</sup> Edition, Tata McGraw Hill, 1991.

**REFERENCES:**

1. Behzad Razavi, “Microelectronics”, 2<sup>nd</sup> edition, Wiley, 2013.
2. R.L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits,” 9<sup>th</sup> Edition, Pearson, 2006.
3. Jimmie J Cathey, “Electronic Devices and Circuits,” Schaum’s outlines series, 3<sup>rd</sup> edition, McGraw-Hill (India), 2010.

**Prerequisites: Semiconductor Physics**

Emphasis on this terminology: Energy band diagram of Insulators, Semiconductors and Metals, Mobility and Conductivity, Electrons and Holes in Intrinsic semiconductor, Donor and Acceptor impurities, drift and diffusion currents, charge densities and semiconductor. Fermi-Dirac function, Carrier concentrations, Fermi level in an intrinsic semiconductor, Fermi level in a semiconductor having impurities.



**(19A04303) PROBABILITY THEORY AND STOCHASTIC PROCESSES**

**Course Objectives:**

- To gain the knowledge of the basic probability concepts and acquire skills in handling situations involving more than one random variable and functions of random variables.
- To understand the principles of random signals and random processes.
- To be acquainted with systems involving random signals.
- To gain knowledge of standard distributions that can describe real life phenomena.

**Unit I**

**Probability Introduced Through Sets and Relative Frequency:** Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events, Problem Solving.

Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties, Problem Solving.

**Unit Outcomes:**

- Understand the fundamental concepts of probability theory, random variables, and conditional probability. (L1)
- Evaluate the different probability distribution and density functions. (L2)

**Unit II**

**Operations on Single Random Variable:** Introduction, Expectation of a random variable, moments-moments about the origin, Central moments, Variance and Skew, Chebyshev's inequality, moment generating function, characteristic function, transformations of random variable.

**Multiple Random Variables:** Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected), Unequal Distribution, Equal Distributions.

**Unit Outcomes:**

- Apply the knowledge to the sum of random variables, central limit theorem in communication system (L2).
- Evaluate the single and multiple random variable concepts to expectation, variance and moments (L4).

### Unit III

**Operations on Multiple Random Variables:** Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties of Gaussian random variables, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

#### Unit Outcomes:

- Apply the different operations to multiple random variables (L2).
- Understand the concepts of linear transformation of Gaussian random variables (L1).

### Unit IV

**Random Processes-Temporal Characteristics:** The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence, First-Order Stationary Processes, Second-Order and Wide-Sense Stationarity, N-Order and Strict-Sense Stationarity. Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

**Random Processes-Spectral Characteristics:** The Power Density Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum and its Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

#### Unit Outcomes:

- Understand and analyze continuous and discrete-time random processes (L1).
- Analyze the concepts and its properties of auto correlation, cross correlation functions and power spectral density (L3).

### Unit V

**Random Signal Response Of Linear Systems:** System Response – Convolution, Mean and Mean squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, Band pass, Band Limited and Narrowband Processes, Properties.

**Noise Definitions:** White Noise, colored noise and their statistical characteristics, Ideal low pass filtered white noise, RC filtered white noise.

**Unit Outcomes:**

- Describe the theory of stochastic processes to analyze linear systems (L2).
- Apply the knowledge to linear systems; low pass and band pass noise models for random processes (L2).

**Course Outcomes:**

After completion of the course, student will be able to

**CO1:** Understanding the concepts of Probability, Random Variables, Random Processes and their characteristics learn how to deal with multiple random variables, conditional probability, joint distribution and statistical independence. (L1)

**CO2:** Formulate and solve the engineering problems involving random variables and random processes. (L2)

**CO3:** Analyze various probability density functions of random variables. (L3)

**CO4:** Derive the response of linear system for Gaussian noise and random signals as inputs. (L3)

**TEXT BOOKS:**

1. Peyton Z. Peebles, “Probability, Random Variables & Random Signal Principles”, 4<sup>th</sup> Edition, TMH, 2002.
2. Athanasios Papoulis and S. Unnikrishna Pillai, “Probability, Random Variables and Stochastic Processes”, 4<sup>th</sup> Edition, PHI, 2002.

**REFERENCES:**

1. Simon Haykin, “Communication Systems”, 3<sup>rd</sup> Edition, Wiley, 2010.
2. Henry Stark and John W. Woods, “Probability and Random Processes with Application to Signal Processing,” 3<sup>rd</sup> Edition, Pearson Education, 2002.
3. George R. Cooper, Clave D. MC Gillem, “Probability Methods of Signal and System Analysis,” 3<sup>rd</sup> Edition, Oxford, 1999.

(19A04304) DIGITAL ELECTRONICS AND LOGIC DESIGN

**Course Objectives:**

- To teach significance of number systems, conversions, binary codes and functionality of logic gates.
- To discuss different simplification methods for minimizing Boolean functions.
- To impart knowledge on operation, characteristics and various configurations of TTL and CMOS logic families.
- To outline procedures for the analysis and design of combinational and sequential logic circuits.
- To introduce programmable logic devices.

**Unit I**

**Number Systems and Codes:** Decimal, Binary, Octal, and Hexa-decimal number systems and their conversions, ASCII code, Excess -3 codes, Gray code.

Binary codes Classification, Error detection and correction – Parity generators and checkers – Fixed point and floating-point arithmetic.

**Boolean Algebra & Logic Gates:** Boolean operations, Boolean functions, Algebraic manipulations, Min-terms and Maxterms, Sum-of-products and Product-of-sum representations, Two-input logic gates, NAND /NOR implementations.

**Minimization of Boolean Functions:** Karnaughmap, Don't-care conditions, Prime implicants, Minimization of functions using Quine-McClusky method.

**Unit Outcomes:**

- Summarize advantages of using different number systems. (L2)
- Explain usefulness of different coding schemes and functionality of logic gates. (L2)
- Apply basic laws and De Morgan's theorems to simplify Boolean expressions. (L3)
- Compare K- Map and Q-M methods of minimizing logic functions. (L5)

**Unit II**

**Combinational Circuits:** Introduction, Analysis of combinational circuits, Design Procedure– Binary Adder-Subtractor, Decimal Adder, Multiplier, Comparator, Code Converters, Encoders, Decoders, Multiplexers, Demultiplexers, Illustrative examples.

**Sequential Circuits-1:** Introduction, Latches –RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip flops, Edge-triggered flip-flops, Flip-flop conversions.

**Unit Outcomes:**

- Apply Boolean algebra for describing combinational digital circuits. (L2)
- Analyze standard combinational circuits such as adders, subtractors, multipliers, comparators etc. (L4)
- Design various Combinational logic circuits. (L4)
- Implement logic functions with decoders and multiplexers. (L5)

### Unit III

**Sequential Circuits-2:** Analysis and Design of Synchronous Sequential Circuits: Moore and Mealy machine models, State Equations, State Table, State diagram, State reduction & assignment, Synthesis using flip flops, Elements of Design style, Top-down design, Algorithmic state Machines (ASM), ASM chart notations.

**Registers and Counters:** Registers, shift registers, Ripple counters, Synchronous counters, Modulus-n Counter, Ring counter, Johnson counter, Up-Down counter.

#### Unit Outcomes:

- Describe behaviour of Flip-Flops and Latches.(L2)
- Compare Moore and Mealy machine models.(L5)
- Design synchronous sequential circuits using flip flops and construct digital systems using components such as registers and counters (L4)
- Utilize concepts of state and state transition for analysis and design of sequential circuits (L3)

### Unit IV

**Memory and Programmable Logic:** RAM, Types of Memories, Memory decoding, ROM, Types of ROM, Programmable Logic Devices (PLDs): Basic concepts, PROM as PLD, Programmable Array Logic (PAL) and Programmable Logic Array (PLA), Design of combinational and sequential circuits using PLDs.

#### Unit Outcomes:

- Define RAM, ROM, PROM, EPROM and PLDs. (L1)
- Describe functional differences between different types of RAM & ROM. (L2)
- Compare different types of Programmable Logic Devices. (L5)
- Design simple digital systems using PLDs. (L4)

### Unit V

**Digital Logic Families:** Unipolar and Bipolar Logic Families, Transistor-Transistor Logic (TTL): Operation of TTL, Current sink logic, TTL with active pull up, TTL with open collector output, Shockley TTL, TTL characteristics, I<sup>2</sup>L, ECL logic Families.

**CMOS:** CMOS Inverter, CMOS characteristics, CMOS configurations - Wired Logic, Open drain outputs, Interfacing: TTL to CMOS and CMOS to TTL, Tristate Logic, Characteristics of Digital ICs: Speed, power dissipation, figure of merit, fan-out, Current and voltage parameters, Noise immunity, operating temperature range, power supply requirements.

**Unit Outcomes:**

- Summarize significance of various TTL , I<sup>2</sup>L, ECL and CMOS subfamilies. (L2)
- Examine Interface aspects of TTL & CMOS logic families. (L5)
- Explain characteristics of digital ICs such as speed, power dissipation, figure of merit, fan-out, noise immunity etc. (L2)
- Compare bipolar and MOS logic families. (L5)

**Course Outcomes:**

After completion of the course, student will be able to

**CO1:** Understand various number systems, error detecting, correcting binary codes, logic families, combinational and sequential circuits. (L1)

**CO2:** Apply Boolean laws, k-map and Q-M methods to minimize switching functions. Also describe the various performance metrics for logic families. (L2)

**CO3:** Design combinational and sequential logic circuits. (L4)

**CO4:** Compare different types of Programmable logic devices and logic families. (L5)

**TEXTBOOKS:**

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 4<sup>th</sup> Edition, Pearson Education, 2013.
2. Z. Kohavi and N. K. Jha, "Switching and Finite Automata Theory", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2010.
3. R. P. Jain, "Modern Digital Electronics", 4<sup>th</sup> edition, McGraw Hill Education (India Private Limited), 2012.

**REFERENCES:**

1. Wakerly J.F., "Digital Design: Principles and Practices", 4<sup>th</sup> Edition, Pearson India, 2008.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", 5th Edition, Cengage Learning India Edition, 2010.
3. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

**(19A02304T) ELECTRICAL TECHNOLOGY**

**Course Objectives:** Student can be able to know

- The constructional features of DC machines, different types of DC machines and their characteristic.
- The constructional details of single phase transformer and their performance characteristics by conducting suitable tests.
- The analysis of three phase balanced and unbalanced circuits, Three phase induction motors and their characteristics.
- The constructional feature and operation of synchronous machines.

**UNIT- I Dc Generators**

D.C. Generators – Principle of Operation – Constructional Features – E. M.F Equation– Numerical Problems – Methods of Excitation – Separately Excited and Self Excited Generators – Build-Up of E.M.F - Critical Field Resistance and Critical Speed - Load Characteristics of Shunt, Series and Compound Generators- Applications

**Unit Outcomes:**

- To know about principle of operation of a DC machine working as a generator
- To distinguish between self and separately excited generators and classification
- To know how emf is developed
- To distinguish between critical field resistance and critical speed
- To know about various characteristics of different types of generators

**UNIT – II D.C. Motors**

D.C Motors – Principle of Operation – Back E.M.F. –Torque Equation – Characteristics and Application of Shunt, Series and Compound Motors-Speed Control of D.C. Motors: Armature Voltage and Field Flux Control Methods. Three Point Starter-Losses – Constant & Variable Losses – Calculation of Efficiency - Swinburne’s Test.

**Unit Outcomes:**

- To know about principle of operation of DC machine working as a motor
- To know about torque developed
- To know about how to control speed of DC shunt motor
- To know about necessity of starter
- To know about various load characteristics of various types of DC motors

### **UNIT-III Single Phase Transformers & Three Phase A.C. Circuits**

Introduction - Single Phase Transformers- Constructional Details- Emf Equation - Operation on No Load and on Load - Phasor Diagrams-Equivalent Circuit - Losses and Efficiency- Regulation-OC and SC Tests - Predetermination of Efficiency and Regulation. Analysis of Balanced Three Phase Circuits – Phase Sequence- Star and Delta Connection - Relation between Line and Phase Voltages and Currents in Balanced Systems - Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems.

#### **Unit Outcomes:**

- To understand the principle of operation of 1- $\phi$  transformer
- To understand computation and predetermination of regulation of a 1- $\phi$  transformer
- To know about basics of three phase circuits
- To distinguish between phase voltages, currents, line values and phase values
- To distinguish between balanced and unbalanced three phase circuits and power measurement

### **UNIT-IV 3-Phase Induction Motors**

Polyphase Induction Motors-Construction Details of Cage and Wound Rotor Machines- - Principle of Operation – Slip- Rotor Emf and Rotor Frequency - Torque Equation- Torque Slip Characteristics – Losses and efficiency.

#### **Unit Outcomes:**

- To know about principle of operation of three phase induction motor
- To distinguish between squirrel cage and slip ring induction motors
- To know about various losses and computation of efficiency of induction motor
- To know about the torque developed by the induction motor
- To understand various characteristics of induction motor

### **UNIT – V Synchronous Machines**

Principle and Constructional Features of Salient Pole and Round Rotor Machines – E.M.F Equation- Voltage Regulation by Synchronous Impedance Method- Theory of Operation of Synchronous Motor.

#### **Unit Outcomes:**

- To know about principle of working of alternator
- To distinguish between salient pole and cylindrical rotor machines
- To know about emf equation



- To know about predetermination of regulation of alternator by synchronous impedance method
- To know about principle of operation of synchronous motor

### **Course Outcomes:**

After completing the course, the student should be able to do the following:

CO1: Able to calculate the e.m.f. generated on DC Generator also able to control speed of different DC motors.

CO2: Able to conduct open circuit and short circuit tests on single phase transformer for knowing their characteristics.

CO3: Able to analyse three phase circuits, three induction motor operating principle and know their torque slip characteristics.

CO4: Able to have knowledge on synchronous machine with which he/she can able to apply the above conceptual things to real-world problems and applications

### **TEXT BOOKS:**

1. I.J.Nagrath & D.P.Kothari, "Electric Machines", 7<sup>th</sup> Edition, Tata Mc Graw Hill, 2005
2. T.K.Nagsarkar and M.S. Sukhija, " Basic Electrical Engineering", 3<sup>rd</sup> Edition, Oxford University Press 2017.

### **REFERENCE BOOKS:**

1. B. R. Gupta, "Fundamentals of Electric Machines", Vandana Singhal, 3<sup>rd</sup> Edition, New age International Publishers, 2005.
2. S. Kamakashiah, "Electromechanics – III", overseas publishers Pvt. Ltd.
3. V.K. Mehta and Rohit Mehta, "Principles of Electrical Engineering", S.Chand Publications, 2005.

**Course Objectives:**

- To verify the theoretical concepts practically from all the experiments.
- To analyze the characteristics of diodes, UJT, BJT, FET, SCR.
- To Model the electronic circuits using tools such as PSPICE/Multisim.

**LIST OF EXPERIMENTS:**

1. Verification of Volt- Ampere characteristics of a PN junction diode and find static, dynamic and reverse resistances of the diode from the graphs obtained.
2. Design a full wave rectifier for the given specifications with and without filters, and verify the given specifications experimentally. Vary the load and find ripple factor. Draw suitable graphs.
3. Verify various clipping and clamper circuits using PN junction diode and draw the suitable graphs.
4. Design a Zener diode based **voltage regulator** against variations of supply and load. Verify the same from the experiment.
5. Study and draw the **output** and **transfer** characteristics of MOSFET (Enhance mode) in Common Source Configuration experimentally. Find **Threshold voltage ( $V_T$ )**,  **$g_m$** , & **K** from the graphs.
6. Study and draw the **output** and **transfer** characteristics of MOSFET (Depletion mode) or JFET in Common Source Configuration experimentally. Find  **$I_{DSS}$** ,  **$g_m$** , &  **$V_P$**  from the graphs.
7. Verification of the input and output characteristics of BJT in **Common Emitter** configuration experimentally and find required **h – parameters** from the graphs.
8. Study and draw the input and output characteristics of BJT in **Common Base** configuration experimentally, and determine required **h – parameters** from the graphs.
9. Verify the Volt Ampere characteristics of SCR experimentally and **determine holding current and break over voltage** from the graph.
10. Study and draw the Volt Ampere characteristics of UJT and determine  **$\eta$** ,  **$I_P$** ,  **$I_V$** ,  **$V_P$** , &  **$V_V$**  from the experiment.
11. Design and analysis of voltage- divider bias/self bias circuit using BJT.
12. Design and analysis of voltage- divider bias/self bias circuit using JFET.
13. Design and analysis of self bias circuit using MOSFET.
14. Design a suitable circuit for switch using CMOSFET/JFET/BJT.

**Tools / Equipment Required:** Software Tool like Multisim/ Pspice or Equivalent, DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices

**Note:** All the experiments shall be implemented using both Hardware and Software. Student has to perform minimum of any 12 experiments

**Course Outcomes:**

CO1: Understand the basic characteristics and applications of basic electronic devices. (L1)

CO2: Observe the characteristics of electronic devices by plotting graphs (L2)

CO3: Analyze the Characteristics of UJT, BJT, FET, and SCR (L3).

CO3: Design FET based amplifier circuits/BJT based amplifiers for the given specifications.(L4)

CO4: Simulate all circuits in PSPICE /Multisim. (L5).

**(19A04305) BASIC SIMULATION LAB**

**Course Objectives:**

- To provide practical exposure with generation and simulation of basic signals using standardized tools.
- To teach analysing signals and sequences using Fourier, Laplace and Z-transforms.
- To enable to write programs for signal processing applications.

**List of Experiments:**

1. Write a program to generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Perform operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Write a program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightages- Plot the discrete spectrum of the signal.
4. Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences. Plot all the sequences.
6. Write a program to find autocorrelation and cross correlation of given sequences.
7. Write a program to verify Linearity and Time Invariance properties of a given Continuous/Discrete System.
8. Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to find response of a low pass filter and high pass filter, when a speech signal is passed through these filters.
11. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
12. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the same for a time period of 0.2 sec.
13. To plot pole-zero diagram in S-plane/Z-plane of given signal/sequence and verify its stability.

**Note:** All the experiments are to be simulated using MATLAB or equivalent software.

**Course Outcomes:**

- CO1:** Understand the basic concepts of programming in MATLAB and explain use of built-in functions to perform assigned task. (L1)
- CO2:** Generate signals and sequences, Input signals to the systems to perform various operations (L2)
- CO3:** Analyze signals using Fourier, Laplace and Z-transforms. (L3)
- CO4:** Compute Fourier transform of a given signal and plot its magnitude and phase spectrum.(L3)
- CO5:** Verify Sampling theorem, Determine Convolution and Correlation between signals and sequences. (L5)

**(19A02304P) ELECTRICAL TECHNOLOGY LAB**

**Course Objectives:**

- To do experiments on DC generators
- To do experiments on DC motors
- To do experiments on 1- $\phi$  transformer
- To do power measurements in 3- $\phi$  balanced and unbalanced circuits
- To do tests on 3- $\phi$  Induction motors
- To do experiment on Alternator
- To do experiment on Synchronous motor

**List of Experiments:**

1. OCC of a separately excited DC generator
2. Load characteristics of DC shunt generator
3. Load characteristics of DC shunt motor
4. Swinburne's test
5. Speed control of DC shunt motor
6. OC & SC tests on a 1- $\phi$  transformer
7. Measurement of Active and reactive powers in a 3- $\phi$  balanced circuit
8. Measurement of 3- $\phi$  power using two wattmeter method in unbalanced circuit
9. Load test on Squirrel cage Induction motor
10. Load test on Slip ring Induction motor
11. Predetermination of regulation of alternator by Synchronous impedance method
12. V and Inverted V curves of Synchronous motor

**Note:** Student has to perform at least 10 experiments

**Course Outcomes:**

- To understand various characteristics of DC generators and DC motors
- To predetermine the efficiency and regulation of a 1- $\phi$  transformer
- To know power measurement in 3- $\phi$  circuits
- To understand various characteristics of Induction motors, Synchronous machines

**(19A99302) BIOLOGY FOR ENGINEERS**

**Course Objectives:** To provide basic understanding about life and life Process. Animal and plant systems. To understand what biomolecules are, their structures and functions. Application of certain biomolecules in Industry.

- Brief introduction about human physiology and bioengineering.
- To understand hereditary units, i.e. DNA (genes) and RNA and their synthesis in living organism.
- How biology Principles can be applied in our daily life using different technologies.
- Brief introduction to the production of transgenic microbes, Plants and animals.

**Unit I: Introduction to Basic Biology**

Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cell. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Brief introduction to five kingdoms of classification.

**Unit Outcomes:**

After completing this unit, the student will be able to

- Summarize the basis of life. (L1)
- Understand the difference between lower organisms (prokaryotes) from higher organisms (eukaryotes). (L2)
- Understand how organisms are classified. (L3)

**Unit II: Introduction to Biomolecules**

Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

**Unit Outcomes:**

After completing this unit, the student will be able to

- Understand what are biomolecules? their role in living cells, their structure, function and how they are produced. (L1)
- Interpret the relationship between the structure and function of nucleic acids. (L2)
- Summarize the applications of enzymes in industry. (L3)
- Understand what is fermentation and its applications of fermentation in industry. (L4)

**Unit III: Human Physiology**

Nutrition: Nutrients or food substances. Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle. Excretory system.

**Unit Outcomes:**

After completing this unit, the student will be able to

- Understand what nutrients are (L1)
- Understand the mechanism and process of important human functions (L2 & L3)

**Unit IV: Introduction to Molecular Biology and recombinant DNA Technology**

Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. rDNA technology. Introduction to gene cloning.

**Unit Outcomes:**

After completing this unit, the student will be able to

- Understand and explain about gene structure and replication in prokaryotes and Eukaryotes (L1)
- How genetic material is replicated and also understands how RNA and proteins are synthesized. (L2)
- Understand about recombinant DNA technology and its application in different fields.(L3)
- Explain what is cloning. (L4)

**Unit V: Application of Biology**

Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Vaccines and antibodies. Basics of biosensors, biochips, Bio fuels, and Bio Engineering. Basics of Production of Transgenic plants and animals.

**Unit Outcomes:**

After completing this unit, the student will be able to Understand.

- How biology is applied for production of useful products for mankind.(L1)
- What are biosensors, biochips etc. (L2)
- Understand transgenic plants and animals and their production (L3)

**Course Outcomes:**

After studying the course, the student will be able to:

- Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
- Explain about biomolecules, their structure and function and their role in the living organisms. How biomolecules are useful in Industry.
- Briefly about human physiology.
- Explain about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.



- Know about application of biological Principles in different technologies for the production of medicines and Pharmaceutical molecules through transgenic microbes, plants and animals.

**Text books:**

1. P.K.Gupta, Cell and Molecular Biology, 5<sup>th</sup> Edition, Rastogi Publications -
2. U. Satyanarayana. Biotechnology, Books & Allied Ltd 2017

**Reference Books:**

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A Global Approach”, Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology 2<sup>nd</sup> ed.. Panima Publications. PP 434.
4. David Hames, Instant Notes in Biochemistry –2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology – 2014

(19A04401) ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

**Course Objectives:**

- To introduce fundamentals of static and time varying electromagnetic fields.
- To teach problem solving in Electromagnetic fields using vector calculus.
- To demonstrate wave concept with the help of Maxwell's equations.
- To introduce concepts of polarization and fundamental theory of electromagnetic waves in transmission lines and their practical applications.
- To analyze reflection and refraction of electromagnetic waves propagated in normal and oblique incidences.

**Unit I**

**Vector Analysis:** Coordinate systems and transformation-Cartesian, Cylindrical and Spherical coordinates

**Vector Calculus:** Differential length area and volume, line surface and volume integrals, del operator, gradient, divergent and curl operations.

Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Divergence Theorem, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.

**Unit Outcomes:**

- Understand basic laws of static electric field. (L1)
- Derive the Maxwell's equations for electrostatic fields. (L3)
- Solve problems applying laws of electrostatics. (L3)

**Unit II**

Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Magnetic dipole, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems.

Faraday's Law and Transformer e.m.f, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's equations for time varying fields, Maxwell's Equations in Different Final Forms and Word Statements, Illustrative Problems

**Unit Outcomes:**

- Understand basic laws of static magnetic field. (L1)
- Derive the Maxwell's equations for magnetic fields. (L3)
- Solve problems applying laws of magneto statics. (L3)
- Derive the Maxwell's equations for electromagnetic fields. (L3)
- Apply the boundary conditions of electromagnetic fields at the interface of different media. (L2)

### **Unit III**

Boundary Conditions of Electromagnetic fields: Dielectric-Dielectric and Dielectric-Conductor Interfaces, Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization, Illustrative Problems.

#### **Unit Outcomes:**

- Understand concept of wave propagation through the Maxwell's equations. (L1)
- Derive wave equations for different media. (L3)
- Explain concept of polarization of electromagnetic wave. (L2)

### **Unit IV**

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector, and Poynting Theorem – Applications, Power Loss in a Plane Conductor, Illustrative Problems.

#### **Unit Outcomes:**

- Understand principles of reflections and refraction for different incidences. (L1)
- State concept of power flow using Poynting vector. (L2)
- Calculate Brewster angle, power flow and surface impedance. (L3)

### **Unit V**

**Transmission Lines:** Introduction, Transmission line parameters, Transmission line equivalent circuit, Transmission line equations and their solutions in their phasor form, input impedance, standing wave ratio, Transmission of finite length- half wave, quarter wave transmission line, Smith chart, graphical analysis of transmission lines using Smith chart, stub matching- single and double stub matching, Illustrative Problems.

#### **Unit Outcomes:**

- Understand the principles of transmission lines and concept of smith chart.(L1)
- Derive the input impedance of transmission line.(L3)
- Finding the line parameters through problem solving.(L4)
- Study the applications of different lengths of transmission lines.(L2)

**Course Outcomes:**

After completion of the course, student will be able to

**CO1:** Explain basic laws of electromagnetic fields and know the wave concept. (L2)

**CO2:** Solve problems related to electromagnetic fields. (L3)

**CO3:** Analyze electric and magnetic fields at the interface of different media. (L3)

**CO4:** Derive Maxwell's equations for static and time varying fields. (L3)

**CO5:** Analogy between electric and magnetic fields. (L5)

**CO6:** Describes the transmission lines with equivalent circuit and explain their characteristic with various lengths. (L2)

**TEXT BOOKS:**

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 4<sup>th</sup> edition. Oxford Univ. Press, 2008.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 7<sup>th</sup> edition., TMH, 2006.

**REFERENCES:**

1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2<sup>nd</sup> Edition, PHI, 2000.
2. John D. Krauss, "Electromagnetics", 4<sup>th</sup> Edition, McGraw- Hill publication 1999.
3. Electromagnetics, Schaum's outline series, 2<sup>nd</sup> Edition, Tata McGraw-Hill publications, 2006.

**(19A04402T) ELECTRONIC CIRCUITS-ANALYSIS AND DESIGN**

**Course Objectives:**

- To design and analyze single and multi stage amplifiers using BJT & FET at low and high frequencies.
- To discuss cascading of single stage amplifiers.
- To explain effect of negative feedback on amplifier characteristics.
- To teach basic principles for analysing RC & LC oscillator circuits.
- To introduce different types of large signal amplifiers and tuned amplifiers.

**Unit I**

**Small Signal Amplifiers Using MOSFETS:** Graphical analysis, Load line and small signal parameters, Small signal equivalent circuit, Small signal analysis of Common source, Common drain, Common gate amplifiers, Comparison of the three basic amplifier configurations, Problem solving.

**JFET Small Signal Amplifiers:** Small signal analysis of common source, common drain, common gate amplifiers, JFET as voltage variable resistor, Problem solving.

**BJT Small Signal Models:** Bipolar linear amplifier, Graphical and ac equivalent circuit, Small signal hybrid- $\pi$  equivalent circuit, Hybrid- $\pi$  equivalent circuit including the early effect, other small signal parameters and equivalent circuits-h-parameters.

**Small Signal Analysis:** Basic CE amplifier circuit, Circuit with Emitter resistance, ac load line analysis, maximum symmetrical swing, Small signal analysis-input and output impedances, Voltage gain, Current gain of CB, CC amplifiers, Problem solving.

**Unit Outcomes:**

- Understand the concepts and equivalent circuit models of small signal amplifiers. (L1)
- Analyze low frequency and high frequency models of BJT and FET. (L3)
- Design BJT and FET amplifier circuits.(L4)
- Determine performance parameters of BJT and FET amplifiers. (L2)

**Unit II**

**Frequency Response:** Amplifier frequency response-different ranges, short circuit and open circuit time constants, time response, transistor amplifiers with circuit capacitors-coupling capacitor effects, load capacitor effects, Bypass capacitor effects, Problem solving, combined effects of coupling and bypass capacitor, high-frequency response model for BJT and MOSFETs, short circuit current gain, Miller effect and its applications, unity-gain bandwidth in BJT and FET amplifiers, CE and CS circuits, CB and CG circuits, Cascode amplifier analysis, emitter and source follower circuits, high frequency response- design application.

### **Unit Outcomes:**

- Analyze the frequency response of single stage amplifiers using BJT & FET at high and low frequencies. (L3)
- Design of single stage amplifiers using BJT and FET with and without coupling capacitors. (L4)
- Explore the various effects of load , bypass and coupling capacitor on the performance of amplifier circuits.(L5)

### **Unit III**

**Differential and Multistage Amplifiers:** Differential amplifier, basic BJT differential pair and its qualitative description, DC transfer characteristics, small signal equivalent circuit analysis, CMRR, differential and common mode gains, differential and common mode input impedances. Basic differential FET pair, small signal equivalent circuit analysis, JFET differential amplifier, differential amplifier with active load, MOSFET differential amplifier with active load, two stage RC coupled amplifier, Darlington pair and simple emitter follower output, voltage gain, input and output impedances, simplified BJT operational amplifier circuit, design applications- CMOS differential amplifier.

### **Unit Outcomes:**

- Understand basic concepts and need of Differential and multistage amplifiers. Also various inter-stage coupling in multi-stage amplifiers. (L1)
- Analyze and examine few common two stage transistor amplifier circuits viz., Cascade amplifiers, Cascode amplifiers, Darlington pairs. (L3)
- Design multiple stage amplifier circuits. (L4)

### **Unit IV**

**Feedback Amplifiers:** General Considerations, Properties of Negative Feedback, Types of Amplifiers, Sense and Return Techniques, Polarity of Feedback , Feedback Topologies, Effect of Nonideal I/O Impedances, Stability in Feedback Systems , Analysis of a feedback Amplifiers - Voltage – Series, Current Series, Current-shunt and Voltage-shunt , Illustrative problems.

**Oscillators:** General Considerations, LC Oscillators, Phase Shift Oscillator, Wien-Bridge Oscillator, Crystal Oscillators, Illustrative Problems.

### **Unit Outcomes:**

- Understand concept of different feedback topologies. (L1)
- Determine the effect of feedback on amplifier characteristics .(L2)
- Analyse characteristics of various types of feedback configurations (L3)
- Explore working principle of oscillator. Also examine different types of oscillators, RC & LC, with detailed mathematical analysis and illustrations. (L2)

## Unit V

### Power Amplifiers:

Classes of amplifiers-Operations of Class A, B, AB, C, class-A: Inductively coupled amplifier, transformer-coupled common emitter amplifier, transformer-coupled emitter-follower amplifier,

Class-AB Push-pull complementary output stages-class-AB output stage with diode biasing, class-AB biasing using the  $V_{BE}$  multiplier, class-AB output stage with input buffer transistors, class –AB output stage utilizing the Darlington configuration, Illustrative Problems.

**Tuned Amplifiers:** Introduction to tuned amplifiers, Role of Q-Factor, Single-tuned, Double-tuned and Stagger-tuned amplifiers.

### Unit Outcomes:

- Know most common classes of power amplifier and their basic characteristics. (L2)
- Understand various distortions of amplifiers and the concept of heat sink.(L1)
- Analyse complementary symmetry topologies. (L3)
- Evaluate conversion efficiency of various topologies. (L4)
- Analyse different types of distortions in power amplifiers. (L3)
- Evaluate the resonant frequency for tuned amplifiers. Analyse characteristics of tuned amplifiers (L5)

### Course Outcomes:

**CO1:** Understand the working principle of multistage amplifiers, Feedback amplifiers, power amplifiers, tuned amplifiers, Multivibrator and Time base generators (L1)

**CO2:** Analyse multistage amplifiers, multistage amplifiers, feedback amplifiers, power amplifiers, tuned amplifier and Multivibrators. (L3)

**CO3:** Design multistage amplifiers, feedback amplifiers, oscillators, Multivibrator, power amplifiers and tuned amplifiers for given specification.(L4)

**CO5:** Evaluate efficiency of large signal (power) amplifiers and voltage regulators (L5)

### TEXT BOOKS:

1. Donald A Neamen, “Electronic Circuits – Analysis and Design,” 3<sup>rd</sup>Edition, McGraw Hill (India), 2019.
2. J. Millman, C Chalkias, “Integrated Electronics”, 4<sup>th</sup> Edition, McGraw Hill Education (India) Private Ltd., 2015.
3. K.Lal Kishore, “Electronic Circuit Analysis”, 2<sup>nd</sup> Edition, B S Publications, 2008.

### REFERENCE BOOKS:

1. Behzad Razavi, "Fundamentals of Micro Electronics", Wiley, 2010.
2. Millman and Taub, Pulse, "Digital and Switching Waveforms", 3rd Edition, Tata McGraw-Hill Education, 2011
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 9th Edition, Pearson/Prentice Hall, 2006.



**(19A02404) CONTROL SYSTEMS**

**Course Objectives:**

To make the students learn about:

- Merits and demerits of open loop and closed loop systems; the effect of feedback
- The use of block diagram algebra and Mason's gain formula to find the overall transfer function
- Transient and steady state response, time domain specifications and the concept of Root loci
- Frequency domain specifications, Bode diagrams and Nyquist plots
- State space modelling of Control system

**UNIT – I CONTROL SYSTEMS CONCEPTS**

Open loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback characteristics, Effects of positive and negative feedback, Mathematical models – Differential equations of translational and rotational mechanical systems and electrical systems, Analogous Systems, Block diagram reduction methods – Signal flow graphs - Reduction using Mason's gain formula. Principle of operation of DC and AC Servo motor, Transfer function of DC servo motor - AC servo motor, Synchros.

**Unit Outcomes:**

At the end of the unit, the student will be able to

- Write the differential equations for mechanical and electrical systems
- Obtain the transfer function from block diagrams, servo motors and signal flow graphs

**UNIT-II TIME RESPONSE ANALYSIS**

Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants, P, PI, PID Controllers.

**Unit Outcomes:**

At the end of the unit, the student will be able to

- Analyze the time domain specifications
- Calculate the steady state errors
- Understand about Proportional, Integral and Derivative controllers along with combinations

### **UNIT – III STABILITY ANALYSIS IN TIME DOMAIN**

The concept of stability – Routh’s stability criterion – Stability and conditional stability – limitations of Routh’s stability. The Root locus concept - construction of root loci-effects of adding poles and zeros to  $G(s)H(s)$  on the root loci.

#### **Unit Outcomes:**

At the end of the unit, the student will be able to

- Analyze the concept of stability in time domain
- Apply the concept of Routh’s stability and Root locus in time domain

### **UNIT – IV FREQUENCY RESPONSE ANALYSIS**

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Stability Analysis from Bode Plots. Polar Plots-Nyquist Plots- Phase margin and Gain margin-Stability Analysis. Compensation techniques – Lag, Lead, Lag-Lead Compensator design in frequency Domain.

#### **Unit Outcomes:**

At the end of the unit, the student will be able to

- Evaluate the frequency domain specifications from Bode, Polar and Nyquist plots
- Design Compensators for various systems
- Deducing transfer functions from Bode Plots
- Understand difference between Phase and Gain margins

### **UNIT – V STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS**

Concepts of state, state variables and state model, state models - differential equations & Transfer function models - Block diagrams. Diagonalization, Transfer function from state model, Solving the Time invariant state Equations- State Transition Matrix and it’s Properties. System response through State Space models. The concepts of controllability and observability, Duality between controllability and observability.

#### **Unit Outcomes:**

At the end of the unit, the student will be able to

- Understand the concept of state space, controllability and observability
- Obtain the transfer function from state space and vice versa
- Understand the state transition method of solving time invariant state equations

#### **Course Outcomes:**

After completing the course, the student should be able to:

- CO1** Understand the concepts of control systems classification, feedback effect, mathematical modelling, time response and frequency response characteristics, state space analysis
- CO2** Apply the concepts of Block diagram reduction, Signal flow graph method and state space formulation for obtaining mathematical and Root locus, Bode, Nyquist, Polar plots for stability calculations, controllability and observability and demonstrate the use of these techniques.
- CO3** Analyse time response analysis, error constants, and stability characteristics of a given mathematical model using different methods.
- CO4** Design and develop different compensators, controllers and their performance evaluation for various conditions. Implement them in solving various engineering applications.

#### **TEXT BOOKS:**

1. Katsuhiko Ogata, "Modern Control Engineering", 5<sup>th</sup> edition, Prentice Hall of India Pvt. Ltd., 2010.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", 5<sup>th</sup> edition, New Age International (P) Limited Publishers, 2007.

#### **REFERENCE BOOKS:**

1. M.Gopal, "Control Systems Principles & Design", 4<sup>th</sup> Edition, Mc Graw Hill Education, 2012.
2. B. C. Kuo and Farid Golnaraghi, "Automatic Control Systems", 8<sup>th</sup> edition, John Wiley and Sons, 2003.
3. Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, "Feedback and Control Systems", 2<sup>nd</sup> Edition, Schaum's outlines, Mc Graw Hill Education, 2013.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, "Control System Design" Pearson, 2000.
5. Gene F. Franklin, J.D. Powell and Abbas Emami-Naeini, Feedback "Control of Dynamic Systems", 6<sup>th</sup> Edition, Pearson, 2010.

(19A04403T) ANALOG COMMUNICATIONS

**Course Objectives**

- To introduce various modulation and demodulation techniques of analog communication system.
- To analyze different parameters of analog communication techniques.
- Know Noise Figure in AM & FM receiver systems.
- Understand Function of various stages of AM, FM transmitters and Know Characteristics of AM & FM receivers.
- Understand the concepts of information theory.

**Unit – I**

**Introduction:** Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.

**Amplitude Modulation & Demodulation:** Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Frequency division multiplexing (FDM), Illustrative Problems.

**Unit Outcomes:**

- Understand the concepts of Amplitude Modulation and demodulation techniques. (L1)
- Apply the concepts to solve problems in Amplitude modulation Schemes. (L2)
- Analyse frequency spectra of modulated signals used in various amplitude modulation (L3)
- Compare the Performance of different amplitude modulation techniques. (L4)

**Unit – II**

**Angle Modulation & Demodulation:** Concept of instantaneous frequency, Generalized concept of angle modulation, Bandwidth of angle modulated waves – Narrow band frequency modulation (NBFM) and Wide band FM (WBFM), Phase modulation, Verification of Frequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves-Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis, & De-emphasis filters, FM Capture Effect, Illustrative Problems.

### **Unit Outcomes:**

- Understand the concepts of Angle modulation and demodulation techniques. (L1)
- Understand importance Pre-emphasis & de-emphasis circuit in FM modulation. (L1)
- Apply the concepts to solve problems in Angle modulation Schemes. (L2)
- Analyse frequency spectra of modulated signals used in various angle modulation (L3)

### **Unit – III**

**Noise in Communication Systems:** Thermal noise, Time domain representation of narrowband noise, filtered white noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSB-SC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

### **Unit Outcomes:**

- Understand different types of noise and sources that effect the performance of the communication system. [L1]
- Analyse performance of analog communication system in the presence of noise. [L3]
- Compare the performance of communication system by evaluating figure of merit for different schemes of modulation. [L4]

### **Unit – IV**

**Analog Pulse Modulation Schemes:** Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

**Radio Receiver:** Working principle of Super heterodyne AM and FM Receivers along with suitable block diagrams, Sensitivity, Selectivity and fidelity.

### **Unit Outcomes:**

- Understand the concepts of Analog Pulse Modulation and Demodulation techniques. [L1]
- Understand the concepts of AM and FM receivers. [L1]
- Apply the concepts to solve problems in Analog pulse modulation schemes. [L2]
- Analyse the performance of AM and FM receivers.[L3]
- Compare the Performance of different Analog Pulse Modulation techniques.[L4]

## Unit – V

**Information Theory:** Introduction, Information and Entropy, and its properties, source coding Theorem, Data Compaction – Prefix coding, Huffman coding, Discrete Memoryless channels, Mutual Information, and its properties, Channel capacity, Channel coding Theorem, Application to binary symmetric channels, differential entropy and mutual information, Information capacity theorem, implication of information capacity theorem, Rate Distortion, Illustrative problems.

### Unit Outcomes:

- Understand the concepts of information theory and different coding techniques.[L1]
- Analyse Binary symmetric channel. [L3]
- Design the channel performance using information theory. [L4]
- Derive equation for Entropy, Mutual information and channel capacity for all types of channels. [L2]

### Course Outcomes

#### After completion of the course, student will be able to

**CO1:** Understand the concepts of various Amplitude, Angle and Pulse Modulation schemes.

Understand the concepts of information theory with random processes. (L1)

**CO2:** Apply the concepts to solve problems in analog and pulse modulation schemes. (L2)

**CO3:** Analysis of analog communication system in the presence of noise. (L3)

**CO4:** Compare and contrast design issues, advantages, disadvantages and limitations of various modulation schemes in analog communication systems.(L4)

**CO5:** Solve basic communication problems & calculate information rate and channel capacity of a discrete communication channel (L5)

### TEXT BOOKS:

1. B. P.Lathi, “Modern Digital and Analog Communication Systems,” 3<sup>rd</sup> Edition, Oxford Univ. press, 2006.
2. John Wiley & Sons Simon Haykin, “Communication Systems,”3<sup>rd</sup> Edition, 2010.
3. Sham Shanmugam, “Digital and Analog Communication Systems”, Wiley-India edition, 2006.(edition)

## REFERENCES:

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", 5th Edition, McGraw-Hill International Edition, 2010.
2. Herbert Taub & Donald L Schilling, "Principles of Communication Systems", 3rd Edition, Tata McGraw- Hill, 2009.
3. R.E. Ziemer & W.H. Tranter, "Principles of Communication-Systems Modulation & Noise", 5<sup>th</sup>edition, Jaico Publishing House2001.
4. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH,2004.(edition)

(19A05304T) PYTHON PROGRAMMING

**Course Objectives:**

- To learn the fundamentals of Python
- To elucidate problem-solving using a Python programming language
- To introduce a function-oriented programming paradigm through python
- To get training in the development of solutions using modular concepts
- To introduce the programming constructs of python

**Unit – I**

**Introduction:** What is a program, Running python, Arithmetic operators, Value and Types.

**Variables, Assignments and Statements:** Assignment statements, Script mode, Order of operations, string operations, comments.

**Functions:** Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

**Unit Outcomes:**

Student should be able to

- List the basic constructs of Python.
- Solve the problems by applying modularity principle.

**Unit – II**

**Case study:** The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring.

**Conditionals and Recursion:** floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input.

**Fruitful Functions:** Return values, Incremental development, Composition, Boolean functions, More recursion, Leap of Faith, Checking types,

**Unit Outcomes:**

Student should be able to

- Apply the conditional execution of the program.
- Apply the principle of recursion to solve the problems.

**Unit - III**



**Iteration:** Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms.

**Strings:** A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison.

**Case Study:** Reading word lists, Search, Looping with indices.

**Lists:** List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.

### **Unit Outcomes:**

Student should be able to

- Use the data structure list.
- Design programs for manipulating strings.

### **Unit – IV**

**Dictionaries:** A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables.

**Tuples:** Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences.

**Files:** Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules.

**Classes and Objects:** Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.

Classes and Functions:

### **Unit Outcomes:**

Student should be able to

- Apply object orientation concepts.
- Use data structure dictionaries.
- Organize data in the form of files.

### **Unit – V**

**Classes and Functions:** Time, Pure functions, Modifiers, Prototyping versus Planning

**Classes and Methods:** Object oriented features, Printing objects, The init method, The \_\_str\_\_ method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation

**Inheritance:** Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Class diagrams, Data encapsulation.

**The Goodies:** Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, defaultdict, Named tuples, Gathering keyword Args,

**Unit Outcomes:**

Student should be able to

- Plan programs using object orientation approach.
- Illustrate the principle of inheritance.

**Course Outcomes:**

Student should be able to

- Apply the features of Python language in various real applications.
- Select appropriate data structure of Python for solving a problem.
- Design object oriented programs using Python for solving real-world problems.
- Apply modularity to programs.

**TEXT BOOKS:**

1. Allen B. Downey, “Think Python”, 2<sup>nd</sup> edition, SPD/O’Reilly, 2016.

**REFERENCE BOOKS:**

1. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
2. Kenneth A. Lambert, B.L. Juneja, “Fundamentals of Python”, CENGAGE, 2015.
3. R. Nageswara Rao, “Core Python Programming”, 2<sup>nd</sup> edition, Dreamtech Press, 2019

**(19A04404) COMPUTER ARCHITECTURE AND ORGANIZATION**

**Course Objectives:**

- To discuss organization and design of a digital computer.
- To explain how to use RTL to represent memory and Arithmetic/ Logic/ Shift operations
- To introduce computer languages, machine, symbolic and assembly levels
- To present organization of central processing unit and concepts of micro-programmed control
- To explain how input-output devices communicate with the other components and methods of data transfer
- To teach different types of addressing modes and memory organization.

**Unit I**

Data Representation: Data Types, Complements, Fixed-Point Representation, Conversion of Fractions, Floating-Point Representation, Other Binary Codes

Register Transfer and Micro-operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit

**Unit Outcomes:**

- Represent various data types found in digital computers in binary form (L2)
- Emphasize representation of numbers employed in arithmetic operations and on binary coding of symbols used in data processing (L5)
- Express micro-operations in symbolic form by using register transfer language (L2)
- Develop composite arithmetic logic shift unit to show hardware design of micro-operations (L3)

**Unit II**

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Complete Computer Description, Design and Accumulator Logic.

Programming the Basic Computer: Machine Language, Assembly Language, the Assembler, Program Loops, programming arithmetic and logic operations

**Unit Outcomes:**

- Describe organization and design of a basic digital computer (L2)

- Illustrate techniques used in assembly language programming (L2)
- Show translation from symbolic code to an equivalent binary program using basic operations of an assembler (L2)

### Unit III

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC).

#### Unit Outcomes:

- Develop execution unit to show general register organization of a typical CPU (L3)
- Explain operation of a memory stack (L2)
- Illustrate various instruction formats together with a variety of addressing modes (L2)
- Discuss characteristics and advantages of reduced instruction set computer(RISC) (L6)

### Unit IV

**Micro-programmed Control:** Control Memory, Address Sequencing, Micro-program example, Design of Control Unit.

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating-Point Arithmetic Operations

#### Unit Outcomes:

- Develop specific micro-programmed control unit to show how to write microcode for a typical set of instructions (L3)
- Design control unit including the hardware for the micro-program sequencer (L6)
- Show procedures for implementing arithmetic algorithms for addition, subtraction, multiplication and division with digital hardware (L2)
- Discuss algorithms to specify the sequence of micro-operations and control decisions required for implementation (L6)

### UNIT V

**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor (IOP), Serial Communication.

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

#### Unit Outcomes:

- Explain how processor interacts with external peripherals through Interface units (L2)

- Compare different modes of data transfer (L4)
- Illustrate procedures for serial data transmission (L2)
- Describe concept of memory hierarchy composed of cache memory, main memory, and auxiliary memory (L2)
- Explain organization and operation of associative memories (L2)

**Course Outcomes:**

**CO1:** Conceptualize basics of organizational and architectural issues of a digital computer (L4)

**CO2:** Emphasize representation of data types, numbers employed in arithmetic operations and binary coding of symbols used in data processing (L5)

**CO3:** Develop low-level programs to perform different basic instructions (L5)

**CO4:** Evaluate various modes of data transfer between CPU and I/O devices (L5)

**CO5:** Analyze various issues related to memory hierarchy (L3)

**CO6:** Design basic computer system using the major components (L4)

**TEXT BOOKS:**

1. M. Morris Mano, “Computer System Architecture”, 3<sup>rd</sup> edition, Pearson Education, 2017.

**REFERENCES:**

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, 5<sup>th</sup> Edition McGraw Hill,
2. John D. Carpinelli, “Computer Systems Organization and Architecture”, 15<sup>th</sup> reprint Pearson Education, 2018,
3. William Stallings, “Computer Organization and Architecture: Designing for Performance”, 8<sup>th</sup> Edition, Pearson

**(19A52301) UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY**

(Common to all)

**Introduction:**

This course discusses the role of human values in one's family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course names as "H-102 Universal Human Values 2 : "Understanding Harmony" is designed which may be covered in their III or IV Semester.

In the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

**Course Objective:**

The objective of the course is four fold:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

**COURSE TOPICS:**

The course has 28 lectures and 14 practice sessions in 5 modules:

**Unit 1:**

**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

## **Unit 2:**

### **Understanding Harmony in the Human Being - Harmony in Myself!**

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

## **Unit 3:**

### **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from

students' lives

#### **Unit 4:**

#### **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

#### **Unit 5:**

#### **Implications of the above Holistic Understanding of Harmony on Professional Ethics**

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
- Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.



## **Text Book**

1. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, “Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics”, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

## **Reference Books**

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, 1999.
2. A. N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi “The Story of My Experiments with Truth”
5. E. F. Schumacher. “Small is Beautiful”
6. Slow is Beautiful –Cecile Andrews
7. J C Kumarappa “Economy of Permanence”
8. Pandit Sunderlal “Bharat Mein Angreji Raj”
9. Dharampal, “Rediscovering India”
10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland(English)
13. Gandhi - Romain Rolland (English)

## **MODE OF CONDUCT (L-T-P-C 2-1-0-2)**

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than “extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to

development of commitment, namely behaving and working based on basic human values.

**OUTCOME OF THE COURSE:**

By the end of the course,

- Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability.
- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

**(19A04402P) ELECTRONIC CIRCUIT ANALYSIS AND DESIGN LAB**

**Course Objectives:**

- To provide a practical exposure for design & analysis of electronic circuits for generation and amplification input signal.
- To learn the frequency response and finding gain, input & output impedance of multistage amplifiers
- To Design negative feedback amplifier circuits and verify the effect of negative feedback on amplifier parameters.
- To understand the application of positive feedback circuits & generation of signals.
- To understand the concept of design and analysis of Power amplifiers and tuned amplifiers
- To construct and analyse voltage regulator circuits.

**LIST OF EXPERIMENTS:**

1. MOSFET Amplifier
  - a. Design and simulate MOSFET (Depletion mode) amplifier using PSPICE /Multisim and study the Gain and Bandwidth of amplifier
  - b. Design common source MOSFET (Enhance mode) amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response
2. JFET Amplifier
  - a. Design and simulate common source FET amplifier using PSPICE /Multisim and study the Gain and Bandwidth of amplifier
  - b. Design common source FET amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response
3. Common Emitter Amplifier (Self bias Amplifier)
  - a. Design and simulate a self- bias (Emitter bias) Common Emitter amplifier using PSPICE /Multisim and study the Gain and Bandwidth of amplifier
  - b. Design voltage divider based Common Emitter amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response.
4. Design and simulate two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve.
5. Design and simulate Darlington amplifier. Determine Gain and Bandwidth from its frequency response curve.
6. Design and Simulate CE – CB Cascode amplifier. Determine Gain and Bandwidth from its frequency response curve.
7. Design and simulate voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier.

8. Design and simulate current shunt feedback for the given specifications. Determine the effect of feedback on the frequency response of a current shunt feedback amplifier.
  9. Design and simulate RC Phase shift oscillator and Wien bridge oscillator for the given specification. Determine the frequency of oscillation.
  10. Design and simulate Hartley and Colpitts oscillators for the given specifications. Determine the frequency of oscillation.
  11. Design and simulate class A power amplifier and find out the efficiency. Plot the output waveforms.
  12. Design and simulate class B push-pull amplifier and find out the efficiency. Plot the output waveforms.
  13. Design and simulate single tuned amplifier. Determine the resonant frequency and bandwidth of a tuned amplifier.
  14. Design and simulate double tuned amplifier. Determine the resonant frequency and bandwidth of a tuned amplifier.
- Note:** Design & simulate any 12 experiments with Multisim / PSPICE or equivalent software and verify the results in hardware lab with discrete components.

### **Course Out Comes**

**After completion of the course, student will be able to**

**CO1:** Understand Characteristics and frequency response of various amplifiers (L1)

**CO2:** Analyze negative feedback amplifier circuits, oscillators, Power amplifiers, Tuned amplifiers. (L3)

**CO3:** Determine the efficiencies of power amplifiers (L2)

**CO4:** Design RC and LC oscillators, Feedback amplifier for specified gain and multistage amplifiers for Low, Mid and high frequencies (L4)

**CO3:** Simulate all the circuits and compare the performance.(L5)

**(19A04403P) ANALOG COMMUNICATIONS LAB**

**Course Objectives**

- To familiarize the students with basic analog communication systems. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course.
- Understand all types of analog modulation / demodulation principles.
- Substantiate pulse modulation techniques.
- To design and implement different modulation and demodulation techniques.
- To write and execute programs in MATLAB to implement various modulation techniques.

**LIST OF EXPERIMENTS**

1. (a) Develop an Amplitude modulation circuit to get modulated signal for various modulation indices. Verify the Spectrum of the modulated signal experimentally and find its Bandwidth.  
(b) Design a suitable demodulated circuit to recover original information signal.
2. Generate a DSB - SC signal using suitable circuit diagram. Extract information bearing signal from DSB-SC signal. Calculate the power of the DSB-SC signal.
3. (a) Develop a Frequency modulation circuit to get modulated signal for various modulation depths. Verify the Spectrum of the modulated signal experimentally and find its Bandwidth.  
(b) Design a suitable demodulated circuit to recover original information signal.
4. (a) Design a Mixer circuit to verify the principle of operation of Mixer experimentally.  
(b) Design a Pre-emphasis & de-emphasis circuit and verify its importance experimentally and plot necessary graph.
5. Construct Pulse Amplitude Modulation circuit and plot modulated signal. Extract the modulated signal by constructing suitable demodulated circuit.
6. Construct Pulse Width Modulation circuit and plot modulated signal. Extract the modulated signal by constructing suitable demodulated circuit.
7. Construct Pulse Position modulation circuit and plot modulated signal. Extract the modulated signal by constructing suitable demodulated circuit.
8. Radio receiver measurements – Sensitivity Selectivity and Fidelity.
9. Simulate AM and FM signals and find power spectrum of each signal. Plot the graphs.
- 10 Simulate PAM and PWM signals and find power spectrum of each signal. Plot the graphs.
11. Generate a complex Gaussian noise (with zero mean unit variance). And pass through an LTI system. Find the power spectrum density of the noise signal available at the output of LTI system.

12. Make use of AM signal from experiment no. 9 add Gaussian noise (with zero mean and unity variance) to the signal. Extract the information bearing signal using suitable system.
13. Simulate Huffman coding.

**Equipment & Software Required:**

**Software:**

1. Computer Systems with latest specifications
2. Connected in LAN (Optional)
3. Operating system (Windows XP)
4. Simulations software (MATLAB)

**Equipment:**

1. Regulated Power Supply (0-30) V
2. CROs (0-20)MHz
3. Function Generators (0-3) MHz
4. RF Signal Generators (0-1000) MHz
5. Multimeters
6. Required Electronic components(active and passive)for the design of experiments from 1-7
7. Radio Receiver Demo kits or Trainers.
8. RF power meter frequency range 0 – 1000MHz
9. Spectrum Analyzer

**Note:** Conduct experiments (9-12) using MATLAB software. Student has to perform minimum twelve Experiments

**Course Outcomes:**

**After the completion of the course students able to**

**CO1:** Understand different analog modulation techniques &Radio receiver characteristics.(L1)

**CO2:** Analyze different analog modulation techniques. (L3)

**CO3:** Design and implement different modulation and demodulation techniques.(L4)

**CO4:** Observe the performance of system by plotting graphs & Measure radio receiver characteristics. (L2)

**CO5:** Simulate all digital modulation and demodulation techniques. (L5)

(19A99301) ENVIRONMENTAL SCIENCE

**Course Objectives:**

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

**UNIT – I**

**Multidisciplinary Nature Of Environmental Studies:** – Definition, Scope and Importance – Need for Public Awareness.

**Natural Resources :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

**Unit Outcomes**

- To know the importance of public awareness
- To know about the various resources

**UNIT – II**

**Ecosystems:** Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Biodiversity And Its Conservation :** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and

local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**Course Outcomes:**

- To know about various eco systems and their characteristics
- To know about the biodiversity and its conservation

**UNIT – III**

**Environmental Pollution:** Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

**Solid Waste Management :** Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

**Course Outcomes:**

- To know about the various sources of pollution.
- To know about the various sources of solid waste and preventive measures.
- To know about the different types of disasters and their managerial measures.

**UNIT – IV**

**Social Issues And The Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

**Course Outcomes:**



- To know about the social issues related to environment and their protection acts.
- To know about the various sources of conservation of natural resources.
- To know about the wild life protection and forest conservation acts.

## UNIT – V

**Human Population And The Environment:** Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**Field Work:** Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

### Unit Outcomes:

- To know about the population explosion and family welfare programmes.
- To identify the natural assets and related case studies.

### Course Outcomes:

At the end of the course, the student will be able to

- Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.
- Understand flow and bio-geo- chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.

### TEXT BOOKS :

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications(India), Pvt. Ltd.

## REFERENCES :

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M.Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice hall of India Private limited
5. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.

(19A04501T) INTEGRATED CIRCUITS AND APPLICATIONS

**Course Objectives:**

- To introduce basic building blocks of Op-Amps & specialized ICs.
- To explain DC and AC performance characteristics of Op-Amps.
- To impart knowledge on linear and non-linear applications of Op-Amps.
- To describe operation & characteristics of data converters.
- To design various circuits using Op-Amps and 555 timer.
- To familiarise specialised ICs such as VCO, PLL, voltage regulators.

**UNIT- I**

**Operational Amplifier:** Introduction, Block diagram, Characteristics and Equivalent circuits of an ideal op-amp, Various types of Operational Amplifiers and their applications, Power supply configurations for OP-AMP applications, Inverting and non-inverting amplifier configurations. The Practical op-amp: Introduction, Input offset voltage, Offset current, Thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio, Slew rate and its Effect, PSRR and Gain – bandwidth product, frequency limitations and compensations, transient response.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand different Offsets present in Op amp & nullification circuits. (L1)
- Examine performance of Op-Amp in open loop and closed configurations. (L2)
- Analyse emitter-coupled differential amplifier. (L3)
- Compare ideal and practical Op-Amps. (L5)

**UNIT- II**

**Applications of Operational Amplifier:** Amplifiers: Adder, Integrator, Differentiator, Difference amplifier and Instrumentation amplifier, Converters: Current to voltage and voltage to current converters, Active Filters: First order filters, second order active finite and infinite gain low pass, high pass, band pass and band reject filters, Sine Wave Oscillators: RC phase shift oscillator, Wien bridge oscillator.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Describe operation of Op-Amp based Linear application circuits, converters, amplifiers and non-linear circuits. (L2)

- Examine different types of oscillators & active filters with detailed mathematical analysis and illustrations. (L3)
- Design circuits such as amplifiers, comparator, differentiators and integrators using operational amplifiers for various applications, Design active filters and oscillators using Op amp for given specifications. (L4)

### UNIT- III

**Non-Linear Applications of Operational Amplifier:** Comparators: Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector, Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger with adjustable threshold levels.

**Waveform Generators:** Square wave and triangular wave generator with duty cycle modulation, Precision Rectifiers: Half and full wave precision, rectifiers, log and antilog amplifiers, voltage to frequency converter, frequency to voltage converter.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Describe operation of Op-Amp based comparators, converters, detectors, rectifiers, sample & hold circuits and waveform generators. (L2)
- Analyse Op-Amp based Comparators, converters, detectors, rectifiers, sample & hold circuits and waveform generators. (L3)
- Design Wave form generators, voltage to frequency converters & frequency to voltage converters for given specification. (L4)

### UNIT- IV

**Data Converters:** Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC. Dual Slope ADC, DAC and ADC Specifications.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Explain operation principles of different A/D & D/A converters. (L2)
- Compare different types of A/D & D/A converter circuits. (L5)
- Inspect ADC & DAC specifications to select the right converter for an application. (L4)

### UNIT -V

**Special Purpose Integrated Circuits:** Functional block diagram, working, design and applications of Timer 555 (Monostable & Astable), Functional block diagram, working and applications of VCO 566, PLL 565, Fixed and variable Voltage regulators.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Describe internal circuit operation of 555 timer, IC voltage regulators (L2)
- Describe functionality of special purpose ICs such as VCO, PLL. (L2)
- Design multi-vibrator circuits using timer. (L4)

### **Course Outcomes:**

- Understand DC and AC characteristics of operational amplifiers & Op amp parameters and functionality of specialized ICs such as 555 TIMER, VCO, PLL & Voltage regulators.
- Make use of Op-Amps and specialized ICs to design circuits for various applications.
- Analyze Op-Amp based Comparators, Waveform generators, Active filters, Converters.
- Design of Op amp based Comparators, Waveform Generators, Active filters, Converters, design various multi-vibrator circuits using IC 555 timer
- Compare different types of A/D and D/A Converter circuits.

### **TEXTBOOKS:**

1. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", 4<sup>th</sup> Edition, Pearson, 2017.
2. D. Roy Choudhury, "Linear Integrated Circuits", 2<sup>nd</sup> Edition, New Age International (p) Ltd, 2003.

### **REFERENCES:**

1. Sergio Franco, "Design with Operational Amplifiers & Analog Integrated Circuits", 3<sup>rd</sup> edition, McGraw Hill, 1988.
2. Jacob Millman, Christos C. Halkias, "Integrated Electronics - Analog and Digital circuits system", Tata McGraw Hill, 2003.
3. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", 5<sup>th</sup> edition Wiley International, 2009.

(19A04502) ANTENNAS AND WAVE PROPAGATION

**Course Objectives:**

- To introduce radiation mechanisms and basic characteristics of antennas.
- To derive mathematical expressions and their application for complete design of antennas.
- To demonstrate various modes of EM wave propagation.
- To explain measurement of antenna parameters
- To introduce design concepts of various types of antennas including micro strip antenna.

**UNIT- I**

**Antenna Characteristics:** Radiation mechanism and current distribution, radiation pattern, directivity, gain, Input impedance, polarization, bandwidth, HPBW. Reciprocity, equivalence of radiation and receive patterns, equivalence of impedances, effective aperture, vector effective length, antenna temperature, Friis transmission formula, problem solving.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand radiation mechanism and basic antenna characteristics. (L1)
- Compute radiation intensity, gain and directivity of antennas. (L2)

**UNIT- II**

**Wire and Antenna Arrays:** Wire and antenna arrays: Radiation resistance and directivity and other characteristics of short dipole, monopole, half-wave dipole, small loop antenna.

Linear array and pattern multiplication, two-element array, uniform array, binomial array, broadside and end-fire arrays.

Rhombic antennas, Yagi-Uda array, Turnstile Antenna, Helical antenna - axial and normal modes, log-periodic Array, spiral antenna.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Derive expressions for radiation resistance, directivity of wire antennas. (L3)
- Obtain radiation pattern of various array antennas using pattern multiplication. (L3)
- Compare radiation pattern and other antenna parameters of broadside and endfire array antennas. (L5)
- To know the design aspects of antenna arrays. (L4)

### UNIT- III

**Aperture Antennas and Lens Antennas:** Aperture Antennas and Lens Antennas: Slot antenna, pyramidal and conical horn antennas, reflector Antenna: flat plate, corner and parabolic reflectors - common curved reflector shapes, Feed mechanisms.

Lens Antennas - Introduction, Geometry of Non-metallic Dielectric Lenses, Zoning, Tolerances, Applications.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand basic principles of aperture and lens antennas. (L1)
- Design aperture and lens antennas. (L4)

### UNIT- IV

**Micro-Strip Antennas And Antenna Measurements:** Micro-strip Antennas and Antenna Measurements: Basic characteristics, feeding methods, methods of analysis - Design of Rectangular and Circular Patch Antennas, Introduction to Smart Antennas - Concept of adaptive beam forming, Measurement of Antenna Parameters, basic setup, radiation pattern measurement, gain, directivity.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Describe feeding methods for micro-strip antennas. (L2)
- Apply the concepts to measure antenna parameters. (L2)
- Design rectangular and circular patch antennas for given specifications. (L4)

### UNIT- V

**Wave Propagation - I:** Introduction, Definitions, Categorizations and General Classifications, Different Modes of Wave Propagation, Ray/Mode Concepts, Ground Wave Propagation (Quantitative Treatment) - Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections, Space Wave Propagation - Introduction, Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super refraction, M- Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

**Wave Propagation - II:** Sky Wave Propagation - Introduction, Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and skip Distance, Multi-hop Propagation, illustrative problems.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand effects of earth's magnetic field on wave propagation (L1)
- Apply the concepts to solve problems related to wave propagation(L2)

- Analyze tropospheric propagation and derive the expression for received field strength (L3)
- Identify layers in ionosphere and their ionization densities (L1)

**Course Outcomes:**

- Understand various antenna parameters, principle of operation of various antennas viz. wired, aperture, micro strip antennas.
- Discuss various EM wave propagation methods in ionosphere and troposphere
- Analyze mathematical aspects of wave propagation, Derive expressions related to radiation mechanisms for antennas
- Design various antennas namely array, micro strip, horn, lens and aperture antennas, etc., for a given application.
- Compare performance of various antennas.

**TEXT BOOKS:**

1. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, “Antennas and Wave Propagation”, 4<sup>th</sup> Edition, TMH, 2010.
2. Jordan, E.C. and Balmain. K. G., “Electromagnetic Waves and Radiating Systems”, Prentice-Hall Publications.

**REFERENCES:**

1. Constantine A. Balanis, “Antenna Theory-Analysis and Design”, Wiley Publication, 2016.
2. K.D. Prasad, “Antenna & Wave Propagation”, Satya Prakash Publications, 2009.
3. Matthew N.O.Sadiku, “Principle of Electromagnetics”, 4<sup>th</sup> edition, Oxford (International), 2012.



(19A52601T) ENGLISH LANGUAGE SKILLS

### Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language skills in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. They should be able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

### Course Objectives

- Facilitate active listening to enable inferential learning through expert lectures and talks
- Impart critical reading strategies for comprehension of complex texts
- Provide training and opportunities to develop fluency in English through participation in formal group discussions and presentations using audio-visual aids
- Demonstrate good writing skills for effective paraphrasing, argumentative essays and formal correspondence
- Encourage use of a wide range of grammatical structures and vocabulary in speech and writing

### UNIT -I

#### Text:

1. **Lines Composed a Few Miles above Tintern Abbey - William Wordsworth**
2. **The Lotos-Eaters - Alfred Tennyson**

**Listening:** Listening to famous speeches for structure and style

**Speaking:** Oral presentations on general topics of interest.

**Reading:** Reading for meaning and pleasure – reading between the lines.

**Writing:** Appreciating and analyzing a poem –Paraphrasing, note-taking.

**Grammar and Vocabulary: Tenses (Advanced Level)** Correcting errors in punctuation -Word roots and affixes.

### Learning Outcomes

At the end of the module, the learners will be able to

- Understand the purpose of rhythm and rhyme and the use of figures of speech in making the presentation lively and attractive
- Apply the knowledge of structure and style in a presentation, identify the audience and make note of key points
- Make formal structured presentations on general topics using grammatical understanding
- Prioritize information from reading texts after selecting relevant and useful points
- Paraphrase short academic texts using suitable strategies and conventions

## UNIT -II

**Text: The Model Millionaire – Oscar Wilde**

**Listening:** Following the development of theme; answering questions on key concepts after listening to stories online.

**Speaking:** Narrating personal experiences and opinions.

**Reading:** Reading for summarizing and paraphrasing; recognizing the difference between facts and opinions.

**Writing:** Summarizing, précis writing, letter and note-making

**Grammar and Vocabulary:** Subject-verb agreement, noun-pronoun agreement, collocations.

### Learning Outcomes

At the end of the module, the learners will be able to

- Comprehend academic lectures, take notes and answer questions
- Make formal structured presentations on academic topics
- Distinguish facts from opinions while reading
- Summarize and make a précis of reports
- Use correct English avoiding common errors in formal speech and writing

## Unit – III

**Text: Speech at IIM Calcutta – Azim Premji**

**Listening:** Identifying views and opinions expressed by different speakers while listening to speeches.

**Speaking:** Small talks on general topics; agreeing and disagreeing, using claims and examples/ evidences for presenting views, opinions and position.

**Reading:** Identifying claims, evidences, views, opinions and stance/position.

**Writing:** Writing structured persuasive/argumentative essays on topics of general interest using suitable claims, examples and evidences.

**Grammar and Vocabulary:** The use of Active and passive Voice, vocabulary for academic texts

### Learning Outcomes

At the end of the module, the learners will be able to

- Critically follow and participate in a discussion
- participate in group discussions using appropriate conventions and language strategies
- comprehend complex texts and identify the author's purpose
- produce logically coherent argumentative essays
- use appropriate vocabulary to express ideas and opinions

## UNIT – IV

### **Text: A Biography of Steve Jobs**

**Listening:** Listening to identify important moments - Understanding inferences; processing of information using specific context clues from the audio.

**Speaking:** Group discussion; reaching consensus in group work (academic context).

**Reading:** Reading for inferential comprehension.

**Writing:** Applying for internship/ job - Writing one's CV/Resume and cover letter.

**Grammar and Vocabulary: Phrasal verbs, phrasal prepositions and technical vocabulary.**

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Draw inferences and conclusions using prior knowledge and verbal cues
- Express thoughts and ideas with acceptable accuracy and fluency
- Develop advanced reading skills for deeper understanding of texts
- Prepare a cv and write a cover letter to seek internship/ job
- Understand the use of technical vocabulary in academic writing

## UNIT –V

### **Text: How I Became a Public Speaker - George Bernard Shaw**

**Listening:** Understanding inferences - processing of explicit information presented in the text and implicit information inferable from the text or from previous/background knowledge.

**Speaking:** Formal team presentations on academic/ general topics.

**Reading:** Intensive and extensive reading.

**Writing:** Structure and contents of a Report – Abstract – Project report features.

**Grammar and Vocabulary:** Correcting common errors, improving vocabulary and avoiding clichés and jargons.

### **Learning Outcomes**

At the end of the module, the learners will be able to

- Develop advanced listening skills for in-depth understanding of academic texts

- Collaborate with a partner to make effective presentations
- Understand and apply the structure of project reports
- Demonstrate ability to use grammatically correct structures and a wide range of vocabulary

### **Course Outcomes**

At the end of the course, the learners will be able to

- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table

### **TEXT BOOK:**

- “Forging Ahead”: A Course Book for B.Tech Students. Orient BlackSwan, 2020.

### **REFERENCE BOOKS:**

- 1) Bailey, Stephen. “Academic writing: A handbook for international students”. Routledge, 2014.
- 2) Chase, Becky Tarver. Pathways: Listening, “Speaking and Critical Thinking”. Heinley ELT; 2nd Edition, 2018.
- 3) Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- 4) Hewings, Martin. “Cambridge Academic English” (B2). CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
- 5). Create a coherent paragraph interpreting a figure/graph/chart/table

(19A04504T) DIGITAL COMMUNICATIONS

**Course Objectives:**

- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.
- To prepare mathematical background for communication signal analysis.
- To study signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.

**UNIT- I:**

**Source Coding Systems:** Introduction, sampling process, quantization, quantization noise, conditions for optimality of quantizer, encoding, Pulse-Code Modulation (PCM), Line codes, Differential encoding, Regeneration, Decoding & Filtering, Noise considerations in PCM systems, Time-Division Multiplexing (TDM), Synchronization, Delta modulation (DM)-Granular noise Slope over distortion, Differential PCM (DPCM), Processing gain, Adaptive DPCM (ADPCM), Comparison of the above systems, Illustrative Problems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand source coding techniques & pulse modulation techniques. (L1)
- Describe and determine the performance of line codes. (L2)
- Analyze different pulse modulation techniques & Distortions. (L3)
- Compare the performance different pulse modulation Schemes. (L5)

**UNIT- II:**

**Baseband Pulse Transmission:** Introduction, Matched filter, Properties of Matched filter, Matched filter for rectangular pulse, Error rate due to noise, Inter-symbol Interference (ISI), Nyquist's criterion for distortion less baseband binary transmission, ideal Nyquist channel, raised cosine filter & its spectrum, Correlative coding – Duo binary & Modified duo binary signalling schemes, Partial response signalling, Baseband M-ary PAM transmission, Eye diagrams, Illustrative Problems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Analyze the performance of baseband pulse transmission system. (L3)

- Describe the generation & detection of pass band modulated signals. (L2)
- Analyze probability of error for various pass band data transmission schemes. (L3)
- Compare the power bandwidth required for various pass band data transmission scheme. (L4)

### UNIT- III:

**Signal Space Analysis:** Introduction, Geometric representation of signals, Gram-Schmidt orthogonalization procedure, Response of bank of correlators to noisy input, Coherent detection of signals in noise - maximum likelihood decoder, Probability of error, Correlation receiver, detection of signals with unknown phase, Illustrative Problems.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concepts of signal space analysis. (L1)
- Examine the characteristics of maximum likelihood decoder. (L2)
- Analyze correlation receiver. (L3)

### UNIT- IV:

**Passband Data Transmission:** INTRODUCTION, Passband transmission model, Coherent modulation schemes- Generation and detection of binary phase shift keying (BPSK), Quadrature shift keying (QPSK), and Binary Frequency shift keying (BFSK). Analysis of probability of error for BPSK, QPSK, BFSK, Power spectra of above mentioned modulated signals. M-ary PSK, M-ary quadrature amplitude modulation (M-ary QAM), Non-coherent orthogonal modulation schemes - Generation and detection of non-coherent BFSK, DPSK - analysis of probability of error and Comparison of power bandwidth requirements for all the above schemes, Illustrative Problems.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Analyse the different digital modulation techniques, generation and detection, power spectra and their probability of error performance. (L3)
- Compare the power bandwidth, bit error probability for various modulation scheme.(L5)

### UNIT- V

**Channel Coding:** Discrete memory less channels, Linear Block Codes-Repetition codes, Syndrome decoding, minimum distance considerations, Cyclic codes- generator polynomial, parity check polynomial, encoder for cyclic code, calculation of syndrome, Convolutional Codes – generator polynomials, state diagrams, Viterbi algorithm, Illustrative problems.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand various error control encoding and decoding techniques. (L1)
- Apply information theory and linear algebra in source coding and channel coding. (L2)
- Analyse the performance of error control codes. (L3)

**Course Outcomes:**

- Understand the elements of digital communication system, baseband pulse transmission, pass band digital modulation, geometric representation of signals, basics of information theory and error correcting codes.
- Apply the knowledge of signals and system & statistical theory to evaluate the performance of digital communication systems.
- Analyze the different coding, modulation techniques, Probability of error performance of digital system.
- Compare the performance of different modulation schemes& error correcting codes.

**TEXT BOOKS:**

1. Simon Haykin, "Communication Systems", Wiley India Edition, 4th Edition, 2011.
2. B.P. Lathi, & Zhi Ding, "Modern Digital & Analog Communication Systems", 4<sup>th</sup> edition, Oxford University Press, International 2010.

**REFERENCES:**

1. Sam Shanmugam, "Digital and Analog Communication Systems", 3<sup>rd</sup> Edition, John Wiley, 2005.
2. Bruce Carlson, and Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", 5<sup>th</sup> Edition, McGraw-Hill International Edition, 2010.
3. Bernard Sklar, "Digital Communications", 2<sup>nd</sup> edition, Prentice-Hall PTR, 2001.
4. Herbert Taub and Donald L Schilling, "Principles of Communication Systems", 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2009.

**(19A05403T) OPERATING SYSTEMS**

**Professional Elective-I**

**Course Objectives:**

The course is designed to

- Understand basic concepts and functions of operating systems
- Understand the processes, threads and scheduling algorithms.
- Provide good insight on various memory management techniques
- Expose the students with different techniques of handling deadlocks
- Explore the concept of file-system and its implementation issues
- Familiarize with the basics of Linux operating system
- Implement various schemes for achieving system protection and security

**UNIT I**

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Open-Source Operating Systems

System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Operating system debugging, System Boot.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Identify major components of operating systems
- Understand the types of computing environments
- Explore several open source operating systems
- Recognize operating system services to users, processes and other systems

**UNIT II**

Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems.

Multithreaded Programming: Multithreading models, Thread libraries, Threading issues, Examples.

Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling, Examples.

Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.



**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the importance, features of a process and methods of communication between processes.
- Improving CPU utilization through multi programming and multithreaded programming
- Examine several classical synchronization problems

**UNIT III**

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation, Examples.

Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation, Examples.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Examine the various techniques of allocating memory to processes
- Summarize how paging works in contemporary computer systems
- Understanding the benefits of virtual memory systems.

**UNIT IV**

Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection

And recovery, Deadlock avoidance, Deadlock prevention.

File Systems: Files, Directories, File system implementation, management and optimization.

Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Investigate methods for preventing/avoiding deadlocks
- Examine file systems and its interface in various operating systems
- Analyze different disk scheduling algorithms

**UNIT V**

System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.

System Security: Introduction, Program threats, System and network threats, Cryptography as a security, User authentication, implementing security defenses, firewalling to protect systems and networks, Computer security classification.

Case Studies: Linux, Microsoft Windows.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Infer various schemes available for achieving system protection.
- Acquiring knowledge about various countermeasures to security attacks
- Outline protection and security in Linux and Microsoft Windows.

**Course Outcomes**

By the end of this course students will be able to:

- Realize how applications interact with the operating system
- Analyze the functioning of a kernel in an Operating system.
- Summarize resource management in operating systems
- Analyze various scheduling algorithms
- Examine concurrency mechanism in Operating Systems
- Apply memory management techniques in design of operating systems
- Understand the functionality of file system
- Compare and contrast memory management techniques.
- Understand the deadlock prevention and avoidance.
- Perform administrative tasks on Linux based systems.

**Text Books:**

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2016.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008.  
(Topics: Inter-process Communication and File systems.)

**Reference Books:**

1. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhare D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.
3. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004

**(19A02403) POWER ELECTRONICS**  
**Professional Elective-I**

**Course Objectives:**

The student will be able to:

1. Understand the differences between signal level and power level devices.
2. Analyze controlled rectifier circuits.
3. Analyze the operation of DC-DC choppers.
4. Analyze the operation of voltage source inverters.

**UNIT-I: Power Switching Devices**

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET, IGBT and GTO.

**Learning Outcomes:**

At the end of the unit, students will be able to

- Understand the basic power semiconductor devices their construction, principle of working and their characteristics.
- Understand in detail about SCR i.e., its characteristics, series and parallel connection of SCR's, specification, its ratings and various commutation methods.
- Apply the above concepts to solve numerical problems.

**UNIT-II: Thyristor Rectifiers**

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor-Numerical problems.

**Learning Outcomes:**

At the end of the unit, students will be able to

- Understand the concepts of phase control technique, midpoint and bridge connections of half and full controlled converters with various loads for both 1 $\emptyset$  and 3 $\emptyset$  phase converters, effect of source inductance and dual converters.
- Analyze and evaluate voltages and currents, active and reactive power inputs to converter with and without freewheeling diode for 1 $\emptyset$  and 3 $\emptyset$  converters.
- Apply the above concepts to solve numerical problems.

**UNIT-III: DC-DC buck converter**

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

**DC-DC boost converter:**

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

**Learning Outcomes:**

At the end of the unit, students will be able to

- Understand the concepts of various control strategies, types of choppers and analyze their principle operation, waveforms of voltages and currents at different loads.
- Apply the above concepts to solve numerical problems.

**UNIT-IV:**

Single phase Voltage Source inverters – operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters – Mc Murray and Mc Murray Bedford inverters, Voltage control techniques for inverters and Pulse width modulation techniques, single phase current source inverter with ideal switches, basic series inverter, single phase parallel inverter – basic principle of operation only, Three phase bridge inverters (VSI) – 180 degree mode – 120 degree mode of operation - Numerical problems.

**Learning Outcomes:**

At the end of the unit, students will be able to

- Understand the construction, working of single phase voltage inverters with their waveforms in various operating modes when different loads are applied and the different modulating techniques available.
- Understand the construction, working of three phase voltage inverters with their waveforms in various operating modes when different loads are applied, harmonic components and the different modulating techniques available.
- Apply the above concepts to solve numerical problems.

**UNIT-V: AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS:**

AC voltage controllers – Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – RMS load voltage, current and power factor - wave forms – Numerical problems. Cyclo converters - Midpoint and Bridge connections - Single phase to single phase step-up and step-down cyclo converters with Resistive and inductive load, Principle of operation, Waveforms, output voltage equation.

### **Learning Outcomes:**

At the end of the unit, students will be able to

- Understand the concept of AC voltage controllers
- Understand the concept of Cyclo Converters

### **Course Outcomes:**

At the end of this course students will be able to:

- Understand the operation, characteristics and usage of basic Power Semiconductor Devices.
- Understand different types of Rectifier circuits with different operating conditions.
- Understand DC-DC converters operation and analysis of their characteristics.
- Understand the construction and operation of voltage source inverters, Voltage Controllers and Cyclo Converters.
- Apply all the above concepts to solve various numerical problem solving

### **TEXT BOOKS:**

1. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", 2<sup>nd</sup> edition, Prentice Hall of India, 1998
2. P.S.Bimbhra,"Power Electronics", 4<sup>th</sup> Edition, Khanna Publishers, 2010.
3. M. D. Singh & K. B. Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 1998.

### **REFERENCE BOOKS:**

1. Ned Moha, "Power Electronics", Wiley, 2011.
2. Robert W. Erickson and Dragan Maksimovic, "Fundamentals of Power Electronics" 2<sup>nd</sup> Edition, Kluwer Academic Publishers, 2004.
3. Vedam Subramanyam, "Power Electronics", New Age International (P) Limited, 1996.
4. V.R.Murthy, "Power Electronics", 1<sup>st</sup> Edition, Oxford University Press, 2005.
5. P.C.Sen, "Power Electronics", Tata Mc Graw-Hill Education, 1987.

(19A05303T) OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Professional Elective-I

Course Objectives:

- To understand object oriented concepts and problem solving techniques
- To obtain knowledge about the principles of inheritance and polymorphism
- To implement the concept of packages, interfaces, exception handling and concurrency mechanism.
- To design the GUIs using applets and swing controls.
- To understand the Java Database Connectivity Architecture

UNIT - I

**Introduction:** Introduction to Object Oriented Programming, The History and Evolution of Java, Introduction to Classes, Objects, Methods, Constructors, this keyword, Garbage Collection, Data Types, Variables, Type Conversion and Casting, Arrays, Operators, Control Statements, Method Overloading, Constructor Overloading, Parameter Passing, Recursion, String Class and String handling methods.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the syntax, semantics and features of Java Programming Language.
- Learn object oriented features and understanding type conversion and casting.
- Understand different types of string handling functions and its usage.

UNIT - II

**Inheritance:** Basics, Using Super, Creating Multilevel hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract classes, Using final with inheritance, Object class,

**Packages:** Basics, Finding packages and CLASSPATH, Access Protection, Importing packages.

**Interfaces:** Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

Learning Outcomes:

At the end of this unit, the student will be able to

- Implement types of Inheritance and developing new classes based on existing classes
- Distinguish between system packages and user defined packages.
- Demonstrate features of interfaces to implement multiple inheritances.

## UNIT - III

**Exception handling** - Fundamentals, Exception types, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes.

**Stream based I/O** (java.io) – The Stream classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, The Console class, Serialization, Enumerations, Autoboxing, Generics.

### Learning Outcomes:

At the end of this unit, the student will be able to

- Learn what exceptions are and how they are handled.
- Learn when to use exception handling and how to create user defined exceptions
- Learn the difference between various files and streams.

## UNIT - IV

**Multithreading:** The Java thread model, Creating threads, Thread priorities, Synchronizing threads, Interthread communication.

**The Collections Framework** (java.util): Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Hashtable, Properties, Stack, Vector, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner.

### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand concurrency, parallelism and multithreading
- Learn the importance of collections and use prebuilt generic data structures from framework.

## UNIT – V

**Applet:** Basics, Architecture, Applet Skeleton, requesting repainting, using the status window, passing parameters to applets

**GUI Programming with Swings** – The origin and design philosophy of swing, components and containers, layout managers, event handling, using a push button, jtextfield, jlabel and image icon, the swing buttons, jtext field, jscrollpane, jlist, jcombobox, trees, jtable, An overview of jmenubar, jmenu and jmenuitem, creating a main menu, showmessagedialog, showconfirmdialog, showinputdialog, showoptiondialog, jdialog, create a modeless dialog.

### Accessing Databases with JDBC:

Types of Drivers, JDBC Architecture, JDBC classes and Interfaces, Basic steps in developing JDBC applications, Creating a new database and table with JDBC.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Learn how to use the Nimbus look-and-feel
- Understand the GUI programming.
- Understand basic steps in developing JDBC applications,

**Course Outcomes:**

**After the completion of the course the student will be able**

- To solve real world problems using OOP techniques.
- To apply code reusability through inheritance, packages and interfaces
- To solve problems using java collection framework and I/O classes.
- To develop applications by using parallel streams for better performance.
- To develop applets for web applications.
- To build GUIs and handle events generated by user interactions.
- To use the JDBC API to access database

**Text Books:**

1. Herbert Schildt “Java The complete reference”, 9<sup>th</sup> edition, McGraw Hill Education (India) Pvt. Ltd.
2. Paul Dietel, Harvey Dietel “Java How to Program”, 10<sup>th</sup> Edition, Pearson Education.

**REFERENCE BOOKS:**

1. T. Budd “Understanding Object-Oriented Programming with Java”, updated edition, Pearson Education.
2. Cay S. Horstmann, “Core Java Volume – 1 Fundamentals”, Pearson Education.
3. Sagayaraj, Dennis, Karthik and Gajalakshmi, “Java Programming for core and advanced learners” University Press
4. Y. Daniel Liang, “Introduction to Java programming”, Pearson Education.
5. P. Radha Krishna, “Object Oriented Programming through Java”, University Press.
6. S. Malhotra, S. Chudhary, “Programming in Java”, 2<sup>nd</sup> edition, Oxford Univ. Press.
7. R.A. Johnson, “Java Programming and Object-oriented Application Development”, Cengage Learning.



(19A04504a) DATA COMMUNICATIONS AND NETWORKING

Professional Elective-I

**Course Objectives:**

- To explain the basic concept of computer communication networks
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce IP addressing, UDP and TCP Models.
- To have the concept of different routing techniques for data communications.

**UNIT- I**

**Introduction to Computer Networks:** Uses of computer Network, Network Software-design Issues for layers, Service primitives and relationship of services to Protocols, Reference models- OSI & TCP/IP, network architectures introduction, Example of Networks-X.25, Frame Relay & ATM, Protocols and Standards.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Enumerate the layers of the OSI model and TCP/IP. (L1)
- Explain the function(s) of each layer. (L2)

**UNIT- II**

**Physical Layer:** Physical layer - Data rate limits, Transmission media-guided and Unguided, Switching systems, Circuit switching, Datagram switching & Virtual circuit switching, Structure of circuit and packet switch, cable modem and DSL technologies, SONET basics, selection of IEEE std 802.11, a, b, c, g.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand principles of data communication using transmission (guided and wireless) media. (L1)
- Know to the concepts of various switching techniques. (L1)
- Explain the basics of DSL, SONET, and IEEE standards. (L2)

**UNIT- III**

**Data link layer:** Framing, Flow & Error control Protocols, HDLC, PPP, Multiple access techniques, random access, controlled access & Channelization, Ethernet types-bridged,

Switched, Full duplex, Fast & gigabit Ethernet, Introduction to Data link layer in 802.11 LAN, connecting devices like passive hubs, repeaters, Active hubs, Bridges, Two-layer Switches, Routers, three layer switches, Gateway etc., Backbone networks, Virtual LANs, Simple Router architecture, Sliding window protocol.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- List the different connecting devices for networking. (L1)
- Understand the principles of error control protocols, multiple access protocols, routers and switches in data link layer. (L1)
- Solve the error control and multiple access based problems. (L2)

## **UNIT- IV**

**Network Layer:** IPv4 address, IPv6 address, Address mapping-ARP, RARP & DHCP, IPv4 datagram detail format, IPv6 datagram detail format, ICMP, IGMP, Network layer issues like Delivery, forwarding, intra-domain and Inter-domain routing, Routing algorithms like Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Path vector routing etc., Addressing types-Physical, Logical & port address.

**Transport Layer:** Transport layer-Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, congestion control and Quality of Service.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the concepts of IPvx and different protocols.(L1)
- Apply the knowledge on different routing algorithms and measure their performance metrics.(L2)
- Distinguish between the connection oriented and connection less transport protocols.(L4)

## **UNIT- V**

**Application Layer:** Application layer protocols and applications like Ping, FTP, telnet, HTTP, SMTP, SNMP, TFTP, BOOTP, DNS, NFS, RPC, X-server, E-mail, Introduction to streaming Audio/Video,P2P file sharing, Introduction to socket programming.

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the importance of application layer and the terminology like FTP, HTTP, SMTP, SNMP,TFTP etc., (L1)
- Know about the P2P file sharing and socket programming.(L2)

**Course Outcomes:**

- Understand the requirement of theoretical & practical aspects of computer networks, functions of various layers involved in data communications, building the skills of sub netting and routing mechanisms.
- Explain the role of protocols in networking.
- Analyze the services and features of the various layers in the protocol stack.

**TEXT BOOKS:**

1. Behrouz A. Forouzan, “Data Communications and Networking”, 4<sup>th</sup> Edition, Tata McGraw Hill, 2007.
2. Andrew Tenenbaum, “Computer Networks”, 4<sup>th</sup> Edition, Pearson Education.
3. Kurose & Ross, “Computer Networking- A top down approach featuring the Internet”, 3<sup>rd</sup> Edition, Pearson Education.
4. William Stallings, “Computer Networks and Cryptography”, 3<sup>rd</sup> Edition, Pearson Education.

**REFERENCES:**

1. Behrouz A. Forouzan, “TCP/IP protocol Suit”, 3<sup>rd</sup> Edition, Tata McGraw Hill Publications.
2. Stevens, “TCP/IP illustrated Volume - I & II”, Pearson education.
3. Feibel Werner, “Encyclopedia of networking”, Pearson education.

**(19A04504b) NANO ELECTRONICS**  
**Professional Elective-I**

**Course Objectives**

- To introduce the challenges in CMOS VLSI device design and fundamental limits of operation.
- To study novel MOS based silicon devices and various multi gate devices.
- To learn about SOI devices and its performance comparison with Silicon devices
- To understand the underlying concepts by setting up and solving the Schrödinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.
- To understand nano electronic systems and building blocks such as: low-dimensional semiconductors, hetero structures, carbon nano tubes, quantum dots, nano wires etc.
- To gain knowledge on spin electronic devices.
- To familiarize students with the present research front in Nano electronics and to be able to critically assess future trends.

**UNIT- I:**

Challenges going to sub-100 nm MOSFETs Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Retrieving the challenges and current trends of CMOS technologies. (L1)
- Explain the fabrication process and limitations in the CMOS design. (L2)

**UNIT- II:**

Novel MOS-based devices Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, Fin FETs, vertical MOSFETs, strained Si devices.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Inferring the latest MOS device in several aspects of latest configurations like SOI, SON, Strained Si and FETs. (L2).
- Choosing different models of MOS devices according to the requirement. (L3)

### **UNIT- III:**

Quantum structures quantum wells, quantum wires and quantum dots, Single electron devices charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Categorize the structure of trendy devices. (L2)
- Integrate and model the device with basic quantum structures. (L4)

### **UNIT- IV:**

Hetero structure based devices Type I, II and III hetero junctions, Si-Ge hetero structure, hetero structures of III-V and II-VI compounds - resonant tunneling devices.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Correlating device structures with type of materials, which are commonly used for fabrication (L5)
- Defend the tunneling devices with several parameters of hetero structures. (L5)

### **UNIT- V:**

Carbon nanotubes based devices CNFET, characteristics; Spin-based devices spin FET, characteristics, Applications of MOSFET, CNFET and Spin FET devcies.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Criticize based on characteristics study for the MOS/FET devices. (L5)
- Adapt the device in specific applications in real-time. (L2)

#### **Course Outcomes:**

- Retrieving the challenges and current trends of CMOS technologies.
- Explain the fabrication process and limitations in the CMOS design, Inferring the latest MOS device in several aspects of latest configurations like SOI, SON, Strained Si and FETs, Categorize the structure of trendy devices, Adapt the device in specific applications in real-time.
- Choosing different models of MOS devices according to the requirement.
- Integrate and model the device with basic quantum structures.
- Correlating device structures with type of materials, which are commonly used for fabrication, defend the tunneling devices with several parameters of hetero structures; compare characteristics study for the MOS/FET devices.

**TEXT BOOKS:**

1. Mircea Dragoman and Daniela Dragoman, “ Nano electronics Principles & devices”, Artech House Publishers, 2005.
2. Karl Goser, “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Springer 2005.

**REFERENCE BOOKS:**

1. Mark Lundstrom and Jing Guo, “Nanoscale Transistors: Device Physics Modelling and Simulation”, Springer, 2005.
2. Vladimir V Mitin, Viatcheslav A Kochelap and Michael A Stroscio, “Quantum hetero structures”, Cambridge University Press, 1999.
3. S M Sze (Ed), “High speed semiconductor devices”, Wiley, 1990.

**(19A01506a) EXPERIMENTAL STRESS ANALYSIS**  
**OPEN ELECTIVE-I**

**Course Objective:**

To bring awareness on experimental method of finding the response of the structure to different types of load.

- Demonstrates principles of experimental approach.
- Teaches regarding the working principles of various strain gauges.
- Throws knowledge on strain rosettes and principles of non destructive testing of concrete.
- Gives an insight into the principles of photo elasticity.

**UNIT-I**

**PRINCIPLES OF EXPERIMENTAL APPROACH:** - Merits of Experimental Analysis Introduction, uses of experimental stress analysis advantages of experimental stress analysis, Different methods –Simplification of problems.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Demonstrate the merits and principles of experimental approach
- Give an insight into the uses and advantages of experimental stress analysis

**UNIT-II**

**STRAIN MEASUREMENT USING STRAIN GAUGES:** - Definition of strain and its relation of experimental Determinations Properties of Strain Gauge Systems-Types of Strain Gauges – Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical strain gauges - Inductance strain gauges – LVDT – Resistance strain gauges – various types –Gauge factor – Materials of adhesion base.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Introduce various strain gauge systems and their properties
- Give information regarding the gauge factor and materials of adhesion bases

**UNIT-III**

**STRAIN ROSSETTES AND NON – DESTRUCTIVE TESTING OF CONCRETE:-** Introduction – the three elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity method –Application to Concrete. Hammer Test – Application to Concrete.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Introduces various strain rosettes and corrections for strain gauges
- Gives an insight into the destructive and non destructive testing of concrete

#### **UNIT-IV**

**THEORY OF PHOTOELASTICITY:** - Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polariscope for various arrangements – Fringe Sharpening. Brewster’s Stress Optic law.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- Introduces stress optic laws.
- Gives the arrangements and working principles of polariscope.

#### **UNIT-V**

**TWO DIMENSIONAL PHOTOELASTICITY:** - Introduction – Iso-chromatic Fringe patterns- Isoclinic Fringe patterns passage of light through plane Polariscope and Circular polariscope Isoclinic Fringe patterns – Compensation techniques – Calibration methods – Separation methods – Scaling Model to prototype Stresses – Materials for photo – Elasticity Properties of Photoelastic Materials.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- Introduces the understanding of different fringe patterns.
- Introduces model analysis and properties of photo elastic materials.

#### **Course Outcomes:**

After completion of the course

- The student will be able to understand different methods of experimental stress analysis
- The student will be able to understand the use of strain gauges for measurement of strain
- The student will be exposed to different Non destructive methods of concrete
- The student will be able to understand the theory of photo elasticity and its applications in analysis of structures

#### **TEXT BOOKS:-**

1. J.W.Dally and W.F.Riley, “Experimental stress analysis College House Enterprises”
2. Dr.Sadhu Singh, “Experimental stress analysis”, khanna Publishers

#### **REFERENCE BOOKS:**

1. U.C.Jindal, “Experimental Stress analysis”, Pearalson Publications.
2. L.S.Srinath, “Experimental Stress Analysis”, MC.Graw Hill Company Publishers.



**(19A01506b) BUILDING TECHNOLOGY**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- To impart to know different types of buildings, principles and planning of the buildings.
- To identify the termite control measure in buildings, and importance of grouping circulation, lighting and ventilation aspects in buildings.
- To know the different modes of vertical transportation in buildings.
- To know the utilization of prefabricated structural elements in buildings.
- To know the importance of acoustics in planning and designing of buildings.

**UNIT-I**

Overview of the course, basic definitions, buildings-types-components- economy and design-principles of planning of buildings and their importance. Definitions and importance of grouping and circulation-lighting and ventilation-consideration of the above aspects during planning of building.

**Learning outcomes:**

At the end of the unit, students will be able to:

- To be able to plan the building with economy and according to functional requirement.

**UNIT-II**

Termite proofing: Inspection-control measures and precautions- lighting protection of buildings-general principles of design of openings-various types of fire protection measures to be considered while panning a building.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Able to know the termite proofing technique to the building and protection form lightening effects.
- To be able to know the fire protection measure that are to be adopted while planning a building.

**UNIT-III**

Vertical transportation in a building: Types of vertical transportation-stairs-different forms of stairs- planning of stairs- other modes of vertical transportation – lifts-ramps-escalators.

**Learning outcomes:**

At the end of the unit, students will be able to:

- To be able to know the different modes of vertical transportation and their suitability

## **UNIT-IV**

Prefabrication systems in residential buildings- walls-openings-cupboards-shelves etc., planning and modules and sizes of components in prefabrication. Planning and designing of residential buildings against the earthquake forces, principles, seismic forces and their effect on buildings.

### **Learning outcomes:**

At the end of the unit, students will be able to:

- Identify the adoption of prefabricated elements in the building.
- Know the effect of seismic forces on buildings

## **UNIT-V**

Acoustics – effect of noise – properties of noise and its measurements, principles of acoustics of building. Sound insulation- importance and measures.

### **Learning outcomes:**

At the end of the unit, students will be able to:

- To know the effect of noise, its measurement and its insulation in planning the buildings

### **Course Outcomes:**

After completion of the course the student will be able to

- Understand the principles in planning and design the buildings.
- Know the different methods of termite proofing in buildings.
- Know the different methods of vertical transportation in buildings.
- Know the implementation of prefabricated units in buildings and effect of earthquake on buildings.
- Know the importance of acoustics in planning and designing of buildings.

## **TEXT BOOKS :**

1. Varghese, “Building construction”, PHI Learning Private Limited.
2. Punmia.B.C, “Building construction”, Jain.A.K and Jain.A.K Laxmi Publications.
3. S.P.Arora and S.P.Brndra “Building construction”, Dhanpat Rai and Sons Publications, New Delhi
4. “Building construction-Technical teachers training institute”, Madras, Tata McGraw Hill.

## **REFERENCE BOOKS:**

1. National Building Code of India, Bureau of Indian Standards

**(19A02506a) ELECTRICAL ENGINEERING MATERIALS**  
**(OPEN ELECTIVE-I)**

**Course Objectives:**

To make the students learn about

- Classification of materials.
- Properties of materials and its applications.
- Domestic wiring and earthing

**UNIT-I Conducting Materials**

Introduction – classification of materials – Metals and Non metals, physical, thermal, mechanical and electrical properties of materials – classification of electrical materials – concept of atom – electron configuration of atom, conductors, general properties of conductors, factors effecting resistivity of electrical materials –electrical/mechanical/thermal properties of copper, aluminum, iron, steel, lead, tin and their alloys – applications.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Understand the classification of conducting materials.
- Analyze the properties of different conducting materials
- Apply the materials where it is applicable
- Know about electron configuration of atom

**UNIT-II Dielectric and High Resistivity Materials**

Introduction – solid, liquid and gaseous dielectrics, leakage current, permittivity, dielectric constant, dielectric loss – loss angle – loss constant, Breakdown voltage and dielectric strength of – solid, liquid and gaseous dielectrics, effect of break down– electrical and thermal effects, Polarization – electric, ionic and dipolar polarization. Effect of temperature and Frequency on dielectric constant of polar dielectrics. High Resistivity materials – electrical / thermal / mechanical properties of Manganin, Constantan, Nichrome, Tungsten, Carbon and Graphite and their applications in electrical equipment.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Understand the classification of dielectric and high resistivity materials.
- Analyze the properties of dielectric and high resistivity materials
- Understand about concept of polarization and dipolar polarization
- Apply the materials where it is applicable

**UNIT-III Solid Insulating Materials**

Introduction – characteristics of a good electrical insulating materials – classification of insulating materials – electrical, thermal, chemical and mechanical properties of solid insulating materials - Asbestos, Bakelite, rubber, plastics, thermo plastics. Resins, polystyrene, PVC, porcelain, glass, cotton and paper.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Understand about various characteristics of solid insulating materials
- Understand the classification of solid insulating materials.
- Analyze the properties of solid insulating materials
- Apply the materials where it is applicable

**UNIT-IV Liquid & Gas Insulating Materials**

Liquid insulating materials – Mineral oils, synthetic liquids, fluorinated liquids – Electrical, thermal and chemical properties – transformer oil – properties – effect of moisture on insulation properties Gaseous insulators – classification based on dielectric strength – dielectric loss, chemical stability properties and their applications.

**Unit Outcomes:**

At the end of the unit, the student will be able to

- Understand the classification of liquid insulating materials.
- Analyze the properties of liquid insulating materials
- Apply the materials where it is applicable
- Understand about properties and classification of gaseous insulators

**UNIT-V Domestic Wiring**

Wiring materials and accessories – Types of wiring – Types of Switches - Specification of Wiring – Stair case wiring - Fluorescent lamp wiring- Godown wiring – Basics of Earthing – single phase wiring layout for a residential building.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand about wiring materials and accessories
- Understand about earthing and wiring layout of domestic buildings
- Design and develop Residential wiring
- Know about godown wiring

**Course Outcomes:**

After completing the course, the student should be able to:

- Understand the classification of materials, domestic wiring materials and earthing.

- Analyze the properties of different electrical materials
- Apply where the materials are applicable based on properties of materials
- Design and develop Residential wiring, godown wiring and earthing.

**Text Books:**

1. G.K. Mithal, “Electrical Engineering Materials”, Khanna publishers, 2<sup>nd</sup> edition, 1991.
2. R.K. Rajput, A course in “Electrical Engineering Materials”, Laxmi publications, 2009.

**Reference Books:**

1. C.S. Indulkar and S. Thiruvengadam, “An Introduction to Electrical Engineering Materials” S Chand & Company, 2008.
2. Technical Teachers Training Institute, “Electrical engineering Materials”, 1<sup>st</sup> Edition, Madras, McGraw Hill Education, 2004.
3. by S.P. Seth, “A course in Electrical Engineering Materials Physics Properties & Applications”, Dhanapat Rai & Sons Publications, 2018.

**(19A03506a) INTRODUCTION TO HYBRID AND ELECTRIC VEHICLES**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- Provide good foundation on hybrid and electrical vehicles.
- To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles.
- Familiarize energy storage systems for electrical and hybrid transportation.
- To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

**UNIT I: Electric Vehicle Propulsion and Energy Sources**

Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge, specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

**Learning Outcomes:**

After successful completion of this unit, the students will be able to

- Summarize the concepts of electrical vehicle propulsion and energy sources. (12)
- Identify the types of power sources for electrical vehicles.(13)
- Demonstrate the design considerations for propulsion system. (12)
- Solve the problems on tractive power and energy required. (13)

**UNIT II: Electric Vehicle Power Plant And Drives**

Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.

**Learning Outcomes:**

After successful completion of this unit, the students will be able to

- Choose a suitable drive scheme for developing an electric vehicles depending on resources.(11)
- List the various power electronic converters. (11)

- Describe the working principle dc/dc converters and buck boost convertor. (12)
- Explain about ac drives. (12)

### **UNIT III: Hybrid And Electric Drive Trains**

Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies. Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

#### **Learning Outcomes:**

After successful completion of this unit, the students will be able to

- Identify the social importance of hybrid vehicles. (13)
- Discuss impact of modern drive trains in energy supplies. (16)
- Compare hybrid and electric drive trains.(12)
- Analyze the power flow control and energy efficiency. (16)

### **UNIT IV: Electric and Hybrid Vehicles - Case Studies**

Parallel hybrid, series hybrid -charge sustaining, charge depleting. Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles.

#### **Learning Outcomes:**

After successful completion of this unit, the students will be able to

- List the various electric and hybrid vehicles in the present market. (11)
- Discuss lightly hybridized vehicle and low voltage systems.(16)
- Explain about hybrid electric heavy duty vehicles and fuel cell heavy duty vehicles. (12)

### **UNIT V: Electric And Hybrid Vehicle Design :**

Introduction to hybrid vehicle design. Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem. Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

#### **Learning Outcomes:**

After successful completion of this unit, the students will be able to

- Illustrate matching the electric machine and the internal combustion engine. (12)
- Select the energy storage technology. (13)
- Select the size of propulsion motor. (13)
- Design and develop basic schemes of electric and hybrid electric vehicles. (13)

### **Course outcomes:**

After learning the course the students will be able to:

- Explain the working of hybrid and electric vehicles. (12)
- Choose a suitable drive scheme for developing an hybrid and electric vehicles depending on resources. (13)
- Develop the electric propulsion unit and its control for application of electric vehicles.(13)
- Choose proper energy storage systems for vehicle applications. (13)
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.(13)

### **Text Books :**

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, 2<sup>nd</sup> edition, CRC Press, 2003.
2. [Amir Khajepour](#), [M. Saber Fallah](#), [Avesta Goodarzi](#), “Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach”, illustrated edition, John Wiley & Sons, 2014.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004.

### **References:**

1. James Larminie, John Lowry, “Electric Vehicle Technology”, Explained, Wiley, 2003.
2. John G. Hayes, [G. Abas Goodarzi](#), “Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles”, 1<sup>st</sup> edition, Wiley-Blackwell, 2018.



(19A03506b) **RAPID PROTOTYPING**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- Familiarize techniques for processing of CAD models for rapid prototyping.
- Explain fundamentals of rapid prototyping techniques.
- Demonstrate appropriate tooling for rapid prototyping process.
- Focus Rapid prototyping techniques for reverse engineering.
- Train Various Pre – Processing, Processing and Post Processing errors in RP Processes.

**UNIT – I**

**10 Hours**

**Introduction:** Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

**RP Software:** Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain prototyping process. (12)
- Classify different rapid prototyping processes. (12)
- Summarize rp software's and represent a 3d model in stl format, other rp data formats. (12)

**UNIT – II**

**8 Hours**

**Solid and Liquid Based RP Systems:** Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications. Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications.

**Fusion Deposition Modeling (FDM):** Principle, Process, Materials, Advantages, Limitations, Applications. **Laminated Object Manufacturing (LOM):** Principle, Process, Materials, Advantages, Limitations, Applications.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the principles, advantages, limitations and applications of Solid and Liquid based AM systems. (L2)
- Identify the materials for Solid and Liquid based AM systems. (L2)

### UNIT – III

8 Hours

**Powder Based RP Systems:** Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

**Other RP Systems:** Three Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications. Ballistic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

#### Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the principles, advantages, limitations and applications of powder based AM systems. (L2)
- Understand the principles, advantages, limitations and applications of other Additive Manufacturing Systems such as 3D Printing, Ballistic Particle Manufacturing and Shape Deposition Modeling. (L2)

### UNIT – IV

8 Hours

**Rapid Tooling:** Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

**Reverse Engineering (RE):** Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

#### Learning Outcomes:

At the end of the unit, the student will be able to

- Classify Rapid Tooling methods. (L2)
- Explain the concepts of reverse engineering and scanning tools. (L2)

### UNIT – V

8 Hours

**Errors in RP Processes:** Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc.

**RP Applications:** Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

#### Learning Outcomes:

At the end of the unit, the student will be able to

- Identify various Pre – Processing, Processing and Post – Processing errors in RP processes. (L2)
- Apply of RP in engineering design analysis and medical applications. (L3)

### **Course Outcomes:**

At the end of the course, the student will be able to

- Use techniques for processing of CAD models for rapid prototyping. (L3)
- Understand and apply fundamentals of rapid prototyping techniques. ((L3)
- Use appropriate tooling for rapid prototyping process. (L3)
- Use rapid prototyping techniques for reverse engineering. (L3)
- Identify Various Pre – Processing, Processing and Post Processing errors in RP processes. (L3)

### **Text Books:**

1. Chua C.K., Leong K.F. and Lim C.S., “Rapid Prototyping: Principles and Applications”, 2<sup>nd</sup> edition, World Scientific Publishers, 2003.
2. Ian Gibson, David W. Rosen, Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 1<sup>st</sup> Edition, Springer, 2010.
3. Rafiq Noorani, “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons, 2006.

### **Reference Books:**

1. Liou W. Liou, Frank W., Liou, “Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development”, CRC Press, 2007.
2. Pham D.T. and Dimov S.S., “Rapid Manufacturing; The Technologies and Application of RPT and Rapid tooling”, Springer, London 2001.
3. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
4. Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC Press, 2005.

**(19A04506a) ANALOG ELECTRONICS**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- To understand the characteristics of various types of electronic devices and circuits (L1).
- To apply various principles of electronic devices and circuits to solve complex Engineering problems (L2).
- To analyze the functions of various types of electronic devices and circuits (L3).
- To evaluate the functions of various types of electronic devices and circuits in real time applications (L3).
- To design various types of electronic circuits for use in real time applications (L4).

**UNIT-I:**

**Diodes and Applications**

Properties of intrinsic and extrinsic semiconductor materials. Characteristics of PN junction diode and Zener diode. Applications of PN diode as a switch, rectifier and Zener diode as regulator. Special purpose diodes: Schottky diode, Tunnel diode, Varactor diode, photodiode and LED.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the characteristics of various types of diodes (L1).
- Apply the principles of diodes to solve complex Engineering problems (L2).
- Analyze the functions of diodes in forward and reverse bias conditions (L3).
- Evaluate the functions of diodes in real time applications (L3).
- Design rectifiers and switches using diodes (L4).

**UNIT-II:**

**BJT and its Applications**

Construction, Operation, and Characteristics in CE, CB and CC configurations. Fixed-Bias and Voltage Divider-Bias. Applications as switch and amplifier.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the characteristics and biasing of BJT (L1).

- Apply the principles of BJT to solve complex Engineering problems (L2).
- Analyse the functions of BJT in various configurations (L3).
- Evaluate the functions of BJT in real time applications (L3).
- Design amplifiers and switches using BJT (L4).

### **UNIT-III:**

#### **FETs and Applications**

**JFETs:**Construction, Operation, and Characteristics in CS configurations. Fixed-Bias and Voltage Divider -Bias. Applications as switch and amplifier.

**MOSFETs:**Construction, Operation, and Characteristics of Enhancement and Depletion modes in CS configurations. Biasing in Enhancement and Depletion modes. Applications as switch.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the characteristics and biasing of FETs (L1).
- Apply the principles of FETs to solve complex Engineering problems (L2).
- Analyze the functions of FETs in CS configuration (L3).
- Evaluate the functions of FETs in real time applications (L3).
- Design amplifiers and switches using FETs (L4).

### **UNIT-IV:**

#### **Feedback Amplifiers and Oscillators**

**Feedback Amplifiers:** Concept of feedback, General characteristics of negative feedback amplifiers, Voltage-series, Current-series, Voltage-shunt, and Current-shunt feedback amplifiers.

**Oscillators:**Conditions for oscillations, Hartley and Colpitts oscillators, RC phase-shift and Wien-bridge oscillators.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of negative & positive feedback and characteristics feedback amplifiers (L1).
- Apply the principles of feedback amplifiers and oscillators to solve complex Engineering problems (L2).
- Analyze the functions of feedback amplifiers and oscillators (L3).
- Evaluate the functions of feedback amplifiers and oscillators in real time applications (L3).
- Design feedback amplifiers and oscillators for specific applications (L4).

### **UNIT-V:**

#### **Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits**

**Wave-Shaping & Multivibrator Circuits:** Introduction, Waveform Shaping Circuits –RC and RL Circuits. Clippers, Comparator and Clampers. Bistable, Schmitt Trigger, Monostable and Astable Multivibrators.

**Linear Integrated Circuits:** Operational Amplifier: Introduction, Block diagram, Basic applications – Inverting, Non-inverting, Summing amplifier, Subtractor, Voltage Follower. IC 555 Timer and IC 7805 Regulator.

### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the operation of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits (L1).
- Apply the principles of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits to complex Engineering solve problems (L2).
- Analyse the functions of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits (L3).
- Evaluate the functions of Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits in real time applications (L3).
- Design Wave-Shaping & Multivibrator Circuits and Linear Integrated Circuits for specific applications (L4).

Note: In all the units, only qualitative treatment is required.

### **Course Outcomes:**

At the end of the course, the student should be able to

- Understand the characteristics of various types of electronic devices and circuits
- Apply various principles of electronic devices and circuits to solve complex Engineering problems
- Analyse the functions of various types of electronic devices and circuits, Evaluate the functions of various types of electronic devices and circuits in real time applications
- Design various types of electronic circuits for use in real time applications.

### **TEXT BOOKS:**

1. S. Salivahanan and N. Suresh Kumar, “Electronic Devices and Circuits”, 4<sup>th</sup> Edition, McGraw Hill Education (India) Pvt Ltd., 2017.

### **REFERENCES:**

1. J. Milliman, Christos C Halkias, and Satyabrata Jit, “Electronics Devices and Circuits”, 4<sup>th</sup> Edition, McGraw Hill Education (India) Pvt Ltd., 2015.
  2. David A. Bell “Electronics Devices and Circuits”, 5<sup>th</sup> Edition, Oxford University Press, 2008.
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**Blooms’ learning levels:**

L1: Remembering and Understanding

L2: Applying

L3: Analyzing/Derive

L4: Evaluating/Design

L5: Creating

**(19A04506b) DIGITAL ELECTRONICS**  
**OPEN ELECTIVE-I**

**Course Objectives:**

- To introduce different methods for simplifying Boolean expressions
- To analyze logic processes and implement logical operations using combinational logic circuits
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines
- To understand concept of Programmable Devices

**UNIT- I**

Minimization Techniques and Logic Gates Minimization Techniques: Boolean postulates and laws – De-Morgan’s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don’t care conditions – Quine - McCluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND– NOR implementations – Multi level gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates.

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Learn Boolean algebra and logical operations in Boolean algebra. (L1)
- Apply different logic gates to functions and simplify them. (L2)
- Analyze the redundant terms and minimize the expression using Kmaps and tabulation methods (L3)

**UNIT- II**

Combinational Circuits -Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.



### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Apply the logic gates and design of combinational circuits(L2)
- Design of different combinational logic circuits(L4)

### **UNIT -III**

Sequential Circuits-Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo-n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Understand the clock dependent circuits (L1)
- Identify the differences between clocked and clock less circuits, apply clock dependent circuits(L2)
- Design clock dependent circuits(L4)

### **UNIT -IV**

Memory Devices Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Understand the principle of operation of basic memory devices, and programmable logic devices. (L1)
- Implement combinational logic circuits using memory and programmable logic devices (L2)

## **UNIT -V**

Synchronous and Asynchronous Sequential Circuits Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits.

### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Understand how synchronous and asynchronous sequential circuit works (L1)
- Understand the FSM and its design principles. (L1)
- Analyze the procedure to reduce the internal states in sequential circuits (L3)
- Illustrate minimization of complete and incomplete state machines and to write a minimal cover table(L2)

### **Course Outcomes:**

- Explain switching algebra theorems and apply them for logic functions, discuss about digital logic gates and their properties, Identify the importance of SOP and POS canonical forms in the minimization of digital circuits.
- Evaluate functions using various types of minimizing algorithms like Boolean algebra, Karnaugh map or tabulation method.
- Analyze the design procedures of Combinational & sequential logic circuits.
- Design of different combinational logic circuits, and compare different semiconductor memories.

### **Text Books:**

1. M. Morris Mano, “Digital Design”, 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. Zvi Kohavi, “Switching and Finite Automata Theory”, 3<sup>rd</sup> Edition, South Asian Edition, 2010,

### **References:**

1. John F.Wakerly, “Digital Design”, Fourth Edition, Pearson/PHI, 2008
2. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.
3. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
4. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 6th Edition, TMH, 2006.
5. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
6. Donald D.Givone, “Digital Principles and Design”, TMH, 2003.

**(19A05506a) FREE AND OPEN SOURCES SYSTEMS**  
**(Open Elective –I)**  
**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Understand the context and operation of free and open source software (FOSS) communities and associated software projects.
- Motivate the students to contribute in FOSS projects
- Familiarize with programming languages like Python, Perl, Ruby
- Elucidate the important FOSS tools and techniques

**UNIT I PHILOSOPHY**

Notion of Community--Guidelines for effectively working with FOSS community--, Benefits of Community based Software Development --Requirements for being open, free software, open source software –Four degrees of freedom - FOSS Licensing Models - FOSS Licenses – GPL- AGPL-LGPL - FDL - Implications – FOSS examples.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Analyze the benefits of Community based Software Development. (L4)
- Explain the degrees of Freedom. (L2)

**UNIT II LINUX**

Linux Installation and Hardware Configuration – Boot Process-The Linux Loader (LILO) - The Grand Unified Bootloader (GRUB) - Dual-Booting Linux and other Operating System - Boot-Time Kernel Options- X Windows System Configuration-System Administration – Backup and Restore Procedures- Strategies for keeping a Secure Server.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Demonstrate Linux Installation and hardware configuration. (L2)
- Compare Linux and Windows System Configurations. (L4)

**UNIT III PROGRAMMING LANGUAGES**

Programming using languages like Python, Perl, Ruby

**Learning outcomes:**

At the end of the unit, students will be able to:

- Explain the syntax of programming Languages Python, Perl and Ruby. (L2)
- Develop applications in the Open source programming Languages. (L6)

**UNIT IV PROGRAMMING TOOLS AND TECHNIQUES**

Usage of design Tools like Argo UML or equivalent, Version Control Systems like Git or equivalent, – Bug Tracking Systems- Package Management Systems

**Learning outcomes:**

At the end of the unit, students will be able to:

- List various programming tools and explain their uses (L1)
- Make use of the various tools while building applications (L3)

**UNIT V FOSS CASE STUDIES**

Open Source Software Development - Case Study – Libre office -Samba

**Learning outcomes:**

At the end of the unit, students will be able to:

- Elaborate the open Source Software Development(L6)
- Compare Libre office with its proprietary equivalent (L5)

**Course Outcomes:**

Upon completion of the course, the students should be able to:

- Demonstrate Installation and running of open-source operating systems.(L2)
- Justify the importance of Free and Open Source Software projects. (L5)
- Build and adapt one or more Free and Open Source Software packages. (L6)
- Utilize a version control system. (L3)
- Develop software to and interact with Free and Open Source Software development projects.(L3)

**TEXT BOOK:**

Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009.

**REFERENCES:**

1. Philosophy of GNU URL: <http://www.gnu.org/philosophy/>.
2. Linux Administration URL: <http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/>.
3. The Python Tutorial available at <http://docs.python.org/2/tutorial/>.

4. Perl Programming book at <http://www.perl.org/books/beginning-perl/>.
5. Ruby programming book at <http://ruby-doc.com/docs/ProgrammingRuby/>.
6. Version control system URL: <http://git-scm.com/>.
7. Samba: URL : <http://www.samba.org/>.
8. Libre office: <http://www.libreoffice.org/>.

**(19A05506b) COMPUTER GRAPHICS and MULTIMEDIA ANIMATION**

**(Open Elective –I)**  
**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Introduce the use of the components of a graphics system and become familiar with the building approach of graphics system components and related algorithms.
- Understand the basic principles of 3- 3-dimensional computer graphics.
- Provide insites on how to scan, convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
- Provide an understanding of mapping from world coordinates to device coordinates, clipping, and projections.
- Discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

**UNIT I OVERVIEW OF COMPUTER GRAPHICS SYSTEM**

OverView of Computer Graphics System – Video display devices – Raster Scan and random scan system – Input devices – Hard copy devices.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Explain the overview of computer graphics with visualization. (L2)
- Classify the Input devices. (L2)
- Distinguish raster scan and random scan systems. (L4)

**UNIT II OUTPUT PRIMITIVES AND ATTRIBUTES**

Drawing line, circle and ellipse generating algorithms – Scan line algorithm – Character Generation – attributes of lines, curves and characters – Antialiasing.

**Learning outcomes:**

At the end of the unit, students will be able to:

- Analyse output primitives and attributes. (L4)
- Design algorithms based on output. (L6)

### **UNIT III TWO DIMENSIONAL GRAPHICS TRANSFORMATIONS AND VIEWING:**

Two-dimensional Geometric Transformations – Windowing and Clipping – Clipping of lines and clipping of polygons.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- Create two-dimensional graphics. (L6)
- Examine the clipping of polygon. (L4)
- Compare different forms of variations. (L2)

### **UNIT IV THREE DIMENSIONAL GRAPHICS AND VIEWING**

Three-dimensional concepts – Object representations- Polygon table, Quadric surfaces, Splines, Bezier curves and surfaces – Geometric and Modelling transformations – Viewing - Parallel and perspective projections.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- Create three-dimensional graphics. (L6)
- Explain the Quadric surfaces and polygon table. (L2)
- Define modelling transformations. (L1)

### **UNIT V REMOVAL OF HIDDEN SURFACES**

Visible Surface Detection Methods – Computer Animation.

#### **Learning outcomes:**

At the end of the unit, students will be able to:

- List the different types of detection methods. (L1)
- Compare various computer animations. (L2)

#### **Course outcomes:**

Upon completion of the course, the students should be able to:

- Explain the basic concepts used in computer graphics. (L2)
- Inspect various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping. (L4)
- Assess the importance of viewing and projections. (L5)
- Define the fundamentals of animation, virtual reality and its related technologies. (L3)
- Analyze the typical graphics pipeline (L4)

## **TEXTBOOK**

1. Hearn, D. and Pauline Baker, M., Computer Graphics (C-Version), 2nd Edition, Pearson Education, 2002.

## **REFERENCES**

1. Neuman, W.M., and Sproull, R.F., Principles of Interactive Computer Graphics, Mc Graw Hill Book Co., 1979.
2. Roger, D.F., Procedural elements for Computer Graphics, Mc Graw Hill Book Co., 1985.
3. Asthana, R.G.S and Sinha, N.K., Computer Graphics, New Age Int. Pub. (P) Ltd., 1996.
4. Floey, J.D., Van Dam, A, Feiner, S.K. and Hughes, J.F, Computer Graphics, Pearson Education, 2001.



**(19A27506a) BREWING TECHNOLOGY**  
**OPEN ELECTIVE - I**

**PREAMBLE**

This course covers the origin of brewing and ingredients used, methods and equipment used and innovations in this field.

**Course Objectives**

- To understand the Beer manufacturing, ingredients and their roles.
- To understand overall view of a brewing industry

**UNIT – I**

Introduction of brewing, history of brewing; Raw materials: barley, hops, water, yeast; Adjuncts for beer production: Maize, rice, millet, wheat, sugar etc. Malt production, role of enzymes for malting; Barley storage, steeping, germination, kilning, cooling, storage;

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Introduction of brewing, history of brewing
- Raw materials like barley, hops, water, yeast
- Adjuncts for beer production: Maize, rice, millet, wheat, sugar etc
- Malt production, role of enzymes for malting
- Barley storage, steeping, germination, kilning, cooling, storage

**UNIT – II**

Malt from other cereals, caramel malt, roasted malt, smoked malt, malt extract; Malt quality evaluation, Wort production, malt milling, Mashing, Mashing vessels; Wort boiling, clarification, cooling and aeration Enzyme properties, starch degradation, b-glucan degradation; Conversion of fatty matter, Biological acidification

**Learning Outcomes:**

At the end of the unit, the student should be able to:

- Malt from other cereals, caramel malt, roasted malt, smoked malt, malt extract

- Malt quality evaluation, Wort production, malt milling, Mashing, Mashing vessels
- Wort boiling, clarification, cooling and aeration Enzyme properties, starch degradation, b-glucan degradation
- Conversion of fatty matter, Biological acidification

### **UNIT – III**

Beer production methods, fermentation technology, changes during fermentation; Filtration procedure and equipment, beer stabilization conditions and durations, beer carbonation process; Packaging equipment and packaging materials, storage conditions and distribution process

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Beer production methods, fermentation technology, changes during fermentation
- Filtration procedure and equipment, beer stabilization conditions and durations, beer carbonation process
- Packaging equipment and packaging materials, storage conditions and distribution process

### **UNIT – IV**

Brewing Equipment. Grain mill, kettles, siphons, carboys, fermentation equipment, wort chillers, pumps beer bottles, cans, labels, bottle caps, sanitation equipments Preventive Production of beer against technology, ling phenomenon of beer, possible measures against staling reactions, oxidation

#### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Brewing Equipments like Grain mill, kettles, siphons, carboys, fermentation equipment, wort chillers
- pumps beer bottles, cans, labels, bottle caps, sanitation equipments
- Preventive Production of beer against technology, ling phenomenon of beer, possible measures against staling reactions, oxidation

## **UNIT – V**

Recent advances: Immobilized Cell Technology in Beer Production, immobilized yeast cell technology Energy management in the brewery and maltings; waste water treatment Automation and plant planning

### **Learning Outcomes:**

At the end of the unit, the student should be able to:

- Immobilized Cell Technology in Beer Production, immobilized yeast cell technology
- Energy management in the brewery and maltings
- waste water treatment Automation and plant planning

### **Course Outcomes:**

By the end of this course, students will attain the:

- Knowledge of beer making, chemistry of ingredients used for brewing,
- Knowledge on brewing industry, Unit operations and equipments involved.

### **TEXT BOOKS**

1. Brewing: “Science and Practice, Brookes and Roger Stevens”, Dennis E. Briggs, Chris A. Boulton, Peter A. 2004, Woodhead publishing limited.
2. Die Deutsche “Bibliothek Technology: “Brewing and Malting”, Wolfgang Kunze. 2010, Bibliographic information published

### **REFERENCES**

1. “Handbook of Brewing”: Process, Technology, Markets, Hans Michael Eblinger. 2009, Wiley-VCH Verlag GmbH & Co.
2. Brewing: “New Technologies”, Charles W. Bamforth. 2006, Woodhead Pub.

**(19A27506b) COMPUTER APPLICATIONS IN FOOD INDUSTRY**  
**(OPEN ELECTIVE – I)**

**PREAMBLE**

This course covers all facets of computerization and various software's used and their usage.

**Course Objectives**

- Able to know about “The necessity of Software & their applications in Food Industries”
- Able to Implement the Programs in ‘C’ to perform various operations that are related to Food Industries.

**UNIT – I**

Computerization, Importance of Computerization in food industry and IT applications in food industries. Computer operating environments and information system for various types of food industries. Introduction to Bar charts and Pie charts & the procedure to develop bar charts and pie charts on given Data.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Computerization, Importance of Computerization in food industry and IT applications in food industries.
- Computer operating environments and information system for various types of food industries.
- Introduction to Barcharts and Piecharts & the procedure to develop barcharts and piecharts on given Data.

**UNIT – II**

Introduction to Software & Programming Languages, Properties, Differences of an Algorithm and Flowcharts, Advantages and disadvantages of Flowcharts & Algorithms. Introduction, Fundamentals & advantages of ‘C’. Steps in learning ‘C’ (Character set, Identifiers, Keywords) Steps in learning ‘C’ (Data types, Constants, Variables, Escape sequences).

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Introduction to Software & Programming Languages, Properties, Differences of an Algorithm and Flowcharts
- Advantages and disadvantages of Flowcharts & Algorithms. Introduction, Fundamentals & advantages of 'C'.
- Steps in learning 'C' (Character set, Identifiers, Keywords)
- Steps in learning 'C' (Data types, Constants, Variables, Escape sequences).

### **UNIT – III**

Steps in learning 'C' (Operators, Statements) Steps in learning 'C' (Header Files, Input & Output functions: Formatted I/O functions, Unformatted I/O functions). Basic Structure of a simple 'C' program. Decision Making/Control Statements. Branching, Concept of Looping & Looping statements.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Steps in learning 'C' (Operators, Statements)
- Steps in learning 'C' (Header Files, Input & Output functions: Formatted I/O functions, Unformatted I/O functions).
- Basic Structure of a simple 'C' program. Decision Making/Control Statements.
- Branching, Concept of Looping & Looping statements.

### **UNIT – IV**

Concept of Functions (Defining a function & Function Prototypes, Types of functions: Library functions & User defined functions. Concept of various types of User Defined Functions (i.e., About 4 types). Concept of Arrays & Types of Arrays (Single, Double and Multi-Dimensional Arrays). Concept of a String Library Functions.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Concept of Functions (Defining a function & Function Prototypes, Types of functions: Library functions & User defined functions.
- Concept of various types of User Defined Functions (i.e., About 4 types).
- Concept of Arrays & Types of Arrays (Single, Double and Multi-Dimensional Arrays).
- Concept of a String Library Functions.

### **UNIT – V**

Concept of Pointers, Structures & Unions. Introduction to Data Structures, Types of Data Structures (Primary & Secondary Data Structures) Concept of Linked Lists, Types of Linked Lists & Basic operations on linked Lists. Concept of Stacks & Operations on Stacks (PUSH &

POP Operations) Concept of Queues and types of Queues Operations on a Queue (ENQUEUE & DEQUEUE Operations)

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Concept of Pointers, Structures & Unions. Introduction to Data Structures, Types of Data Structures (Primary & Secondary Data Structures)
- Concept of Linked Lists, Types of Linked Lists & Basic operations on linked Lists.
- Concept of Stacks & Operations on Stacks (PUSH & POP Operations)
- Concept of Queues and types of Queues Operations on a Queue (ENQUEUE & Dequeue Operations)

### **Course Outcomes**

By the end of the course, the students will be able to

- know about the various steps which are related to computer and Software and their application in Food Industries
- know about the various steps which are necessary to implement the programs in 'C'

### **TEXT BOOKS**

1. Yeswanth Kanethkar, Let us 'C'
2. Balaguruswamy E., "Computer Programming in 'C'"
3. Mark Allen Waise , "Data Structures"

### **REFERENCES**

1. M. S Excel 2000, Microsoft Corporation
2. M. S. Office – Microsoft Corporation
3. Verton M.V. "Computer concepts for Agri Business", AVI Pub. Corp., West Port, USA.

**(19A54506a) OPTIMIZATION TECHNIQUES**  
**(OPEN ELECTIVE-I)**

**Course Objectives:**

The student will be able to learn:

- The basic concepts of Optimization
- The emphasis of this course is on different classical Optimization techniques linear programming and simplex algorithms.
- About optimality of balanced transportation Problems
- About Constrained and unconstrained nonlinear programming.
- About principle of optimality and dynamic programming

**UNIT – I Introduction and Classical Optimization Techniques:**

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions – Numerical examples.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know how to formulate statement of optimization problem with or without constraints
- To know about classification of single and multivariable optimization problems
- To know about necessary and sufficient conditions in defining the optimization problems
- To understand how to formulate Kuhn-Tucker conditions and to solve numerical problems

**UNIT – II Linear Programming**

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm – Numerical examples.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know about formulation of LPP
- To know about formulations of GPP

- To understand various theorems in solving simultaneous equations
- To understand about necessity of Simplex method and to solve numerical problems

### **UNIT – III Nonlinear Programming – One Dimensional Minimization methods**

Introduction, Unimodal function, Elimination methods- Unrestricted Search, Exhaustive Search, Dichotomous Search, Fibonacci Method, Golden Section Method and their comparison; Interpolation methods - Quadratic Interpolation Method, Cubic Interpolation Method and Direct Root Methods – Numerical examples.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To know about NLP in one dimensional optimization problems
- To understand about various search methods
- To learn about various interpolation methods
- To distinguish and compare the various elimination methods with numerical examples

### **UNIT – IV Unconstrained & Constrained Nonlinear Programming**

**Unconstrained Optimization Techniques:** Introduction- Classification of Unconstrained Minimization Methods, General Approach, Rate of Convergence, Scaling of Design Variables; Direct Search methods- Random Search Methods, Grid Search Method, Pattern Directions, Powell's Method and Simplex Method

**Constrained Optimization Techniques:** Introduction, Characteristics of a Constrained Problem, Direct Search Methods - Random Search Methods, Basic Approach in the Methods of Feasible Directions, Rosen's Gradient Projection Method, Generalized Reduced Gradient Method and Sequential Quadratic Programming.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- To distinguish between unconstrained and constrained optimization problems
- To learn about direct search methods in unconstrained NLP problems and comparison
- To understand about direct search methods in constrained NLP problems and comparison
- To do exercises for solving numerical examples of various methods

### **UNIT – V Dynamic Programming**

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution – Numerical examples.

#### **Learning Outcomes:**



At the end of unit, students will be able to understand the following

- To know what is DP problem?
- To know about computational procedure in solving DPP
- To know Calculus and Tabular methods of solving with numerical examples of various methods

**Course Outcomes:**

The student gets thorough knowledge on:

- Basic methods, principles in optimization
- Formulation of optimization models, solution methods in optimization
- Finding initial basic feasible solutions.
- Methods of linear and non-linear (constrained and unconstrained) programming.
- Applications to engineering problems.

**TEXT BOOKS:**

1. S. S. Rao, “Engineering optimization”: Theory and practice 3rd edition, New Age International (P) Limited, 1998.
2. H.S. Kasana & K.D. Kumar, “Introductory Operations Research Springer (India)”, 2004.

**REFERENCES:**

1. R Fletcher, “Practical Methods of Optimization” , 2<sup>nd</sup> Edition, Wiley Publishers, 2000.
2. Jorge Nocedal and Wright S, “Numerical Optimization Springer”, 1<sup>st</sup> Edition, 1999.
3. by K.V. Mital and C. Mohan, “Optimization Methods in Operations Research and systems Analysis” 3<sup>rd</sup> Edition, New Age International (P) Limited, 1996.
4. by S.D. Sharma, “Operations Research”, Kedar Nath, 2012.
5. by H.A. Taha, “Operations Research”, 9<sup>th</sup> Edition, An Introduction Pearson, 2010.
6. G. Hadley, “Linear Programming”, Narosa, 2002.

**(19A52506a) TECHNICAL COMMUNICATION AND PRESENTATION SKILLS  
(OPEN ELECTIVE)**

**Course Objectives:**

- To develop awareness in students of the relevance and importance of technical communication and presentation skills.
- To prepare the students for placements
- To sensitize the students to the appropriate use of non-verbal communication
- To train students to use language appropriately for presentations and interviews
- To enhance the documentation skills of the students with emphasis on formal and informal writing

**SYLLABUS**

**UNIT -1:**

**Basics of Technical Communication** – Introduction – Objectives & Characteristics of Technical Communication – Importance and need for Technical communication - LSRW Skills – Barriers to effective communication

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of LSRW skills
- Identify and overcome the barriers to effective communication
- Realize the need and importance of technical communication

**UNIT -II**

**Informal and Formal Conversation** - Verbal and Non-verbal communication –Kinesics, Proxemics, Chronemics, Haptics, Paralanguage

**Learning Outcomes:**

At the end of the module, the learners will be able to

- State the difference between formal and informal conversation.
- Apply the knowledge of the difference between the verbal and non-verbal communication
- Evaluate the different aspects of non-verbal communication.

## **UNIT -III**

**Written communication** – Differences between spoken and written communication – Features of effective writing –Advantages and disadvantages of spoken and written communication- Art of condensation- summarizing and paraphrasing

### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Know the difference between written and spoken communication
- Apply the awareness of features of effective writing.
- Implement the understanding of summarizing and paraphrasing.

## **UNIT -IV**

**Presentation Skills** – Nature and importance of oral presentation – Defining the purpose – Analyzing the audience - Planning and preparing the presentation, organizing and rehearsing the presentation –Individual and group presentations - Handling stage fright

### **Learning Outcomes:**

At the end of the module, the learners will be able to

- State the importance of presentation skills in corporate climate.
- Analyze the demography of the audience.
- Plan, prepare and present individual and group presentations.

## **UNIT -V**

**Interview Skills** – The Interview process –Characteristics of the job interview – Pre-interview preparation techniques – Projecting the positive image – Answering Strategies

### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Identify the characteristics of the job interview.
- Understand the process of Interviews.
- Develop a positive image using strategies in answering FAQs in interviews

### **Course Outcomes**

- Understand the importance of effective technical communication
- Apply the knowledge of basic skills to become good orators
- Analyze non-verbal language suitable to different situations in professional life
- Evaluate different kinds of methods used for effective presentations
- Create trust among people and develop employability skills

**TEXT BOOKS:**

1. Ashrif Rizvi, "Effective Technical Communication", TataMcGrahill, 2011
2. Meenakshi Raman & Sangeeta Sharma, "Technical Communication", 3<sup>rd</sup> Edition, O U Press 2015

**REFERENCES:**

1. Pushpalatha & Sanjay Kumar, "Communication Skills", Oxford Univsesity Press
2. Barron's/Books on TOEFL/GRE/GMAT/CAT/IELTS DELTA/Cambridge University Press.2012.
3. Butterfield Jeff, "Soft Skills for Everyone", Cengage Publications, 2011.
4. Universities Press (India) Pvt Ltd., "Management Shapers Series", Himayatnagar, Hyderabad 2008.
5. John Hughes & Andrew Mallett, "Successful Presentations" Oxford.
6. Edgar Thorpe and Showick Thorpe, "Winning at Interviews" Pearson
7. Munish Bhargava, "Winning Resumes and Successful Interviews", McGraw Hill

(19A51506a) CHEMISTRY OF ENERGY MATERIALS

**Course Objectives:**

- To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
- To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
- Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
- To understand and apply the basics of calculations related to material and energy flow in the processes.

**UNIT-1: Electrochemical Systems:** Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batteries.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Solve the problems based on electrode potential (L3)
- Describe the Galvanic Cell (L2)
- Differentiate between Lead acid and Lithium ion batteries (L2)
- Illustrate the electrical double layer (L2)

**UNIT-2: Fuel Cells:** Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe the working Principle of Fuel cell (L2)
- Explain the efficiency of the fuel cell (L2)
- Discuss about the Basic design of fuel cells (L3)

- Classify the fuel cell (L2)

**UNIT-3: Hydrogen Storage:** Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogel storage by high pressure methods. Liquifaction method.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Differentiate Chemical and Physical methods of hydrogen storage (L2)
- Discuss the metal organic frame work (L3)
- Illustrate the carbon and metal oxide porous structures (L2)
- Describe the liquification methods (L2)

**UNIT-4: Solar Energy:** Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Apply the photo voltaic technology (L3)
- Demonstrate about solar energy and prospects (L2)
- Illustrate the Solar cells (L2)
- Discuss about concentrated solar power (L3)

**UNIT-5: Photo and Photo electrochemical Conversions:** Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Differentiate between Photo and Photo electrochemical Conversions (L2)
- Illustrate the photochemical cells (L2)
- Identify the applications of photochemical reactions (L3)
- Interpret advantages of photoelectron catalytic conversion (L2)

**Course Outcome:**

- Ability to perform simultaneous material and energy balances.
- Student learn about various electrochemical and energy systems
- Knowledge of solid, liquid and gaseous fuels
- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively

**References :**

1. Physical chemistry **by** Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7<sup>th</sup> Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff

(19A04501P) INTEGRATED CIRCUITS AND APPLICATIONS LAB

LIST OF EXPERIMENTS

Course Objectives:

- To familiarize different Analog ICs.
- To implement linear and nonlinear application circuits by Op amp.
- To realize active filters using Op amp.
- To design of various multi-vibrator circuits using 555 timer application
- To design and Understand the working of mixed signal circuits like Analog to Digital Convertors, Digital to analog Convertors and Phase Locked Loop.
- To understand the working of a few application specific analog ICs and to design circuits based on these ICs.

**Conduct any 12 experiments from the following list. Out of them any 4 experiments may be conducted using software tools.**

Note: All the Hardware experiments may be performed using ICs 741, TL082, 555,565

**Interpretation of data sheets (741, TL082, 555, 565)**

1. Applications of Op-amp  
Design and test the performance of the following circuits using Op-amp IC741/TL082
  - a. Inverting amplifier
  - b. Non-inverting amplifier
  - c. Voltage follower
  - d. Summer
2. Design and test the performance of practical differentiator and integrator circuits for various time constants. Plot the graphs.
3. Comparator circuits  
To study zero crossing detectors, window detector and Schmitt trigger using Op-Amp.
4. Signal converters  
Construct suitable circuits for Voltage to Current and Current to Voltage converters using Op-Amp.
5. Active filters using Op-amp  
Design and test the performance of 2<sup>nd</sup> and 3<sup>rd</sup> order Butterworth LPF, HPF.
6. Active filters using Op-amp  
Design and test the performance of 2<sup>nd</sup> and 3<sup>rd</sup> order Butterworth BPF and BSF.
7. Construct and verify the performance of
  - a. Logarithmic and antilog amplifiers
  - b. Instrumentation amplifier
8. Precision rectifiers  
Conduct experiments on half wave and full wave precision rectifiers and draw the



- output waveforms.
9. Design the monostable multivibrator circuit and verify their performance practically using Op-Amp and IC 555.
  10. Design the astable multivibrator circuit and verify their performance practically using Op-Amp and IC 555.
  11. Data converters  
Construct and study performance of
    - a. DAC circuits – R-2R and ladder type.
    - b. Successive approximation type ADC.
  12. To study performance of PLL IC565
  13. Design a DC power supply using 78XX/79XX andLM723, verify the same practically.

### **Equipment required for**

#### **Laboratory Software:**

- i. Multisim/ Pspice/Equivalent Licensed simulation software tool
- ii. Computer Systems with required specifications

#### **Hardware:**

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components
10. Bread Boards
11. Connecting Wires
12. CRO Probes

#### **Course Outcomes:**

- Understand the working of Op amp ICs & Application specific analog ICs.
- Analyze operational amplifier based circuits for linear and non-linear applications.
- Design Operational amplifiers for linear and nonlinear application, Multivibrator circuits using 555 & application specific ICs.
- Simulate all linear and nonlinear application based Op amp Circuits and circuits based on application specific ICs.
- Compare theoretical, practical & simulated results in integrated circuits.

**(19A52601P) ENGLISH LANGUAGE SKILLS LAB**

**Course Objectives**

- students will be exposed to a variety of self instructional, learner friendly modes of language learning
- Students will cultivate the habit of reading passages from the computer monitor. Thus providing them with the required facility to face computer based competitive exams like GRE, TOEFL, and GMAT etc.
- students will learn better pronunciation through stress, intonation and rhythm
- students will be trained to use language effectively to face interviews, group discussions, public speaking
- students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

**UNIT -I**

1. Phonetics for listening comprehension of various accents - 2
2. Formal Presentations using PPT slides without Graphic Elements
3. Paraphrasing

**Learning Outcomes**

At the end of the module, the learners will be able to

- Understand different accents spoken by native speakers of English
- Make formal structured presentations on general topics using PPT slides without graphical elements
- Paraphrase short academic texts using suitable strategies and conventions

**UNIT- II**

1. Debate – 2 (Following Argument)
2. Listening to short speeches/ short stories for note-making and summarizing
3. E-mail Writing

**Learning Outcomes**

At the end of the module, the learners will be able to

- Participate in formal discussions and speak clearly on a specific topic using suitable discourse markers
- Make formal structured presentations on academic topics using ppt slides with relevant graphical elements
- Write formal emails in the standard format

### **UNIT- III**

1. Listening for Discussions
2. Group Discussions
3. Writing Persuasive/argumentative essays on general topics

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Follow a discussion to identify the salient points
- Participate in group discussions using appropriate conventions and language strategies
- Produce logically coherent persuasive/argumentative essays

### **UNIT-IV**

1. Reviewing film/ book
2. Group Discussions – reaching consensus in Group Work
3. Resume Writing – Cover Letter – Applying for Internship

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Judge a film or book
- Express thoughts and ideas with acceptable accuracy and fluency with a view to reach consensus in group discussions
- Prepare a CV and write a cover letter to seek internship/ job

### **UNIT-V**

1. Writing Project Reports
2. Editing Short Texts
3. Answering FAQs in Interviews

#### **Learning Outcomes**

At the end of the module, the learners will be able to

- Collaborate with a partner to make effective presentations
- Understand the structure and produce an effective project report.
- Edit short texts according to different needs of the work place.

#### **Course Outcomes**

- Remember and understand the different aspects of the English language proficiency with emphasis on LSRW skills

- Apply communication skills through various language learning activities
- Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
- Evaluate and exhibit acceptable etiquette essential in social and professional settings
- Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

### **SUGGESTED SOFTWARE:**

- Walden Infotech English Language Communication Skills.
- iTell- Orell Digital Language Lab
- Digital Teacher
- LES(Learn English Select) by British council
- TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.
- Lingua TOEFL CBT Insider, by Dreamtech
- English Pronunciation in Use (Elementary, Intermediate, Advanced) CUP
- Cambridge Advanced Learners' English Dictionary with CD.

### **REFERENCE BOOKS:**

The software consisting of the prescribed topics elaborated above should be procured and used.

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication" O U Press 2009.
2. Barron's Books on TOEFL/GRE/GMAT/CAT/IELTS /DELTA/Cambridge University Press.2012.
3. Butterfield Jeff, "Soft Skills for Everyone", Cengage Publications, 2011.
4. "Practice Psychometric Tests": How to familiarize yourself with genuine recruitment tests, 2012.
5. David A McMurrey & Joanne Buckely "Handbook for Technical Writing" CENGAGE Learning 2008.
6. "A Textbook of English Phonetics for Indian Students", 2<sup>nd</sup> Edition, T.Balasubramanyam. (Macmillan), 2012.
7. "A Handbook for English Laboratories", E. Suresh Kumar, P. Sreehari, Foundation Books, 2011

Note: Links provided by APSHE on LSRW, grammar and vocabulary

**(19A04503P) DIGITAL COMMUNICATIONS LAB**

**Course Objectives**

- To Develops skills for performance analysis of practical digital communication systems.
- To understand the fundamental concepts on TDM, Pulse modulations& digital modulation techniques.
- To evaluate the performance of PCM, DPCM and DM in a digital communication system.
- To learns how to use MATLAB software and hardware effectively and creatively to synthesis digital communication systems.

**LIST OF EXPERIMENTS**

**Minimum of Twelve experiments to be conducted (any six from Part-A)**

**HARDWARE EXPERIMENTS (PART – A)**

1. Generation of random data using linear feedback shift registers at a given data rate. Plot the random data.
2. Construct Time division multiplexing circuit to multiplex three users' data.
3. Verify the functionality of each block in Pulse code modulation system practically.
4. Find the processing gain in a Differential pulse code modulation circuit experimentally.
5. Verify the operation of Delta modulation and demodulation.
6. Design and verify modulated and demodulated circuit for Frequency shift keying.
7. Construct a modulated and demodulated circuit for Differential phase shift keying.
8. Design and verify working principle of QPSK modulation and demodulation with suitable setup.

**SOFTWARE EXPERIMENTS (PART-B)**

**Modeling of Digital Communications using MATLAB**

1. Study Sampling Theorem and verify the effect of under sampling and oversampling while retrieving the original signal.
2. Understand functioning of each block in Pulse code modulation circuit and verify through simulation.
3. Write a program on Differential pulse code modulation and demodulation.
4. Write a program on Frequency shift keying modulation schemes for given two carrier frequencies, determine the bit error probability.
5. Write a program and verify QPSK modulation and demodulation, determine the bit error probability.
6. Write a program and verify Differential phase shift keying modulation scheme is a non-coherent modulation scheme, determine the bit error probability is inferior to that of QPSK.

### **EQUIPMENT REQUIRED FOR LABORATORIES:**

1. RPS - 0 – 30V
2. CROs - 0 – 20 MHz.
3. Function Generators - 0 – 1 MHz
4. RF Generators - 0 – 1000 MHz.
5. Multimeters
6. Required Electronic Components (Active and Passive) which include ICs as well.
7. Arbitrary Wave form generators/ PNS generators – 2 Nos. (To generate digital data at required data rates)
8. Licensed MATLAB software with required toolboxes.

### **Course Outcomes**

- Understand real time behavior of different digital modulation schemes and technically visualize spectra of different digital modulation schemes.
- Design and implement different modulation and demodulation techniques.
- Analyze digital modulation & demodulation techniques.
- Simulate all digital modulation and demodulation techniques in MATLAB.

**(19A99601) MANDATORY COURSE: RESEARCH METHODOLOGY**

**Course Objectives :**

The objective of this course is

- To understand the basic concepts of research and research problem
- To make the students learn about various types of data collection and sampling design
- To enable them to know the method of statistical evaluation
- To make the students understand various testing tools in research
- To make the student learn how to write a research report
- To create awareness on ethical issues in research

**Syllabus**

**UNIT- I**

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – Research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of research and its process
- Explain various types of research
- Know the steps involved in research design
- Understand the different research approaches

**UNIT- II**

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design. Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation. Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of sampling and sampling design
- Explain various techniques in measurement and scaling

- Learn various methods of data collection
- Design survey questionnaires for different kinds of research
- Analyze the questionnaires

### **UNIT- III**

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

#### **Learning Outcomes:-**

After completion of this unit student will

- Know the association of two variables
- Understand the importance of correlation and regression
- Compare and contrast correlation and regression
- Learn various types of correlation
- Apply the knowledge of C&R Analysis to get the results

### **UNIT- IV**

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multivariate Analysis

#### **Learning Outcomes:-**

After completion of this unit student will

- Know the statistical inference
- Understand the hypothesis testing procedure
- Compare and contrast Parametric and Non-parametric Tests
- Understand the use of chi-square test in investigating the distribution of categorical variables
- Analyze the significance of variance and covariance

### **UNIT- V**

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

#### **Learning Outcomes:-**

After completion of this unit student will

- Learn about report writing
- Understand how to write research paper



- Explain various techniques of interpretation
- Understand the importance of professional ethics in research
- Design a scientific paper to present in the conferences/seminars

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand basic concepts and its methodologies
- Demonstrate the knowledge of research processes
- Read, comprehend and explain research articles in their academic discipline
- Analyze various types of testing tools used in research
- Design a research paper without any ethical issues

### **TEXT BOOKS:**

1. C.R.Kothari, “Research Methodology:Methods and Techniques”,2<sup>nd</sup> edition, New Age International Publishers.
2. A Step by Step Guide for Beginners, “Research Methodology”: Ranjit Kumar, Sage Publications

### **REFERENCES:**

1. P.Narayana Reddy and G.V.R.K.Acharyulu, “Research Methodology and Statistical Tools”, 1<sup>st</sup> Edition, Excel Books,New Delhi.
2. Donald R. “Business Research Methods”, Cooper & Pamela S Schindler, 9<sup>th</sup> edition.
3. S C Gupta, “Fundamentals of Statistics”, 7<sup>th</sup> edition Himalaya Publications

**(19A04601T) MICROPROCESSORS AND MICROCONTROLLERS**

**Course Objectives:**

- To introduce fundamental architectural concepts of microprocessors and microcontrollers.
- To impart knowledge on addressing modes and instruction set of 8086 and 8051.
- To introduce assembly language programming concepts.
- To explain memory and I/O interfacing with 8086 and 8051.
- To introduce 16 bit and 32 bit microcontrollers.

**UNIT- I**

Introduction to 8085 and 8086 Microprocessors: 8085 Microprocessor Architecture, Pin Diagram, Flag Register, Interrupts of 8085. Register Organisation of 8086, Architecture, Pin Diagram, Flag Register, Physical Memory concept, Memory addressing in 8086, Stack organization of 8086, Addressing Modes in 8086, Interrupt structure of 8086.

**Learning Outcomes:-**

After completion of this unit student will

- Summarize features of a microprocessor (L2)
- Explain about ISR and interrupt structure of 8086 (L2)
- Distinguish between Intel 8085 & 8086 microprocessors (L5)

**UNIT- II**

8086 Microprocessor Instruction Set and Addressing Modes, Instruction Set of 8086, Assembly Language Programming, Simple programs, Assembler Directives, Procedures and Macros, String Instructions.

**Learning Outcomes:-**

After completion of this unit student will

- Understand instruction set of 8086 microprocessor (L1)
- Explain addressing modes of 8086 (L2)
- Develop assembly language programs for various problems (L2)

**UNIT- III**

Memory interacting with 8086 and Peripheral Devices, Interfacing SRAMs, DRAMs and EPROMs to 8086, Programmable Peripheral Interface 8255, Programmable Interval Timer

8253, Programmable Interrupt Controller 8259, Programmable Communication Interface 8251 USART, DMA Controller 8257.

### **Learning Outcomes:-**

After completion of this unit student will

- Demonstrate memory &I/O interfacing with 8086 (L2)
- Describe interfacing of 8086 with peripheral devices (L2)

### **UNIT- IV**

Intel 8051 Microcontroller, Microprocessor vs Microcontroller, 8051 Microcontroller Architecture, Microcontroller 8051 pin diagram, 8051 Ports, Internal and External Memory, Counters and Timers, Serial Communication in 8051, Interrupts in 8051, Addressing Modes, Data Transfer Instructions, Data and Bit-Manipulation Instructions, Arithmetic Instructions, simple programs.

### **Learning Outcomes:-**

After completion of this unit student will

- Describe architecture and features of Intel 8051 microcontroller (L2)
- Develop assembly language programs to perform various operations using 8051 (L2)
- Distinguish between microprocessor and a microcontroller (L5)

### **UNIT- V**

ARM Architectures and Processors: What is ARM Architecture, ARM Processor Families, ARM Cortex-M Series, Cortex-M0+ Processor Overview, Cortex-M0+ Block Diagram, Registers, Memory Map, Bit-band Operations, Endianness, ARM Cortex-M0+ Processor Instruction Set – ARM and Thumb Instruction Set.

### **Learning Outcomes:-**

After completion of this unit student will

- Explain architecture and addressing modes of ARM Cortex M0+. (L2)
- Explain the Assembly instruction set of ARM Cortex M0+. (L2)

### **Course Outcomes:**

- Understand instruction set of 8086 microprocessor and ARM architecture.

- Explain addressing modes of 8086, develop assembly language programs for various problems, describe interfacing of 8086 with peripheral devices, architecture and addressing modes of ARM Cortex M0+, assembly instruction set of ARM Cortex M0+.
- Distinguish between microprocessor and microcontroller, 8085& 8086 microprocessors, design applications using microcontrollers.

**Text Books:**

1. K M Bhurchandi, A K Ray, “Advanced Microprocessors and Peripherals”, 3<sup>rd</sup> edition, McGraw Hill Education, 2017.
2. Raj Kamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design”, 2<sup>nd</sup> edition, Pearson, 2012.
3. Alexander G. Dean “Embedded Systems Fundamentals on Arm Cortex-M based Microcontrollers”: A Practical Approach

**References:**

1. Ramesh S Gaonkar, “Microprocessor Architecture Programming and Applications with the 8085”, 6<sup>th</sup> edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, “ the 8051 Microcontroller”, 3<sup>rd</sup> edition, Cengage Learning, 2004.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer’s Guide: “Designing and Optimizing System Software”, Elsevier, 2004.
4. John H. Davies, Newness, “MSP 430 Microcontroller Basics”, Elsevier Publications, 2008.

(19A04602T) DIGITAL SIGNAL PROCESSING

**Course Objectives:**

- To provide background and fundamental material for the analysis and processing of digital signals.
- To familiarize the relationships between continuous-time and discrete time signals and systems.
- To study fundamentals of time, frequency and Z-plane analysis and to discuss the inter-relationships of these analytic method.
- To study the designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specifications.
- To introduce a few real-world signal processing applications.
- To acquaint with DSP processor.

**UNIT- I:**

**Discrete Fourier Transform:** Discrete Fourier series, Properties of Discrete Fourier series, Discrete Fourier Transform (DFT), The DFT as a linear transformation, Relationship of the DFT to other transforms, Properties of DFT.

**Fast Fourier Transforms:** Efficient computation of DFT algorithms - Radix 2-Decimation-in-Time & Decimation-in-Frequency algorithms, Inverse FFT, Illustrative problems.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of DFT and its properties.(L1)
- Find N-Point DFT/FFT for a given signal/sequence.(L2)

**UNIT- II:**

**IIR Digital Filters:** Review of analog filter design, Frequency transformation in the analog and digital domains, Design of IIR filters from Analog filters – Approximation of derivatives, Impulse invariance, Bilinear transformation, Design of Butterworth, Chebyshev filters, Illustrative problems.

**Realization of IIR Systems:** Structures for IIR systems–Direct form I& Direct form II, Transposed, Cascade form, Parallel form and Lattice structures, Signal flow graphs.

**Learning Outcomes:-**

After completion of this unit student will

- Understands signal flow graph and block diagram representations of difference equations that realize digital filters(L1)
- Realization of different structures for IIR filters(L2)
- Design of IIR filters using different techniques. (L4)

### **UNIT- III:**

**FIR Digital Filters:** Linear phase FIR filter, characteristic response, location of zeros, Design of FIR filter using Windowing Techniques - Rectangular, Hanning, Hamming, Kaiser, Bartlett, Blackman, Design of FIR filter by Frequency sampling technique, Illustrative problems.

**Realization of FIR Systems:** Structures for FIR systems - Direct form, Cascade form and Lattice structures. Comparison of FIR and IIR filters.

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of FIR filter(L1)
- Realization of different structures for FIR filters(L2)
- FIR filter design based on windowing methods.(L4)
- Compare FIR and IIR filters (L5)

### **UNIT -IV:**

**Architectures for Programmable DSP Devices:** Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues.

#### **Learning Outcomes:-**

After completion of this unit student will

- Recognize the fundamentals of fixed and floating point architectures of various DSPs.(L1)
- Learn the architecture details and instruction sets of fixed and floating point DSPs.(L1)
- Illustrate the control instructions, interrupts, and pipeline operations.(L2)

### **UNIT- V:**

**Programmable Digital Signal Processors:** Introduction, Commercial Digital signal-processing Devices, Architecture of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

## **Learning Outcomes:-**

After completion of this unit student will

- Illustrate the features of on-chip peripheral devices and its interfacing along with its programming details.(L2)
- Analyze and implement the signal processing algorithms in DSPs. (L3)

## **Course Outcomes**

- Understand the basic concepts of IIR and FIR filters, DSP building blocks to achieve high speed in DSP processor, DSP TMS320C54XX architecture and instructions.
- Compute the fast Fourier transforms and find the relationship with other transforms. Realization of digital filter structures.
- Design of FIR and IIR digital filters.
- Compare FIR and IIR filters.

## **TEXT BOOKS:**

1. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications," Pearson Education/PHI, 4th ed., 2007.
2. Avtar Singh and S. Srinivasan, "Digital Signal Processing," Thomson Publications, 2004.

## **REFERENCES:**

1. Sanjit K Mitra, "Digital signal processing, A computer base approach," Tata McGraw Hill, 3<sup>rd</sup> edition, 2009.
2. A.V.Oppenheim and R.W. Schaffer, & J R Buck, "Discrete Time Signal Processing," 2<sup>nd</sup>, Pearson Education, 2012.
3. B. P. Lathi, "Principles of Signal Processing and Linear Systems," Oxford Univ. Press, 2011.
4. B. Venkata Ramani and M.Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications," TMH, 2004.

(19A04603) DIGITAL SYSTEM DESIGN THROUGH VHDL

**Course Objectives:**

- Learn and understand the architectures of Field-programmable Gate Arrays.
- Translate a software application into hardware logic for FPGA architectures.
- Design synthesizable systems based on industry-standard coding methods.
- Build testbenches and create data models to verify bit-true accurate designs.
- Acquire the knowledge about Design and modelling of Parwan CPU, vending machine, washing machine, etc.

**UNIT-I**

**Introduction and Field-Programmable Gate Arrays:** Hardware Description Languages, FPGA Boards and Software Tools, Transistor as a Switch, Logic Gates from Switches, FPGA Building Blocks, Layout of the Xilinx Artix-7 XC7A35T FPGA, Resources of FPGA, Clock Management, The XADC Block, High-Speed Serial I/O Transceivers, Peripheral Component Interconnect Express Interface, FPGA-Based Digital System Design Philosophy, Advantages and Disadvantages of FPGAs, Usage Areas of FPGAs, Introduction to VHDL, VHDL Fundamentals, Entity and Architecture Representations, Dataflow Modeling, Behavioral Modeling, Timing and Delays in Modeling, Hierarchical Structural Representation, Testbench Formation in VHDL, Structure of a VHDL Testbench File, Displaying Test Results.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the architecture of FPGA devices (L2)
- Know the software tools used in digital design (L1)
- Understand the VHDL design styles to design digital systems (L2)

**UNIT-II:**

**VHDL Data Types and Operators:** Data Types in VHDL, Signal and Variable Data Types, Data Values, Naming a Signal or Variable, Defining Constants, Defining Arrays, Operators in VHDL, Application on Data Types and Operators, FPGA Building Blocks Used in Data Types and Operators, Implementation Details of Vector and Arithmetic Operations.

**Learning Outcomes:-**

After completion of this unit student will

- Know various data types used in VHDL language (L2)
- Understand the VHDL operators and apply them in digital design (L3)



- Implement various arithmetic and logical operations in digital design (L3)

### UNIT-III:

**Combinational Circuits:** Logic Gates, Combinational Circuit Analysis, Logic Function Formation between Input and Output, Boolean Algebra, Gate-Level Minimization, Combinational Circuit Implementation, Truth Table-Based Implementation, Implementing Combinational Circuits, Combinational Circuit Design,

**Combinational Circuit Blocks:** Adders in VHDL, Comparators in VHDL, Decoders in VHDL, Encoders in VHDL, Multiplexers in VHDL, Parity Generators and Checkers in VHDL, Applications on Combinational Circuit Blocks, Sample Designs, Home Alarm System, Digital Safe System, Car Park Occupied Slot Counting System, Applications on Combinational Circuits, Implementing the Home Alarm System, Implementing the Digital Safe System, Implementing the Car Park Occupied Slot Counting System, FPGA Building Blocks Used in Combinational Circuits,

**Data Storage Elements:** Latches in VHDL, Flip-Flops in VHDL, Register, Memory, Read-Only Memory, ROM in VHDL, ROM Formation Using IP Blocks, Random Access Memory, Application on Data Storage Elements, FPGA Building Blocks Used in Data Storage Elements.

#### Learning Outcomes:-

After completion of this unit student will

- Design and analyze various combinational logic circuits (L4)
- Use VHDL in design of combinational logic circuits to analyze the behaviour (L4)
- Implement various memory and data storage elements using VHDL (L4)

### UNIT-IV:

**Sequential Circuits:** Sequential Circuit Analysis, State Table, State Diagram, State Representation in VHDL, Timing in Sequential Circuits, Synchronous Operation, Asynchronous Operation, Shift Register as a Sequential Circuit, Shift Registers in VHDL, Multiplication and Division Using Shift Registers, Counter as a Sequential Circuit, Synchronous Counter, Asynchronous Counter, Counters in VHDL, Frequency Division Using Counters, Sequential Circuit Design, Applications on Sequential Circuits

#### Learning Outcomes:-

After completion of this unit student will

- Design sequential logic circuits (L4)
- Use VHDL in design of sequential logic circuits to analyze the behavior (L4)
- Create VHDL structural models to design sequential logic circuits (L5)

### UNIT-V:

**CPU Modeling and Design:** Defining a Comprehensive Example, Parwan CPU Memory Organization of Parwan, Instruction Set, Instruction Format, Programming in Parwan Assembly, Behavioral Description of Parwan, Timing and Clocking, Packages, Interface Description of Parwan, Parwan Behavioral Architecture, Parwan Bussing Structure, Interconnection of Components, Global View of Parwan Components, Instruction Execution

**Advanced Applications:** Vending Machine, Digital Clock, Moving Wave via LEDs, Translator, Air Freshener Dispenser, Obstacle-Avoiding Tank, Intelligent Washing Machine, Non-Touch Paper Towel Dispenser, Car Parking Sensor System, Digital Table Tennis Game

### **Learning Outcomes:-**

After completion of this unit student will

- Understand the design of Parwan CPU (L5)
- Develop VHDL models for various advanced digital applications (L5)
- Use VHDL in design of digital design systems like washing machines, car parking systems (L5)

### **Course Outcomes:**

- Understand the architecture of FPGAs, tools used in modelling of digital design and modelling styles in VHDL.
- Learn the IEEE Standard 1076 Hardware Description Language (VHDL).
- Analyze and design basic digital circuits with combinatorial and sequential logic circuits using VHDL.
- Model complex digital systems at several levels of abstractions, behavioural, structural.
- Design complex digital CPU, vending machine and washing machines etc and analyze the case studies.

### **Text Books:**

1. CemUnsalan, Bora Tar “Digital System Design with FPGA Implementation Using Verilog and VHDL” McGraw-Hill Education, 2017
2. ZainalabedinNavabi “VHDL: Analysis and Modeling of Digital Systems” VHDL: Analysis and Modeling of Digital Systems, Z. Navabi, McGraw Hill International Ed. 1998.

### **References:**

1. J. Bhaskar “A VHDL Primer”, Pearson Education India, 3<sup>rd</sup> edition, 2015
2. Stephen Brown and Zvonko Vranesic “Fundamentals of digital logic design with VHDL” Tata McGraw Hill, 2nd edition, 2009.

**(19A04605a) INTRODUCTION TO WIRELESS AND CELLULAR  
COMMUNICATIONS  
PROFESSIONAL ELECTIVE-II**

**Course Objectives:**

- To be familiar with evolution of Wireless communication standards
- To understand cellular concepts and various terminology used in wireless & cellular communications
- To analyze the propagation effects in free space and different types of fading channels.
- To be able to apply different concepts of equalization and diversity schemes for better performance of receivers.
- To understand and apply the knowledge of 3G and 4G communication technologies for designing suitable receivers to counter balance the effects of fading channels

**Unit 1: Overview of Cellular Systems and evolution:** Introduction, Mobile Radio Systems around the world and US, examples of wireless communication systems, Comparison and trends in wireless communication systems, Evolution of 2G/3G/4G/5G Communication Standards.

Cellular Concepts – Frequency reuse, Cochannel and Adjacent channel Interference, C/I, Handoff, Blocking, Erlang Capacity, Improving coverage and capacity in cellular systems.

**Unit 2:** Wireless propagation Part 1: Link budget, Free-space path loss, Noise figure of receiver, Large Scale Propagation effects.

Wireless propagation Part II: Small scale multipath propagation, Multipath fading, Shadowing, Fading margin, shadowing margin, Channel Models.

**Unit 3:** Equalization & Diversity: Introduction, Types of equalization techniques, Diversity Schemes -Antenna Diversity, Time Diversity.

**Unit 4:** Multiple Access Techniques: Introduction, Types of access techniques, Wireless Channel Capacity, Introduction to MIMO.

**Unit 5:** CDMA Part I – PN codes, generation, properties, CDMA Part II, OFDM and LTE Part I OFDM and LTE Part II.

**Course Outcomes:**

- CO1: Understand different technologies used in the evaluation of wireless communication standards.
- CO2: Apply the concepts of frequency reuse, fading channel characteristics, equalization and diversity techniques to find the solutions for a given problem.
- CO3: Analyze the performances of different technologies used in 2G, 3G standards of wireless communication.

- CO4: Solve some complex problems to design receivers due to small scale fading, effects of the channel.
- CO5: Compare various technologies used in different generations of wireless communication to know the merits and demerits of each technology.

**Text Books:**

1. T. S. Rappaport, "Wireless Communications – Principles and Practice" (2nd edition) Pearson, 2010, ISBN 9788131731864
2. A. Molisch, "Wireless Communications," Wiley, 2005 Haykin & Moher, "Modern Wireless Communications" Pearson 2011 (Indian Edition)
3. J. G. Proakis, "Digital Communications," McGraw Hill
4. A. Goldsmith, "Wireless Communications," Cambridge Univ Press, 2005
5. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

**(19A04605b) FABRICATION TECHNIQUES FOR MEMS-BASED SENSORS:  
CLINICAL PERSPECTIVE  
PROFESSIONAL ELECTIVE-II**

**Course Objectives:**

- To be familiar with microengineering devices, clean room, metallic impurities and wafer cleaning process.
- To understand the principles of MEMs based sensors and different technologies used in the fabrication process.
- To know the design process flow for fabricating microengineering devices, Process flow for microheater
- To understand process flow for Fabricating Flexible Force Sensors, Force Sensors on Silicon, and Fabricating VOC sensors,

**Unit 1:** Introduction to microengineering devices and its applications, Clean room, contaminants, wafer cleaning processes (DI water, RCA, metallic impurities, etc.).

**Unit 2:** Introduction to the microheater, force sensors, microfluidic devices, its specifications, and applications, Masks - Types of masks, Types of Photoresists, Spin Coaters Lithography process: optical lithography, x-ray, and e-beam lithography, lift-off techniques, soft lithography, Use of resists (spin coating, positive and negative photoresists), photoresist pre-baking, exposure, and development.

**Unit 3:** Etching: Isotropic/anisotropic, selectivity, wet and plasma assisted etching, Types of wafers and orientations, Techniques of metallization: PVD [(Sputtering – DC, RF, and Magnetron), thermal evaporation, e-beam evaporation], Chemical Vapor Deposition: Dielectric films (Plasma Enhance Chemical Vapor Deposition (PECVD)), Atomic Layer Deposition.

**Unit 4:** Understanding and designing the process flow for fabricating microengineering devices, Process flow for microheater, force sensors, and microfluidic devices, Wafer dicing and bonding techniques, Microfluidic Chips.

**Unit 5:** Process Flow for Fabricating Flexible Force Sensors and Force Sensors on Silicon, Process Flow for Fabricating VOC sensors, Biochips, Clinical Research: Problems and Solutions using Microengineering Device, Visit to non-conventional Class 10000 Clean Room and discussing few equipment within.

**Course Outcomes:**

- **CO1:** Understand the principles of MEMs based sensors, clean room, types of wafers, and different technologies used in the fabrication process.
- **CO2:** Analyze the process flow for Fabricating Flexible Force Sensors, Force Sensors on Silicon, and Fabricating VOC sensors.

- **CO3:** design process flow for fabricating microengineering devices, Process flow for microheater.

### **Books and references**

1. J.D. Plummer, M.D. Deal, P.G. Griffin, Silicon VLSI Technology, Pearson Education, 2001.
2. S.A.Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988
3. Senturia S. D., Microsystem Design, Kluwer Academic Publisher, 2001 Madou, M Fundamentals of Microfabrication, CRC Press, 1997.
4. Gad-el-Hak, M., Ed., The MEMS Handbook; CRC Press: New York, NY, 2002.

(19A04605c) INTEGRATED PHOTONICS DEVICES AND CIRCUITS  
PROFESSIONAL ELECTIVE-II

**Course Objectives:**

- To be familiar with Photonic Integrated Circuits, multimode waveguides, various types of directional couplers, and CMOS Compatible Silicon Photonics Technology.
- To understand the concepts of coupled mode theory, fiber to waveguide converters, and directional couplers.
- To analyze the functionality of multimode waveguides, various types of directional couplers Reconfigurable Filters and Tunable Delay Lines, and FPPGAs.
- To design single mode, multimode waveguides, bends, and photonic crystal waveguides and Integrated Optical High-Speed Modulators.

**Unit 1:** Introduction to Photonic Integrated Circuits – Functional Building Blocks; Theory of Optical Waveguide – The Basic Building Block; Orthogonality Condition of Guided Modes, Introduction to Photonic Integrated Circuits – Functional Building Blocks; Theory of Optical Waveguide – The Basic Building Block; Orthogonality Condition of Guided Modes.

**Unit 2:** Design Principle of Single-Mode and Multimode Waveguides: Channel and Ridge/Rib waveguides, Waveguide Bends; Slot and Photonic Crystal Waveguides, Design Principle of Single-Mode and Multimode Waveguides: Channel and Ridge/Rib waveguides, Waveguide Bends; Slot and Photonic Crystal Waveguides.

**Unit 3:** Coupled Mode Theory; Waveguide Distributed Bragg Reflector (DBR) and Sub-Wavelength Grating (SWG) waveguide; Adiabatic Mode-Size Converter (MSC), Fiber-to-Waveguide, Vertical Grating Coupler (VGC), Coupled Mode Theory; Waveguide Distributed Bragg Reflector (DBR) and Sub-Wavelength Grating (SWG) waveguide; Adiabatic Mode-Size Converter (MSC), Fiber-to-Waveguide Vertical Grating Coupler (VGC).

**Unit 4:** Directional Coupler (DC), Multi-Mode Interferometric Coupler (MMIC). Mach-Zehnder Interferometer (MZI) and Microring Resonator (MRR): Filters and Delay Lines, Directional Coupler (DC), Multi-Mode Interferometric Coupler (MMIC). Mach-Zehnder Interferometer (MZI) and Microring Resonator (MRR): Filters and Delay Lines. Practical Planar Lightwave Circuits and CMOS Compatible Silicon Photonics Technology Platforms; Thermo-Optic and Electro-Optic Switches; Reconfigurable Filters and Tunable Delay Lines, Concept of Field Programmable Photonic Gate Array (FPPGA).

**Unit 5:** Practical Planar Lightwave Circuits and CMOS Compatible Silicon Photonics Technology Platforms; Thermo-Optic and Electro-Optic Switches; Reconfigurable Filters and Tunable Delay Lines, Concept of Field Programmable Photonic Gate Array (FPPGA),

**Course Outcomes:**

- CO1: Get familiarity with Photonic Integrated Circuits, multimode waveguides, various types of directional couplers, and CMOS Compatible Silicon Photonics Technology.
- CO2: Understand the concepts of coupled mode theory, fiber to waveguide converters, and directional couplers.
- CO3: Analyze the functionality of multimode waveguides, various types of directional couplers Reconfigurable Filters and Tunable Delay Lines, and FPPGAs.
- CO4: Design single mode, multimode waveguides, bends, and photonic crystal waveguides and Integrated Optical High-Speed Modulators.

**Books and references**

- 1) Silicon Photonics – An Introduction, G.T. Reed (Wiley)
- 2) Photonics: Optical Electronics for Modern Communication, Yariv and Yeh (Oxford)
- 3) Optoelectronic Integrated Circuit Design and Device Modeling, Jianjun Gao (Wiley)



**(19A04605d) ELECTRICAL MEASUREMENT AND ELECTRONIC  
INSTRUMENTS  
PROFESSIONAL ELECTIVE-II**

**Course Objectives:**

- To remember the basic definitions of some important measurement parameters of electrical and electronic instruments.
- To understand the basic principles of different measuring meters (voltage, current, and other passive parameters), CROs, and transducers.
- To apply the knowledge of DC and AC meters while solving problems related to measurement errors.
- To analyze the performance of various electric and electronic instruments like energy meters, analog & digital meters, CROs, function generators and signal generators.
- To design the AC& DC multi-meters function generators and function generators for the given specifications.

**Unit 1:** Measurement Error, Accuracy and Instrument grades, Electro-mechanical instruments, electromechanical ammeters, voltmeters and ohmmeters.

**Unit 2:** Electromechanical wattmeter and energy meter, Resistance Measurement, Impedance Measurement: AC Bridges, Potentiometers: DC and AC, Instrument transformers: CT & PT.

**Unit 3:** Magnetic Measurement, Analog Instrumentation Basics, Analog Instrumentation, Digital Instrumentation Basics, Digital Instrumentation, Signal and Function Generators, Spectrum Analyzer.

**Unit 4:** Oscilloscope and Electronic probes: Introduction, Block diagram of CRO, Electron beam generation, Deflection Assembly – Horizontal and Vertical amplifiers and associated blocks, Digital CRO, basic principle, types of digital CROs, Probes – types of probes and associated principles.

**Unit 5:** Transducers: Introduction, types of transducers – Strain gauge, LVDT, Inductive and capacitive transducers, electromechanical transducers.

**Course Outcomes:**

- CO1: Remember the basic definitions of some important measurement parameters of electrical and electronic instruments.
- CO2: Understand the basic principles of different measuring meters (voltage, current, and other passive parameters), CROs, and transducers.

- CO3: Apply the knowledge of DC and AC meters while solving problems related to measurement errors.
- CO4: Analyze the performance of various electric and electronic instruments like energy meters, analog & digital meters, CROs, function generators and signal generators.
- CO5: Design the AC& DC multi-meters function generators and function generators for the given specifications.

### **Books and references**

1. Electronic Instrumentation and Measurements: David A. Bell
2. A course in Electrical and Electronic Measurements and Instrumentation: A. K. Sawhney
3. Basic Electrical Measurements: M B Stout
4. Electrical Measurements and Measuring Instruments, E.W Golding, F.C Widdis
5. Electronic Measurements and Instrumentation: William David Cooper.

**(19A04605e) PRINCIPLES AND TECHNIQUES OF MODERN RADAR SYSTEMS**  
**PROFESSIONAL ELECTIVE-II**

**Course Objectives:**

- To understand the basic principles of RADAR and its variants, RADAR based Microwave imaging.
- To apply the fundamental knowledge of various RADARs, Matched Filter and to find the range between the target and RADAR, frequency and phase of the received signal.
- To analyze the received data from the target using CW RADAR & MTI RADAR and to find the distance, tracking range for clutter analysis.

**Unit 1:** Basic Principles: Fundamental elements of Radar and its block diagram, Radar equation – Signal to Noise Power Ratio (SNR), Radar Cross section – Cross sections of small targets, Examples of target cross sections, cross section fluctuations and models.

**Unit 2:** CW Radar – Principle, block diagram, FMCW Radar, Pulsed Radar Principles, Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, range measurement.

**Unit 3:** Tracking in Radar, Frequency measurement and tracking, Angular resolution, Monopulse Technique, Detection Theory: Match Filtering, Radar Ambiguity Function.

**Unit 4:** Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging, Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models.

**Unit 5:** Ground Penetrating Radar for close sensing, Radar Tomography and Radar based Microwave Imaging, Emerging and Modern Applications of Radar Principles.

**Course Outcomes:**

- CO1: Understand the basic principles of RADAR and its variants, RADAR based Microwave imaging.
- CO2: Apply the fundamental knowledge of various RADARs, Matched Filter and to find the range between the target and RADAR, frequency and phase of the received signal.
- CO3: Analyze the received data from the target using CW RADAR & MTI RADAR and to find the distance, tracking range for clutter analysis.

## **Books and references**

1. Introduction to Radar Systems, M.I. Skolnik, 3rdEdition, Tata Mcgraw hill edition, 2001
2. Radar Systems Analysis and Design using MATLAB, B.R.Mahafza, 3rd Edition, CRC Press, 2013.
3. Radar Principles, Peyton Z. Peebles, Jr., Wiley India, 2008.
4. Monopulse Principles and Techniques, S.M.sherman and D.K.Barton, 2ndEdition,Artech house, 2011
5. Fundamentals of Radar Signal Processing, M.A.Richards, TMH, 2005
6. Ground Penetrating Radar: Theory and Applications, Ed: H.M. Jolt, Elsevier, 2009
7. Microwave Imaging, M.Pastorino, John Wiley, 2010

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ECE) – III-II** **L T P C**  
**3 0 0 3**  
**(19A01604a) INDUSTRIAL WASTE AND WASTE WATER MANAGEMENT**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To teach Health and Environment Concerns in waste water management
- To teach material balance and design aspects of the reactors used in waste water treatment.
- To impart knowledge on selection of treatment methods for industrial waste water
- To teach common methods of treatment in different industries
- To provide knowledge on operational problems of common effluent treatment plant

**UNIT –I**

**Industrial water Quantity and Quality requirements:**

Boiler and cooling waters–Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills Selection of source based on quality, quantity and economics. Use of Municipal wastewater in Industries – Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, Elutriation, Removal of Colour, Odour and Taste.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Learn the procedures for assessment of quality of Industrial water
- Suggest different processes of handling waste water

**UNIT –II**

**Basic theories of Industrial Wastewater Management:** Industrial waste survey - Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis -Wastewater characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction – Neutralization and Equalization, Segregation and proportioning- recycling, reuse and resources recovery

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Measure industrial waste water flow
- Characterize waste water
- Suggest techniques for treatment of waste water.

### **UNIT –III**

**Industrial wastewater disposal management:** Discharges into Streams, Lakes and oceans and associated problems, Land treatment - Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand options for waste water disposal.
- Explain functioning of common effluent treatment plants

### **UNIT – IV**

**Process and Treatment of specific Industries-1:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand the character of waste water from Steel plants and refineries
- Suggest suitable waste water treatment techniques

### **UNIT – V**

**Process and Treatment of specific Industries-2:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Pharmaceutical Plants

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand the character of waste water from tanneries and distilleries
- Suggest suitable waste water treatment techniques

### **Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Design treatment methods for any industrial wastewater.
- Examine the manufacturing process of various industries.
- Assess need for common effluent treatment plant for an industry
- Test and analyze BOD, COD, TSS and MPN in waste water.

### **TEXT BOOK**

1. M. N. Rao and A. K. Dutta, “Wastewater Treatment”, Oxford & IBH, New Delhi.
2. K.V. S. G. Murali Krishna, “Industrial Water and Wastewater Management”.

### **REFERENCES**

1. A. D. Patwardhan, “Industrial Wastewater treatment”, PHI Learning, Delhi
2. Metcalf and Eddy Inc., “Wastewater Engineering”, Tata McGraw Hill co., New Delhi.
3. G. L. Karia & R.A. “Christian Wastewater Treatment- Concepts and Design Approach”, Prentice Hall of India.

**(19A01604b) BUILDING SERVICES AND MAINTAINANCE**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To impart knowledge in concepts of building maintenance
- To insists the student to observe various practices of good building maintenance
- To teach the importance safety in buildings
- To demonstrate the use of ventilation in buildings.
- To give the list of different types of machineries in buildings

**UNIT – I**

**PLUMBING SERVICES:** Water supply system- fixing of pipes in buildings – maintenance of buildings- water meters-sanitary fittings-design of building drainage- gas supply systems

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand water supply system
- Understand the building drainage system.

**UNIT – II**

**VENTILATION:** Necessity of ventilation – functional requirements – systems of ventilation-natural ventilation-artificial ventilation-air conditioning-systems of air conditioning-essentials of air conditioning-protection against fire caused by air conditioning systems.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand concepts of ventilation
- Understand concepts of air conditioning

**UNIT – III**

**THERMAL INSULATION:** Heat transfer system-thermal insulating materials-methods of thermal insulation-economics of thermal insulation-thermal insulation of exposed walls, doors, windows and roofs.

**Learning Outcomes:**

At the end of the unit, students will be able to:



- Understand methods of insulation
- Understand materials of insulation

#### **UNIT – IV**

**FIRE SAFETY:** Causes of fire in buildings-fire safety regulations-characteristics of fire resisting materials- fire resistant construction-heat and smoke detectors-fire alarms-fire fighting pump and water storage.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understand safety regulations of fire system
- Know about the implementation and usage of various fire resistant materials in building construction

#### **UNIT – V**

**MACHINERIES IN BUILDINGS:** Lifts-essential requirements-design considerations-escalators-essential requirements-electrical installations in buildings-lighting in buildings-methods of electrical wiring-earthing

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Understanding of different machineries of buildings
- Understanding of electrical installation of buildings

#### **Course Outcomes:**

Student will be able to understand

- Concepts of plumbing, drainage system and gas supply system
- Concepts of ventilation and air conditioning
- Concepts of thermal insulation and economics of thermal insulation
- Concepts of fire safety in buildings and fire resistant construction
- Concepts of different machineries of buildings

#### **TEXT BOOKS:**

1. B.C.Punmia, Er. Ashok K jain, Arun K Jain “Building construction”, Laxmi publications pvt.ltd. New Delhi.
2. Janardhan Jah, S.K Sinha, “Building construction”, Khanna publishers
3. Rangwala, “Building construction”, Charoathar publishing house.

**REFERENCE BOOKS:**

1. David V Chaddrton, "Building services engineering", Outledge
2. P.C Varghees "Building construction", Printice hall india

**(19A02604a) INDUSTRIAL AUTOMATION**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To understand the basic concepts of Automation
- To understand the concepts of automation cycle and hardware components
- To gain knowledge about pneumatic and hydraulic devices
- To understand the concepts of sensors and actuators
- To know the use of Robotics used in industries automation

**UNIT -I:**

**Introduction to Automation**

Definition and fundamentals of automation, reasons for Automating, basic elements of an automated system: Power, Program and control system, safety, maintenance & repair diagnosis, error detection and recovery, Automation principles and strategies: USA principle, strategies of automation and production system, automation migration strategy

**Learning Outcomes:**

At the end of the unit, students will be able to:

- To understand the fundamental concepts of automation and its basic elements
- To understand system safety requirements
- To understand about maintenance and repair strategies
- To know about production system automation

**UNIT- II:**

**Mechanization and Automation**

Basic principles of Mechanization and automation, product cycle, hard Vs flexible automation, Capital- intensive Vs low cost automation. Types of systems-mechanical, electrical, hydraulic, pneumatic and hybrid systems, Automation using CAMS, Geneva mechanisms, gears etc. Assembly line Automation: automated assembly systems, transfer systems, vibratory bowl feeders, non-vibratory feeders, part orienting, feed track, part placing & part escapement systems. Introduction to Material storage/ handling and transport systems, and its automation using AS/RS, AGVS and conveyors etc.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about how to analyse the various automation methods
- To know about assembling and placing of various parts
- To distinguish between mechanization and automation of systems
- To know about material storage, handling and automation using various approaches

### **UNIT -III:**

#### **Pneumatics and hydraulics**

Hydraulic and pneumatic devices-Different types of valves, Actuators and auxiliary elements in Pneumatics & hydraulics , their applications and use of their ISO symbols. Synthesis and design of circuits (up to 3 cylinders)–pneumatic, electro pneumatics and hydraulics. Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- To know design of various pneumatic and hydraulic components
- To understand about synthesis and design of Pneumatic circuits
- To understand about electro pneumatic circuits
- To design using various solenoid valves with and without grouping

### **UNIT -IV:**

#### **Sensors & Actuators Sensors**

Selection of sensors (Displacement, temperature, acceleration, force /pressure) based on static and dynamic characteristics. Interfacing: Concept of interfacing, bit accuracy and sampling speed, amplifying electronics, and microcontroller. Actuators: Principle and selection of electro mechanical actuators (1) DC motors (2) Stepper Motors (3) Solenoid Actuators (4) Servo Motors (5) BLDC

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about selection of sensors and actuators based on dynamic characteristics
- To understand about necessity of interfacing sensors with Microcontroller
- To understand principle and selection of actuators
- To apply various electro mechanical actuators to certain machines

### **UNIT- V:**

#### **Robots and their applications**

Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback

controls: Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications of robots

### **Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about Robots, classification, selection and specifications
- To understand the use of robotics in industrial applications
- To know about various feedback controls of Robot
- To understand how adaptive control strategies can be used in Robots

### **Course Outcomes:**

1. Understand the basic concepts of Industrial automation
2. Design and analysis of automation methods, placing and assembling of various parts
3. Design of various processing and control circuits using pneumatic and hydraulic elements
4. Selection of sensors based on the industrial application
5. Role of robotics in industrial applications

### **TEXT BOOKS:**

1. Stamatis Manesis and George Nikolakopoulos, "Introduction to Industrial Automation", CRC Press, 2018.
2. Frank Lamb, "Industrial Automation", Hands on, Mc Graw Hill Education, 2013.

### **REFERENCES:**

1. Richerd L. Shell and Ernest L. Hall, "Hand Book of Industrial Automation", CRC Press, 2000.

**(19A02604b) SYSTEM RELIABILITY CONCEPTS**  
**(OPEN ELECTIVE-II)**

**Course Objectives:**

To make the students learn about:

- The Basic concepts, rules for combining probabilities of events, failure density and distribution functions.
- Evaluation of network Reliability / Unreliability and types of redundancies.
- Evaluation of network Reliability / Unreliability using conditional probability method.
- Expected value and standard deviation of Exponential distribution and Measures of reliability.
- Evaluation of Limiting State Probabilities of one, two component repairable models.

**UNIT-I:**

**Basic Probability Theory**

Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples

**Learning Outcomes:**

At the end of the unit, students will be able to:

- To know about basic rules for probabilities of events
- To distinguish between pdf and cdf
- Get detailed information about Probability of failure density and distribution functions
- Obtain the expected value and standard deviation for binomial distribution.

**UNIT-II:**

**Network Modeling and Reliability Evaluation**

Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutset based approach – complete event tree and reduced event tree methods - Examples.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- How to find the Probability of success and failures of network using different approaches for series-parallel configurations.
- Classification of redundancies.
- To find reliability / unreliability of complex systems using different methods
- Comparison of approaches to solve probability index of SISO system

### **UNIT-III:**

#### **Time Dependent Probability**

Basic concepts – Reliability functions  $f(t)$ ,  $Q(t)$ ,  $R(t)$ ,  $h(t)$  – Relationship between these functions – Bath tub curve – Exponential failure density and distribution functions - Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems - Evaluation of reliability measure – MTTF for series and parallel systems – Examples.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concepts of time domain functions and relationship between them.
- Obtain the expected value and standard deviation for exponential distribution.
- Obtain the values of probabilistic measures for series and parallel configurations.
- To obtain probabilistic measures for fully redundant and partially redundant configurations

### **UNIT-IV:**

#### **Discrete Markov Chains & Continuous Markov Processes**

**Markov Chains:** Basic concepts – Stochastic transitional Probability matrix – time dependent probability evaluation – Limiting State Probability evaluation – Absorbing states.

**Markov Processes:** Modeling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach - Examples.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concepts of Stochastic Transitional Probability Matrix, Limiting State Probability
- To know about evaluation for one and two component repairable models.
- Understand the concept of Frequency balance approach.

- To distinguish between Markov chains and Markov processes

## **UNIT-V:**

### **Multi Component & Approximate System Reliability Evaluation**

Recursive relation for evaluation of equivalent transitional rates– cumulative probability and cumulative frequency and ‘n’ component repairable model – Series systems, Parallel systems, Basic probability indices – Series, Parallel systems – Complex Systems– Cutset approach – Examples.

#### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concepts of recursive relation for evaluation of equivalent transitional rates.
- Obtain the cumulative probability and cumulative frequency for different systems
- To know about computation of basic probability indices for series, parallel configurations
- To know how to evaluate basic probability indices using cut set approach

#### **Course Outcomes:**

After completing the course, the student should be able to do the following:

- Understand the concepts for combining Probabilities of events, Bernoulli’s trial, and Binomial distribution.
- Network Reliability/Unreliability using conditional probability, path and cutset based approach, complete event tree and reduced event tree methods.
- Understanding Reliability functions and to develop relationship between these functions, expected value and standard deviation of Exponential distribution and measures of reliabilities.
- Analyze the time dependent reliability evaluation of single component repairable model, frequency and duration concepts, Frequency balance approach.
- Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and ‘n’ component repairable model.

#### **Text Books:**

1. Roy Billinton and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Reprinted in India B. S. Publications, 2007.
2. E. Balagurusamy, “Reliability Engineering”, Tata McGraw Hill, 2003.



### **Reference Books:**

1. E. E. Lewis , “Introduction to Reliability Engineering” Wiley Publications.
2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill, 2000.
3. by Ajit Kumar Verma, Srividya Ajit and Durga Rao Karanki, Springer, “Reliability and Safety Engineering” 2<sup>nd</sup> edition, 2016.
4. Rausand and Arnljot Hoyland, “System Reliability Theory Marvin”, Wiley Publications.

(19A03604a) INTRODUCTION TO MECHATRONICS

OPEN ELECTIVE

**Course Objectives:**

- Familiarize the technologies behind modern mechatronic systems.
- Explain fundamentals for the development of fully automated system.
- Develop a robotic or automated systems focusing on the hardware and software integration.
- Demonstrate the development and design of mechatronic system and MEMS.

**UNIT – I**

**Introduction:** Definition of Mechatronics, Need for Mechatronics in Industry, Objectives of mechatronics, mechatronics design process, Mechatronics key elements, mechatronics applications – Computer numerical control (CNC) machines, Tool monitoring systems, Flexible manufacturing system (FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the role of mechatronics in industry.(12)
- Identify the application of mechatronics in automation industry.(13)

**UNIT – II**

**Sensors:** Static characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Classify various types of sensors. (12)
- Choose sensors for particular application. (13)
- Measure different quantity's using sensors. (14)

**UNIT – III**

**Actuators:** Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys, Selection criteria for actuators.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Classify various actuation systems. (I2)
- Choose the criterion for different actuators. (I1)

### **UNIT – IV**

**Microprocessors, Microcontrollers and Programmable Logic Controllers:** Architecture of Microprocessor, Microcontroller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the architecture of microprocessors, microcontrollers and PLC. (L2)
- Formulate various programs using PLC. (L6)

### **UNIT – V**

Design of mechatronics systems, Mechatronics design elements, Traditional mechatronics systems, Embedded systems, Procedure for designing a mechatronic systems.

### **Learning Outcomes:**

At the end of the unit, the student will be able to

- Understanding design of mechatronics . (L2)
- Various Mechatronics systems. (L4)
- Design Aspects of Mechatronic systems. (L2)

### **Course Outcomes**

Upon successful completion of this unit, the student will be able to:

- Explain mechatronics systems in industry. (I2)
- Identify mechatronic systems encountered in practice. (I3)
- Examine the components of a typical mechatronic system. (I4)
- Compare the various techniques used for development of mems. (I4)
- Develop programs using plc. (I6)

### **Text books:**

1. Er R. Rajput, “ A Text book of Mechatronics”, S.Chand,2<sup>nd</sup> edition-2016.
2. James J Allen, “Micro Electro Mechanical Systems Design”, CRC Press Taylor & Francis group, 2005.

**Reference Text books:**

1. WBolton, “Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering”, 3<sup>rd</sup> edition, Pearson Education Press, 2005.
2. Devadas Shetty and Richard A Kolk, “Mechatronic System Design”, 2<sup>nd</sup> edition, Cengage learning, 2010.
3. Clarence W. de Silva, “Mechatronics an Integrated Approach”, CRC Press, 2004.
4. Ganesh S Hedge, “Mechatronics”, Jones & Bartlett Learning, 2010.

(19A03604b) OPTIMIZATION TECHNIQUES THROUGH MATLAB  
OPEN ELECTIVE-II

**Course Objectives**

- Introduce basics of MATLAB
- Familiarize the fundamentals of optimization
- Explain single variable optimization using various methods
- Implement multi variable optimization using various methods
- Train various evolutionary algorithms.

**UNIT -I**

**Introduction to MATLAB:** Overview, MATLAB Preliminaries, Basics of MATLAB, Beyond the Basics of MATLAB, Popular Functions and Commands, Plotting using MATLAB, Optimization with MATLAB.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Write simple codes in MATLAB. (L3)
- Plot the data using MATLAB. (L3)
- Implement optimization models in MATLAB. (L3)

**UNIT -II**

**Introduction to Optimization:** Statement of an optimization problem, Classifications of optimization Problems: Single variable optimization, Multi variable optimization with no constraints, Multi variable optimization with equality constraints, Multi variable optimization with inequality constraints, Convex and Concave programming.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Build optimization problem. (I1)
- Solve various optimization problems(13)
- Compare convex and concave programming (14)

**UNIT -III**

**Single Variable Optimization:** Finite difference method, Central difference method, Runge-Kutta method, interval halving method, golden section method with MATLAB code.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Understand various methods involving single variable optimization. (12)
- Develop codes in matlab for different methods. (13)
- Identify methods for solving a single variable optimization problem. (13)

#### UNIT- IV

**Multi Variable Optimization:** Conjugate gradient method, Newton's method, Powell's method, Fletcher- Reeves method, Hook and Jeeves method, interior penalty function with MATLAB code.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Apply various methods involving multi variable optimization. (12)
- Develop codes in matlab for solving various multi variable optimization problems. (13)
- Choose methods for solving a multi variable optimization problem. (13)

#### UNIT -V

**Evolutionary Algorithms:** Overview, Genetic Algorithms: Basics of Genetic Algorithms, Options in MATLAB, Multi Objective Optimization using Genetic Algorithms, Ant Colony Optimization, Simulated Annealing, Particle Swarm Optimization.

#### Learning Outcomes:

After completion of this unit, students will be able to

- Apply different types of genetic algorithms. (13)
- Model optimization problems using genetic algorithms in matlab. (13)
- Compare different genetic algorithms for performance. (15)

#### Course Outcomes:

After completion of this course the student can be able to

- Use optimization terminology and concepts, and understand how to classify an optimization problem.(14)
- Apply optimization methods to engineering problems.(13)
- Implement optimization algorithms.(13)
- Compare different genetic algorithms. (15)
- Solve multivariable optimization problems. (14)

#### TEXT BOOKS:

1. Rao V.Dukkipati, MATLAB: “An Introduction with Applications”, Anshan, 2010.
2. Achille Messac, “Optimization in practice with MATLAB”, Cambridge University Press, 2015.

3. Jasbir S Arora, "Introduction to optimum design", 2<sup>nd</sup> edition. Elsevier, 2004.

**REFERENCES:**

1. Cesar Perez Lopez, "MATLAB Optimization Techniques", Academic press, Springer publications, 2014.
2. Steven C.Chapra, "Applied Numerical Methods with MATLAB for Engineers and scientists": 4<sup>th</sup> edition, McGraw-Hill Education, 2018.

(19A04604a) **BASICS OF VLSI  
OPEN ELECTIVE-II**

**Course Objectives:**

The objectives of the course are to

- Learn and Understand IC Fabrication process steps required for various MOS circuits
- Understand and Experience VLSI Design Flow
- Learn Transistor-Level CMOS Logic Design
- Understand VLSI Fabrication and Experience CMOS Physical Design
- Learn to Analyze Gate Function and Timing Characteristics

**UNIT – I**

**Introduction:** Introduction to MOS Technology – MOS, PMOS, NMOS, CMOS and BiCMOS technologies, fabrication fundamentals: Oxidation, Lithography, Diffusion, Ionimplantation, Metallization and Encapsulation.

**Basic Electrical Properties:** Basic Electrical Properties of MOS, CMOS and BiCMOS Circuits,  $I_{DS}$ - $V_{DS}$  relationships, MOS transistor threshold Voltage,  $g_m$ ,  $g_{ds}$ , figure of merit  $\omega_0$ , Pass transistor, NMOS inverter, Various pull - ups, Determination of pull-up to pulldown ratio ( $Z_{pu} / Z_{pd}$ ), CMOS Inverter analysis and design, BiCMOS inverters, Latch-up in CMOS circuits.

**Learning Outcomes:**

After completion of this unit, students will be able to

- Demonstrate a clear understanding of CMOS fabrication flow and technology scaling (L2)
- Analyze the electrical properties of MOS and BiCMOS circuits (L3)
- Design MOSFET based logic circuit (L4)

**UNIT – II**

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layouts, Lambda based design rules, Contact cuts, CMOS Lambda based design rules, Layout Diagrams for logic gates, Transistor structures, wires and vias, Scaling of MOS circuits- Scaling models, scaling factors, scaling factors for device parameters, Limitations of Scaling.



### **Learning Outcomes:**

After completion of this unit, students will be able to

- Understand the design rules and layout diagram for logic gates, limitations of scaling (L1)
- Draw the Layout of simple MOS circuit using Lambda based design rules (L2)

### **UNIT – III**

**Gate Level Design and Layout:** Architectural issues, Switch logic networks: Gate logic, Alternate gate circuit: Pseudo-NMOS Dynamic CMOS logic. Basic circuit concepts, Sheet Resistance  $R_s$  and its concept to MOS, Area Capacitance Units, Calculations, The delay unit  $T$ , Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out, Choice of layers

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Apply basic circuit concepts to MOS circuits. (L2)
- Estimate the propagation delays in CMOS circuits (L3).

### **UNIT – IV**

**Subsystem Design:** Subsystem Design, Shifters, Adders, ALUs, Multipliers: Array multiplier, Serial Parallel multiplier, Parity generator, Comparators, Zero/One Detectors, Up/Down Counter, Memory elements: SRAM, DRAM, ROM, Serial Access Memories.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Apply the Lambda based design rules for subsystem design (L2)
- Design of Adders, Multipliers and memories etc (L4)
- Design digital systems using MOS circuits (L4)

### **UNIT – V**

**Semiconductor Integrated Circuit Design:** PLDs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Programmable Logic Array Design Approach.

### **Learning Outcomes:**

After completion of this unit, students will be able to

- Analyze various architectures and device technologies of PLDs (L3)
- Design simple logic circuit using PLA, PAL, FPGA and CPLD. (L4)

**Course Outcomes:**

- Learn the basic fabrication process of MOS transistors, study CMOS inverter circuits, basic circuit concepts such as Sheet Resistance, Area Capacitance and Delay calculation, Field programmable gate arrays and realization techniques, CPLDs and FPGAs for implementing the various logic functions.
- Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality.
- Analyze the performance of CMOS Inverter circuits
- Compare various Scaling models and understand the effect of scaling on device parameters

**TEXT BOOKS:**

1. Kamran Eshraghian, “Essentials of VLSI circuits and systems”, EshraghianDouglasand A. Pucknell, PHI, 2005 Edition
2. Wayne Wolf, “Modern VLSI Design”, 3rd Edition, Pearson Education, 1997.

**REFERENCE BOOKS:**

1. John .P. Uyemura, “CMOS logic circuit Design”, Springer, 2007.
2. Neil H. E Weste, “CMOS VLSI Design – A Circuits and Systems Perspective”, 3<sup>rd</sup> edition, DavidHarris, Ayan Banerjee, Pearson, 2009.

**(19A04604b) PRINCIPLES OF COMMUNICATION SYSTEMS**  
**OPEN ELECTIVE-II**

**Course Objectives:**

- To understand the concept of various modulation schemes and multiplexing.
- To apply the concept of various modulation schemes to solve engineering problems.
- To analyse various modulation schemes.
- To evaluate various modulation scheme in real time applications.

**UNIT-I:**

**Amplitude Modulation**

Introduction to Noise and Fourier Transform. An overview of Electronic Communication Systems. Need for Frequency Translation, Amplitude Modulation: DSB-FC, DSB-SC, SSB-SC and VSB. Frequency Division Multiplexing. Radio Transmitter and Receiver.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of noise, Fourier transform, carrier modulation and frequency division multiplexing (L1).
- Apply the concept of amplitude modulation to solve engineering problems (L2).
- Analyse various amplitude modulation schemes (L3).
- Evaluate various amplitude modulation schemes in real time applications (L3).

**UNIT-II:**

**Angle Modulation**

Angle Modulation, Tone modulated FM Signal, Arbitrary Modulated FM Signal, FM Modulation and Demodulation. Stereophonic FM Broadcasting.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of angle modulation and its components (L1).
- Apply the concept of frequency modulation to solve engineering problems (L2).
- Analyse angle modulation schemes (L3).
- Evaluate frequency modulation scheme in real time applications (L3).

### **UNIT-III:**

#### **Pulse Modulation**

Sampling Theorem: Low pass and Band pass Signals. Pulse Amplitude Modulation and Concept of Time Division Multiplexing. Pulse Width Modulation. Digital Representation of Analog Signals.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of various pulse modulation schemes and time division multiplexing (L1).
- Analyse various pulse modulation schemes (L3).

### **UNIT-IV:**

#### **Digital Modulation**

Binary Amplitude Shift Keying, Binary Phase Shift Keying and QuadraturePhase Shift Keying, Binary Frequency Shift Keying. Regenerative Repeater.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of various digital modulation schemes (L1).
- Analyze various digital modulation schemes (L3).

### **UNIT-V:**

#### **Communication Systems**

Satellite, RADAR, Optical, Mobile and Computer Communication (Block diagram approach only).

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of various communication systems (L1).

Note: The main emphasis is on qualitative treatment. Complex mathematical treatment may be avoided.

#### **Course Outcomes:**

- Understand the concept of various modulation schemes and multiplexing (L1).
- Apply the concept of various modulation schemes to solve engineering problems (L2).
- Analyse various modulation schemes, and evaluate various modulation scheme in real time applications (L3).

**TEXT BOOKS:**

1. Herbert Taub, Donald L Schilling and Goutam Saha, “Principles of Communication Systems”, 3<sup>rd</sup>Edition, Tata McGraw-Hill Publishing Company Ltd., 2008.

**REFERENCES:**

1. B. P. Lathi, Zhi Ding and Hari M. Gupta, “Modern Digital and Analog Communication Systems”, 4<sup>th</sup> Edition, Oxford University Press, 2017.
2. K. Sam Shanmugam “Digital and Analog Communication Systems”, Wiley India Edition, 2008.

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**Blooms’ Learning levels:**

L1: Remembering and Understanding

L2: Applying

L3: Analyzing, Evaluating

(19A05604a) FUNDAMENTALS OF VR/AR/MR

Open Elective-II  
(Common to CSE & IT)

**Course Objectives:**

This course is designed to:

- Explore the history of spatial computing and design interactions
- Understand the foundational principles describing how hardware, computer vision algorithms function
- Learn Virtual reality animation and 3D Art optimization
- Demonstrate Virtual reality
- Introduce to the design of visualization tools

UNIT-I

**How Humans interact with Computers:** Common term definition, introduction, modalities through the ages (pre- 20<sup>th</sup> century, through world war-II, post world war-II, the rise of personal computing, computer miniaturization), why did we just go over all of this?, types of common HCI modalities, new modalities, the current state of modalities for spatial computing devices, current controllers for immersive computing systems, a note on hand tracking and hand pose recognition.

**Designing for our Senses, Not our Devices:** Envisioning a future, sensory technology explained, who are we building this future for?, sensory design, five sensory principles, Adobe's AR story.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Explain common modalities and their pros and cons.(L2)
- Demonstrate Mapping modalities to current industry inputs(L2)
- Explore the importance of design with spatial computing(L5)

UNIT-II

**Virtual Reality for Art:** A more natural way of making 3D art, VR for animation.

**3D art optimization:** Introduction, draw calls, using VR tools for creating 3D art, acquiring 3D models vs making them from scratch.

**How the computer vision that makes augmented reality possible works:** Who are we?, a brief history of AR, how and why to select an AR platform, mapping, platforms, other development considerations, the AR cloud.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Utilize VR tools for creating 3D Animations(L3)
- Analyze how and why to Select an AR Platform(L4)

### UNIT-III

**Virtual reality and augmented reality:** cross platform theory: Why cross platform? The role of game engines, understanding 3D graphics, portability lessons from video game design, simplifying the controller input.

**Virtual reality toolkit:** open source framework for the community: What is VRTK and why people use it?, the history of VRTK, welcome to the steam VR unity toolkit, VRTK v4, the future of VRTK, success of VRTK.

**Three virtual reality and augmented reality development practices:** Developing for virtual reality and augmented reality, handling locomotion, effective use of audio, common interaction paradigms.

#### Learning Outcomes:

At the end of the unit, students will be able to:

- Explain why the design approach should be considered at a holistic high level based on the goal of the experience(L2)
- Build VR solutions using Virtual reality toolkit(L6)
- Interpret the development practices in three Virtual reality and Augmented reality development(L2)

### UNIT-IV

**Data and machine learning visualization design and development in spatial computing:** Introduction, understanding data visualization, principles for data and machine learning visualization design and development in spatial computing, why data and machine learning visualization works in spatial computing, 2D data visualization vs 3D data visualization in spatial computing, interactivity in data visualizations and in spatial computing, animation, failures in data visualization, good data visualization design optimize 3D spaces, data representations, info graphics, and interactions, defining distinctions in data visualization and big data for machine, how to create data visualization: data visualization creation pipeline, webXR, data visualization challenges in XR, data visualization industry use case examples of data visualization, 3D reconstruction and direct manipulation of real world data, data visualization is for everyone, hands on tutorials, how to create data visualization, resources.

#### Learning Outcomes:

At the end of the unit, students will be able to:

- Understand, define, and set data and machine visualization design and development principles in embodied reality(L1)
- Demonstrate best practices, and practical tools to create beautiful and functional data visualizations.(L2)

## UNIT-V

**Character AI and Behaviors:** Introduction, behaviors, current practice: Reactive AI, more intelligence in the system, Deliberative AI, machine learning.

**The virtual and augmented reality health technology ecosystem:** VR/AR health technology application design, standard UX isn't intuitive, tutorial: insight Parkinson's experiment, companies, case studies from leading Academic institutions.

### Learning Outcomes:

At the end of the unit, students will be able to:

- Design a behavioral AI system for a video game(L6)
- Identify issues related to design of virtual reality (VR) and augmented reality (AR) experiences deployed in a health-care context(L3)
- Explain the use of motion data from controllers to reduce the visible tremor of a Parkinson's patient in a virtual environment(L2)

### Course outcomes

Upon completion of the course, the students should be able to:

- Explain how the humans interact with computers (L2)
- Apply technical and creative approaches to make successful applications and experiences. (L3)
- Design audio and video interaction paradigms (L6)
- Design Data visualization tools (L6)
- Apply VR/MR/AR in various fields in industry (L3)

### Text book

1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, "Creating Augmented & Virtual Realities", 1<sup>st</sup> edition, O'REILLY, 2019.

### References

1. Steve Aukstakalnis, "Practical Augmented Reality", Pearson Education, 2017.



**(19A05604b) DATA SCIENCE**  
**Open Elective-II**  
**(Common to CSE & IT)**

**Course Objectives**

This course is designed to:

- Understand the approaches for handling data related problems
- Explore the mathematical concepts required for Data science
- Explain the basic concepts of data science.
- Elucidate various Machine Learning algorithms.
- Introduce Natural Language Processing and Recommender Systems

**UNIT- I**

Introduction to Data Science, A Crash Course in Python, Visualising Data.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Describe the importance of data analysis (L1).
- Identify the key connectors of Data Science (L4).
- Interpret and Visualize the data using bar charts, line charts and scatter plots (L3).

**UNIT-II**

Linear Algebra, Statistics, Probability, Hypothesis and Inference, Gradient Descent.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Identify the Correlation between two vectors (L4).
- Test a given hypothesis (L3).
- Compute mean, median and mode for the given data (L3).

**UNIT-III**

Getting Data, Working with Data, Machine Learning, k-Nearest Neighbors, Naïve Bayes.

**Learning Outcomes:**

At the end of the unit, students will be able to:

- Compute dimensionality reduction using PCA (L3).

- Differentiate supervised and unsupervised learning methods (L4).
- Describe overfitting, under fitting, bias, variance and goodness of learning (L1).
- Solve classification problem using k-nearest neighbour classifier (L3).
- Apply Naïve Bayes classifier to solve decision making problem (L3).

#### **UNIT-IV**

Simple Linear Regression, Multiple Regression, Logistic Regression, Decision Trees, Neural Networks.

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Describe gradient descent approach, maximum likelihood estimation and method of least squares (L1).
- Apply SVM to determine a hyperplane with maximum margin (L3).
- Determine decision tree for given data (L5).
- Describe Perceptron and Back Propagation (L3).

#### **UNIT-V**

Clustering, Natural Language Processing, Network Analysis, Recommender Systems.

Database and SQL, MapReduce

#### **Learning Outcomes:**

At the end of the unit, students will be able to:

- Determine Clusters in data using k-means and Hierarchical Clustering methods (L5).
- Apply basic SQL Operations using NotQuiteABase (L3).
- Compare User-Based and Item-Based Collaborative Filtering (L2).
- Describe Grammer and MapReduce (L1).

#### **Course Outcomes:**

After completion of this course the student would be able to

- Visualize the data using bar charts, line charts and scatter plots (L4).
- Analyse Correlation between two data objects (L4).
- Demonstrate feature selection and dimensionality reduction.(L2)
- Solve decision making problems using k-NN, Naïve Bayes, SVM and Decision. Trees (L3).
- Determine Clusters in data using k-means and Hierarchical Clustering methods (L3).
- Design basic SQL Operations using NotQuiteABase (L6)
- Demonstrate the way to use machine learning algorithms using python. (L2)

**Text Books:**

1. Data Science from Scratch, First Principles with Python - Joel Grus, O'Reilly, First Edition.

**Reference Books:**

1. The Data Science Handbook, Field Cady, WILEY.
2. An Introduction to Data Science, Jeffrey M. Stanton, Jeffrey Stanton, 2012

**(19A27604a) FOOD TOXICOLOGY**  
**OPEN ELECTIVE II**

**PREAMBLE**

This text covers about toxins and their relation in food. Examination, identification and prevention of toxins.

**Course Objectives**

- To know the various toxins and their evaluation.
- To understand their tolerance and control measures.

**UNIT – I**

Principles of Toxicology: classification of toxic agents; characteristics of exposure; spectrum of undesirable effects; interaction and tolerance; biotransformation and mechanisms of toxicity. Evaluation of toxicity: risk vs. benefit: experimental design and evaluation: prospective and retrospective studies: Controls :Statistics (descriptive, inferential): animal models as predictors of human toxicity: Legal requirements and specific screening methods: LD50 and TD50: in vitro and in vitro studies; clinical trials.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Classification of toxic agents; characteristics of exposure;
- Spectrum of undesirable effects; interaction and tolerance; biotransformation and mechanisms of toxicity.
- Evaluation of toxicity: risk vs. benefit: experimental design and evaluation:
- Prospective and retrospective studies: Controls: Statistics (descriptive, inferential): animal models as predictors of human toxicity:
- Legal requirements and specific screening methods: LD50 and TD50: in vitro and in vitro studies; clinical trials.

**UNIT – II**

Natural toxins in food: natural toxins of importance in food- toxins of plant and animal origin; microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins), natural occurrence, toxicity and significance, determination of toxicants in foods and their management.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Natural toxins in food: natural toxins of importance in food- toxins of plant and animal origin
- Microbial toxins (e.g., bacterial toxins, fungal toxins and algal toxins), natural occurrence, toxicity and significance
- Determination of toxicants in foods and their management

### **UNIT – III**

Food allergies and sensitivities: natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies; food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions); Safety of genetically modified food: potential toxicity and allergenicity of GM foods. Safety of children consumables.

#### **Learning outcomes:**

At the end of unit, students will be able to understand the following

- Natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies
- Food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions)
- Potential toxicity and allergenicity of gm foods. Safety of children consumables.

### **UNIT – IV**

Environmental contaminants and drug residues in food: fungicide and pesticide residues in foods; heavy metal and their health impacts; use of veterinary drugs (e.g. Malachite green in fish and  $\beta$ - agonists in pork); other contaminants in food, radioactive contamination of food, Food adulteration and potential toxicity of food adulterants.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Fungicide and pesticide residues in foods; heavy metal and their health impacts
- Use of veterinary drugs (e.g. Malachite green in fish and  $\beta$ - agonists in pork); other contaminants in food, radioactive contamination of food
- Food adulteration and potential toxicity of food adulterants.

### **UNIT – V**

Food additives and toxicants added or formed during food processing: safety of food additives; toxicological evaluation of food additives; food processing generated toxicants: nitroso-compounds, heterocyclic amines, dietary Supplements and toxicity related to dose: common dietary supplements; relevance of the dose; possible toxic effects.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Safety of food additives; toxicological evaluation of food additives;
- Nitroso-compounds, heterocyclic amines, dietary supplements and toxicity related to dose
- Common dietary supplements; relevance of the dose; possible toxic effects.

### **Course Outcomes**

By the end of course

- Student will gain knowledge on principles of toxicity and characteristics of toxins and their classification. Examination and prevention of toxins in foods and etc.

### **TEXT BOOKS**

1. Helferich, W., and Winter, C.K “Food Toxicology”,. CRC Press, LLC. Boca Raton, FL. 2007.
2. Shibamoto, T., and Bjeldanes, L. “Introduction to Food Toxicology”, 2009, 2<sup>nd</sup> Edition. Elsevier Inc., Burlington, MA.
3. Watson, D.H. “Natural Toxicants in Food”, CRC Press, LLC. Boca Raton, FL1998.

### **REFERENCES**

1. Duffus, J.H., and Worth, H.G. J. “Fundamental Toxicology”, The Royal Society of Chemistry. 2006.
2. Stine, K.E., and Brown, T.M. “Principles of Toxicology”, 2<sup>nd</sup> Edition. CRC Press. 2006.
3. Tönu, P. “Principles of Food Toxicology”. CRC Press, LLC. Boca Raton, FL. 2007.

**(19A27604b) FOOD PLANT EQUIPMENT DESIGN**  
**OPEN ELECTIVE - II**

**PREAMBLE**

This text focuses on materials used for food plant equipment and factors considered for design of various equipment.

**Course Objectives:**

- To understand the material properties and codes used.
- To know the design considerations.
- To study the design of evaporators, dryers, crystallizers and etc.

**UNIT – I**

Materials and properties: Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes. Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings
- Corrosion prevention linings equipment, choice of materials, material codes
- Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor
- Temperature effects, radiation effects, effects of fabrication method, economic considerations

**UNIT – II**

Design of pressure and storage vessels: Operating conditions, design conditions and stress; Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories. Design of heat exchangers: Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of pressure and storage vessels includes operating conditions, design conditions and stress
- Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories
- Design of heat exchangers like shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort

### **UNIT – III**

Design of evaporators and crystallizers: Design of single effect and multiple effect evaporators and its components; Design of rising film and falling film evaporators and feeding arrangements for evaporators; Design of crystallizer and entrainment separator

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of evaporators like single effect and multiple effect evaporators and its components; rising film and falling film evaporators and feeding arrangements for evaporators;
- Design of crystallizer and entrainment separator

### **UNIT – IV**

Design of agitators and separators: Design of agitators and baffles; Design of agitation system components and drive for agitation. Design of centrifuge separator; Design of equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems. Design of freezing equipment: Design of ice-ream freezers and refrigerated display system

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of agitators and baffles like Design of agitation system components and drive for agitation.
- Design of centrifuge separator like equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems.
- Design of freezing equipment like ice-ream freezers and refrigerated display system



## **UNIT – V**

Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer. Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder. Design of fermenters: Design of fermenter vessel, design problems

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Design of dryers like tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer
- Design of extruders like Cold and hot extruder design, design of screw and barrel, design of twin screw extruder.
- Design of fermenter vessel, design problems

### **Course Outcomes**

By the end of the course, the students will

- acquires knowledge on theoretical aspects to be design considerations for a food plant equipment and designing of evaporators, separators, storage vessels and etc.

### **TEXT BOOKS**

1. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas, “Food plant design”, CRC press 2005.
2. George D. Saravacos and Zacharias B. Maroulis, “Food Plant Economics”, CRC Press 2007.

### **REFERENCES**

1. Peters M., Timmerhaus K. & Ronald W., “Plant Design & Economics for Chemical Engineers”, McGraw Hill.
2. James R Couper, “Process Engg. Economics (Chemical Industries) CRC Press 3. Aries & Newton, Chemical Engg. Cost Estimation”, McGraw Hill.

**(19A54604a) WAVELET TRANSFORMS AND ITS APPLICATIONS**

**OPEN ELECTIVE-II**

**Course Objective:**

This course provides the students to understand Wavelet transforms and its applications.

**UNIT-I-**

**Wavelets**

Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets -effectiveness of Wavelet Analysis -The Discrete Wavelet Transform The Discrete-Time and Continuous Wavelet Transforms.

**Learning Outcomes:**

Students will be able to

- Understand wavelets and wavelet expansion systems.
- Find wavelet transforms in continuous as well as discrete domains.

**UNIT-II-**

**A Multiresolution Formulation of Wavelet Systems**

Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

**Learning Outcomes:**

Students will be able to

- Illustrate the multi resolution analysis, scaling function.
- Implement parseval theorem.

**UNIT-III-**

**Filter Banks and the Discrete Wavelet Transform :** Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - - Different Points of View.

**Learning Outcomes:**

Students will be able to

- Form fine scale to coarse scale analysis.
- Perform decimating synthesis.
- Find the lattices and lifting.

#### **UNIT-IV**

Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

#### **Learning Outcomes:**

Students will be able to

- Perform multi resolution versus time frequency analysis.
- Perform numerical complexity of discrete wavelet transforms.

#### **UNIT-V**

Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

#### **Learning Outcomes:**

Students will be able to

- Understand the orthogonal bases and Biorthogonal Bases.
- Find the Frames and Tight Frames using Fourier series.

#### **Course Outcomes:**

After the completion of course, students will be able to

- Understand wavelets and wavelet expansion systems.
- Illustrate the multi resolution analysis and scaling functions.
- Form fine scale to coarse scale analysis.
- Find the lattices and lifting.
- Perform numerical complexity of discrete wavelet transforms.
- Find the frames and tight frames using fourier series.

#### **TEXT BOOKS:**

1. C. Sidney Burrus, Ramesh A. Gopinath, "Introduction to Wavelets and Wavelets Transforms", Prentice Hall, (1997).
2. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999).

#### **REFERENCE BOOKS:**

1. Raghuveer Rao, "Wavelet Transforms", Pearson Education, Asia.

**(19A52604a) SOFT SKILLS**  
**(OPEN ELECTIVE-II)**

**Course Objectives**

- To develop awareness in students of the relevance and importance of soft skills
- To provide students with interactive practice sessions to make them internalize soft skills
- To develop Time management, Positive thinking & Decision making skills
- To enable to manage stress effectively
- To enable them to develop employability skills

**SYLLABUS**

**UNIT – I**

**INTRODUCTION**

Definition – Scope – Importance- – Methods of improving soft skills – Limits- Analysis – Interpersonal and intrapersonal skills - Verbal and Non-verbal skills.

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of soft skills
- Identify the methods of improving soft skills
- Analyze various soft skills in different situations
- Distinguish various soft skills
- Apply various soft skills in day to day life and in workplace

**UNIT – II INTRAPERSONAL SKILLS**

Knowing self/temperaments/traits - Johari windows – quotient skills(IQ, EQ, SQ), creativity, decision-making-Attitude – Confidence Building - Positive Thinking –Time Management – Goal setting.

**Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand self and its temperament.
- Apply various techniques to know the self.

- Develop positive thinking
- Develop creative thinking and decision-making skills
- Apply self-knowing tools in day to day and professional life.

### **UNIT – III**

#### **INTERPERSONAL SKILLS**

Leadership Skills – Negotiation skills – Team-building – Crisis Management – Event Management – Ethics and Etiquettes.

#### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of interpersonal skills
- Analyze various tactics in negotiation skills.
- Develop team building spirit.
- Develop crisis management
- Apply interpersonal skills through etiquettes.

### **UNIT – IV**

#### **VERBAL SKILLS**

Importance of verbal skills in corporate climate, Listening skills –Mother Tongue Influence (MTI) - Speaking skills – Public speaking - Oral presentations - Writing skills –E-mail etiquettes – Memos - Indianism

#### **Learning Outcomes:**

At the end of the module, the learners will be able to

- Understand the importance of verbal skills in corporate climate.
- Explain the need of listening skills.
- Explore MTI and suggest remedies to avoid it.
- Interpret various contexts of speaking.
- Apply verbal skills in personal and professional life.

### **UNIT – V NON-VERBAL SKILLS**

Importance of body language in corporate culture – body language-Facial expressions – eye contact – posture – gestures – Proxemics – Haptics – Dress Code – Paralanguage –Tone, pitch, pause& selection of words

## **Learning Outcomes:**

At the end of the module, the learners will be able to

- Comprehend the importance of non-verbal communication.
- Expound the need of facial expressions, postures and gestures.
- Analyze proxemics, haptics etc.
- Understand the importance of dress code.
- Apply various techniques to use para language

## **Course Outcomes**

- Recognize the importance of verbal and non verbal skills
- Develop the interpersonal and intrapersonal skills
- Apply the knowledge in setting the SMART goals and achieve the set goals
- Analyze difficult situations and solve the problems in stress-free environment
- Create trust among people and develop employability skills

## **Text Books**

1. Meenakshi Raman & Shalini Upadhyay “ Soft Skills”, Cengage Learning, 2018.
2. S. Balasubramaniam, “Soft Skills for Interpersonal Communication”, Orient Black Swan, 2017.

## **References**

1. Barun K. Mitra, “Personality Development and Soft Skills”, –OXFORD Higher Education 2018.
2. Alka Wadkar, “Life Skills for Success “, Sage Publications 2016.
3. Robert M Sheffield, “Developing Soft Skills”, Pearson, 2010.
4. Diana Booher, “Communicate With Confidence”, Tata McGrawhill, 2012.

**(19A51604a) CHEMISTRY OF POLYMERS AND ITS APPLICATIONS**

**Course Objectives:**

- To understand the basic principles of polymers
- To synthesize the different polymeric materials and their characterization by various instrumental methods.
- To impart knowledge to the students about fundamental concepts of Hydro gels of polymer networks, surface phenomenon by micelles
- To enumerate the applications of polymers in engineering

**Unit – I : Polymers-Basics and Characterization**

Basic concepts: monomers, repeat units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: condensation, addition, radical chain, ionic and coordination and copolymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution Measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Classify the polymers (L3)
- Explain polymerization mechanism (L2)
- Differentiate addition, condensation polymerizations (L2)
- Describe measurement of molecular weight of polymer (L2)

**Unit – II : Synthetic Polymers**

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization.

Preparation and significance, classification of polymers based on physical properties, Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications.

Preparation of Polymers based on different types of monomers, Olefin polymers, Diene polymers, nylons, Urea - formaldehyde, phenol - formaldehyde and melamine Epoxy and Ion exchange resins. Characterization of polymers by IR, NMR, XRD.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Differentiate Bulk, solution, Suspension and emulsion polymerization (L2)
- Describe fibers and elastomers (L2)
- Identify the thermosetting and thermo polymers (L3)
- Characterize the properties of polymers by IR, NMR, XRD etc.,

### **Unit – III : Natural Polymers & Modified cellulotics**

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulotics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEAK.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe the properties and applications of polymers (L2)
- Interpret the properties of cellulose, lignin, starch, rosin, latex etc., (L2)
- Discuss the special plastics of PES, PAES, PEEK etc., (L3)
- Explain modified cellulotics (L2)

### **Unit-IV: Hydrogels of Polymer networks and Drug delivery**

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, **Applications** of hydrogels in drug delivery.

Introduction to drug systems including, drug development, regulation, absorption and disposition, routes of administration and dosage forms. Advanced drug delivery systems and controlled release.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Identify types of polymer networks (L3)
- Describe methods involve in hydrogel preparation (L2)
- Explain applications of hydrogels in drug delivery (L2)
- Demonstrate the advanced drug delivery systems and controlled release (L2)



## **Unit – V : Surface phenomena**

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Demonstrate electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles etc., (L2)
- Explain photoelectron spectroscopy (L2)
- Discuss ESCA and Auger spectroscopy to the study of surfaces (L3)
- Differentiate micelles and reverse micelles (L2)

### **Course Outcomes**

At the end of the course, the student will be able to:

- Understand the state of art synthesis of Polymeric materials
- Understand the hydro gels preparation, properties and applications in drug delivery system.
- Characterize polymers materials using IR, NMR, XRD.
- Analyze surface phenomenon fo micelles and characterise using photoelectron spectroscopy, ESCA and Auger spectroscopy.

### **References :**

1. A Text book of Polymer science, Billmayer
2. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B.Miller, Prentice Hall
4. Polymer Chemistry – G.S.Mishra
5. Polymer Chemistry – Gowarikar
6. Physical Chemistry –Galston
7. Drug Delivery- Ashim K. Misra

**HUMANITIES ELECTIVE-I**

**(19A52602a) ENTREPRENEURSHIP & INCUBATION**

**COURSE OBJECTIVES :**

The objective of this course is

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
- To facilitate the student in knowing various sources of finance in starting up of a business
- To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

**Syllabus**

**UNIT-I**

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

**Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand the concept of Entrepreneur and Entrepreneurship in India
- Know Entrepreneurship process and emergence of Entrepreneurship
- Analyze the differences between Entrepreneur and Intrapreneur
- Develop a creative mind set and personality
- Understand recent trends in Entrepreneurship across the globe

**UNIT-II**

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the process of starting a new venture
- Analyze the sources of new methods in generating business idea
- Evaluate market feasibility, financial feasibility and technical feasibility
- Design and draw business plans in project preparation and prepare project reports

### **UNIT-III**

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the various sources of finance to start a new venture
- Contrast & compare between Long term & Short term finance sources
- Analyze the role of banks and other financial institutions in promoting entrepreneurship in India
- Evaluate the need and importance of MSMEs in the growth of country

### **UNIT-IV**

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand the role of government in promoting women entrepreneurship
- Know various incentives, subsidies and grants available to women entrepreneurs
- Analyze the role of export-oriented units
- Know about the tax concessions available for Women entrepreneurs
- Prepare to face the issues and challenges.

## **UNIT-V**

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence the Type/benefits of incubators - Corporate/educational / institutional incubators - Broader business incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure - Value proposition

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to:

- Understand the importance of business incubation
- Apply brilliant ideas in the process of business incubation
- Analyze the process of business incubation/incubators.
- Contrast & Compare between business incubation and business incubators.
- Design their own business incubation/incubators as viable-business unit.

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand the concept of Entrepreneurship and challenges in the world of competition.
- Apply the Knowledge in generating ideas for New Ventures.
- Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
- Evaluate the role of central government and state government in promoting Entrepreneurship.
- Create and design business plan structure through incubations.

## **TEXT BOOKS**

1. D F Kuratko and T V Rao, “Entrepreneurship” - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit : [login.cengage.com](http://login.cengage.com))
- 2 . Nandan H, “ Fundamentals of Entrepreneurship”, PHI, 2013

## **REFERENCES**

1. Vasant Desai, “Small Scale Industries and Entrepreneurship”, Himalaya Publishing 2012.
2. Rajeev Roy “Entrepreneurship”, 2<sup>nd</sup> Edition, Oxford, 2012.
3. B.Janakiramand M.Rizwanall “Entrepreneurship Development: Text & Cases”, Excel Books, 2011.
4. Stuart Read, Effectual “Entrepreneurship”, Routledge, 2013.

## **E-RESOURCES**

1. Entrepreneurship-Through-the-Lens-of-enture Capital
2. <http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship>
3. [http://nptel.ac.in/courses/122106032/Pdf/7\\_4.pdf](http://nptel.ac.in/courses/122106032/Pdf/7_4.pdf)
4. <http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurhip/50>

**Course Objectives :**

The objective of this course is

- To inculcate the basic knowledge of micro economics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To know the various types of Market Structures & pricing methods and its strategies
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on Accounting and to explain the process of preparing Financial statements

**Syllabus**

**UNIT I -**

**INTRODUCTION TO MANAGERIAL ECONOMICS DEMAND**

Managerial Economics – Definition – Nature & Scope - Contemporary importance of Managerial Economics - Demand Analysis - Concept of Demand - Demand Function - Law of Demand - Elasticity of Demand - Significance - Types of Elasticity - Measurement of Elasticity of Demand - Demand Forecasting - Factors governing Demand Forecasting - Methods of Demand Forecasting - Relationship of Managerial Economics with Financial Accounting and Management.

**Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the nature and scope of Managerial Economics and its importance
- Understand the concept of demand and its determinants
- Analyze the Elasticity and degree of elasticity
- Evaluate Demand forecasting methods
- Design the process of demand estimation for different types of demand

**UNIT -II**

**THEORY OF PRODUCTION AND COST ANALYSIS**

**Production Function** – Least-cost combination - Short-run and Long-run Production Function - Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns -

Internal and External Economies of scale – **Cost & Break Even Analysis** - Cost concepts and Cost behavior - Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems) - Managerial significance and limitations of Break-Even Analysis.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the production function, Input-Output relationship and different cost concepts
- Apply the least-cost combination of inputs
- Analyze the behavior of various cost concepts
- Evaluate BEA for real time business decisions
- Develop profit appropriation for different levels of business activity

## **UNIT –III**

### **INTRODUCTION TO FORMS OF BUSINESS ORGANIZATIONS AND MARKETS**

**Market structures** - Forms of Business Organizations - Sole Proprietorship - Partnership - Joint Stock Companies - Public Sector Enterprises-Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition – Monopoly - Monopolistic Competition – Oligopoly - Price-Output Determination - Pricing Methods and Strategies.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the structure of markets, features of different markets and forms of business organizations
- Apply the price output relationship in different markets
- Analyze the optimum output levels to maximize profit in different markets
- Evaluate price-output relationship to optimize cost, revenue and profit
- Interpret Pricing Methods and Strategies

## **UNIT -IV**

**CAPITAL AND CAPITAL BUDGETING** Concept of Capital - Significance - Types of Capital - Components of Working Capital - Sources of Short-term and Long-term Capital - Estimating Working capital requirements – Cash Budget - **Capital Budgeting** – Features of Capital Budgeting Proposals – Methods and Evaluation of Capital Budgeting Projects – Pay Back Method – Accounting Rate of Return (ARR) – Net Present Value (NPV) – Internal Rate Return (IRR) Method (simple problems)

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Know the concept of capital budgeting and its importance in business
- Contrast and compare different investment appraisal methods
- Analyze the process of selection of investment alternatives using different appraisal methods

- Evaluate methods of capital budgeting for investment decision making and for maximizing returns
- Design different investment appraisals and make wise investments

## UNIT –V

### INTRODUCTION TO FINANCIAL ACCOUNTING AND ANALYSIS

Accounting Concepts and Conventions - Introduction Double-Entry Book Keeping, Journal, Ledger, Trial Balance - Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). *Financial Analysis* - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

#### Learning Outcomes:

At the end of the Unit, the learners will be able to

- Know the concept, convention and significance of accounting
- Apply the fundamental knowledge of accounting while posting the journal entries
- Analyze the process and preparation of final accounts and financial ratios
- Evaluate the financial performance of an enterprise by using financial statements

#### Data Books Required:

Present Value Factors table

#### Course Outcomes:

At the end of the course, students will be able to

- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets
- Apply concepts of production, cost and revenues for effective business decisions
- Students can analyze how to invest their capital and maximize returns
- Evaluate the capital budgeting techniques
- Prepare the accounting statements and evaluate the financial performance of business entity.

#### TEXT BOOKS:

1. Varshney & Maheswari: “Managerial Economics”, Sultan Chand, 2013.
2. Aryasri: “Business Economics and Financial Analysis”, 4<sup>th</sup> edition, MGH, 2019

#### REFERENCES:

1. Ahuja Hl “Managerial economics” 3<sup>rd</sup> edition, Schand, 2013
2. S.A. Siddiqui and A.S. Siddiqui: “Managerial Economics and Financial Analysis”, New Age International,. 2013.



3. Joseph G. Nellis and David Parker: "Principles of Business Economics", 2<sup>nd</sup> edition, Pearson, New Delhi.
4. Domnick Salvatore: "Managerial Economics in a Global Economy", Cengage, 2013.

**(19A52602c) BUSINESS ETHICS AND CORPORATE GOVERNANCE**

**Course Objectives :**

The objectives of this course are

- To make the student understand the principles of business ethics
- To enable them in knowing the ethics in management
- To facilitate the student role in corporate culture
- Impart knowledge about the fair trade practices
- Encourage the student in knowing them about the corporate governance

**Syllabus**

**BUSINESS ETHICS AND CORPORATE GOVERNANCE**

**UNIT -I**

**Introduction** – Meaning - Nature and Scope – Loyalty and Ethical Behaviour, Values across Cultures; Business Ethics – Ethical Practices in Management. Types of Ethics – Characteristics – Factors influencing , Business Ethics – Importance of Business Ethics - Arguments for and against business ethics Basics of business ethics Corporate Social Responsibility – Issues of Management – Crisis Management

**Learning Outcomes:**

After completion of this unit student will

- Understand the meaning of loyalty and ethical Behavior
- Explain various types of Ethics
- Know about the factors influencing business ethics
- Understand the corporate social responsibility of management

**UNIT –II**

**ETHICS IN MANAGEMENT**

Introduction – Ethics in HRM – Marketing Ethics – Ethical aspects of Financial Management- Technology Ethics and Professional ethics. The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures, Culture and Individual Ethics.

**Learning Outcomes:**

After completion of this unit student will

- Understand the meaning of Marketing Ethics
- Analyze Differentiate between Technical ethics and professional ethics
- Know about the ethical value system
- Understand the Code and culture

### **UNIT-III**

#### **ROLE OF CORPORATE CULTURE IN BUSINESS**

Meaning – Functions – Impact of corporate culture – cross cultural issues in ethics, Emotional Honesty – Value of humility – Promote happiness – karma yoga – proactive – flexibility and purity of mind. The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures, Culture and Individual Ethics.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the corporate culture in business
- Analyze Ethical Value System Know about the ethical value system
- Know Universalism, Utilitarianism, Distributive Justice
- Differentiate Ethical Values in different Cultures

### **UNIT- IV**

Law and Ethics – Relationship between Law and Ethics, Other Bodies in enforcing Ethical Business Behavior, Impact of Laws on Business Ethics; Social Responsibilities of Business – Environmental Protection, Fair Trade Practices, Fulfilling all National obligations under various Laws, Safeguarding Health and wellbeing of Customers.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand Law and Ethics
- Analyze Social Responsibilities of Business
- Know Environmental Protection and Fair Trade Practices
- Implementing National Safeguarding Health and wellbeing of Customers

### **UNIT –V**

#### **CORPORATE GOVERNANCE**

Meaning – scope - Issues, need, corporate governance code, transparency & disclosure, role of auditors, board of directors and shareholders; Global issues of governance, accounting and regulatory frame work, corporate scams, committees in India and abroad, corporate social responsibility composition of BODs - Cadbury Committee - various committees - reports on corporate governance - Benefits and Limitations

of Corporate Governance with living examples.

### **Learning Outcomes:**

After completion of this unit student will

- Understand corporate governance code
- Analyze role of auditors, board of directors and shareholders
- Know accounting and regulatory frame work
- Implementing corporate social responsibility

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand business ethics and ethical practices in management.
- Understand the role of ethics in management
- Apply the knowledge in cross cultural ethics
- Analyze law and ethics
- Evaluate corporate governance

### **TEXT BOOKS:**

1. Murthy CSV: “Business Ethics and Corporate Governance”, HPH
2. Bholanath Dutta, S.K. Podder – “Corporation Governance”, VBH.

### **REFERENCE BOOKS:**

1. Dr. K. Nirmala, KarunakaraReaddy : “Business Ethics and Corporate Governance”, HPH
2. H.R.Machiraju: “Corporate Governance”
3. K. Venkataramana, “Corporate Governance”, SHBP.
4. N.M.Khandelwal : “Indian Ethos and Values for Managers”

**(19A52602d) ENTERPRISE RESOURCE PLANNING**

**Course Objectives :**

The objectives of this course are

- To provide a contemporary and forward-looking on the theory and practice of
- Enterprise Resource Planning
- To enable the students in knowing the Advantages of ERP
- To train the students to develop the basic understanding of how ERP enriches the
- Business organizations in achieving a multidimensional growth.
- Impart knowledge about the historical background of BPR
- To aim at preparing the students, technologically competitive and make them ready to self-upgrade with the higher technical skills.

**Syllabus**

**UNIT-I**

**Introduction to ERP:** Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM),

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of ERP
- Explain various Business modeling
- Know the contemporary technology like SCM, CRM
- Understand the OLAP

**UNIT-II**

**Benefits of ERP:** Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

**Learning Outcomes:**

After completion of this unit student will

- Understand the Advantages of ERP
- Explain the challenges associated with ERP System
- Analyze better customer satisfaction
- Differentiate Improved Information Accuracy and Design-making Capability

### **UNIT-III**

**ERP Implementation Lifecycle:** Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the implementation of ERP life cycle
- Explain the challenges associated with implementing ERP system
- Analyze the need of re-engineering
- Know the recent trends in team training testing and go-live

### **UNIT-IV**

**BPR:** Historical background: Nature, significance and rationale of business process reengineering (BPR), Fundamentals of BPR. Major issues in process redesign: Business vision and process objectives, Processes to be redesigned, Measuring existing processes,

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the business process reengineering
- Explain the challenges associated with BPR
- Analyze the need of process redesign
- Differentiate between process to be redesign and measuring existing process

### **UNIT-V**

**IT in ERP:** Role of information technology (IT) and identifying IT levers. Designing and building a prototype of the new process: BPR phases, Relationship between BPR phases. MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the role of IT
- Explain the challenges in Designing and building a prototype of the new process

- Analyze the need of MIS
- Differentiate between DSS and EIS

**Course outcomes:**

At the end of the course, students will be able to

- Understand the basic use of ERP Package and its role in integrating business functions.
- Explain the challenges of ERP system in the organization
- Apply the knowledge in implementing ERP system for business
- Evaluate the role of IT in taking decisions with MIS
- Create reengineered business processes with process redesign

**TEXT BOOKS:**

1. Pankaj Sharma. “Enterprise Resource Planning”. Aph Publishing Corporation, New Delhi, 2004.
2. Alexis Leon, “Enterprise Resource Planning”, IV Edition, Mc.Graw Hill, 2019

**REFERENCE BOOKS:**

1. Marianne Bradford “Modern ERP”, 3<sup>rd</sup> edition.
2. “ERP making it happen Thomas f. Wallace and Michael
3. Directing the ERP Implementation Michael w pelphrey

(19A52602e) SUPPLY CHAIN MANAGEMENT

**Course Objectives :**

The objectives of this course are

- To provide Knowledge on logistics and supply chain management
- To enable them in designing the distribution network
- To train the students in knowing the supply chain Analysis
- Impart knowledge on Dimensions of logistic
- To know the recent trends in supply chain management

**Syllabus**

**UNIT-1**

**Introduction to Supply Chain Management**

Supply chain - objectives - importance - decision phases - process view -competitive and supply chain strategies - achieving strategic fit – supply chain drivers - obstacles – framework - facilities -inventory-transportation-information-sourcing-pricing.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the meaning and objectives of supply chain management
- Explain supply chain drivers
- Know the steps involved in SCM frame work
- Understand transportation information and pricing

**UNIT-2**

**Designing the distribution network**

Role of distribution - factors influencing distribution - design options - e-business and its impact – distribution networks in practice –network design in the supply chain - role of network -factors affecting the network design decisions modeling for supply chain. Role of transportation - modes and their performance – transportation infrastructure and policies - design options and their trade-offs tailored transportation.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the different distribution network



- Explain the factors influencing network design in the supply chain
- Know the Role of transportation
- Analyze design options and their trade-offs

### **UNIT-3**

#### **Supply Chain Analysis.**

Sourcing - In-house or Outsource - 3rd and 4th PLs - supplier scoring and assessment, selection - design collaboration - Procurement process - Sourcing planning and analysis. Pricing and revenue management for multiple customers, perishable products, seasonal demand, bulk and spot contracts.

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of supply chain Analysis
- Explain design collaboration
- Know procurement process -sourcing planning and analysis
- Understand seasonal demand, bulk and spot contracts

### **UNIT-4**

#### **Dimensions of Logistics**

A macro and micro dimension - logistics interfaces with other areas - approach to analyzing logistics systems - logistics and systems analysis - techniques of logistics system analysis - factors affecting the cost and importance of logistics. Demand Management and Customer Service Outbound to customer logistics systems - Demand Management –Traditional Forecasting - CPFRP - customer service - expected cost of stock outs - channels of distribution.

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand dimensions of logistics
- Explain logistics interfaces with other areas
- Know techniques of logistics system analysis
- Understand Demand Management

### **UNIT-5**

**Recent Trends in Supply Chain Management**-Introduction, New Developments in Supply Chain Management, Outsourcing Supply Chain Operations, Co-Maker ship, The Role of E-Commerce in Supply Chain Management, Green Supply Chain Management, Distribution Resource Planning, World Class Supply Chain Management

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the recent trend in supply chain management
- Explain The Role of E-Commerce in Supply Management
- Know Green Supply Chain Management
- Understand Distribution Resource Planning

**Course Outcomes:**

At the end of the course, students will be able to

- Understand the strategic role of logistic and supply chain management in the cost reduction and offering best service to the customer
- Understand Advantages of SCM in business
- Apply the knowledge of supply chain Analysis
- Analyze reengineered business processes for successful SCM implementation
- Evaluate Recent trend in supply chain management

**TEXT BOOKS:**

1. Sunil Chopra and Peter Meindl, Supply Chain Management – “Strategy, Planning and Operation”, 3<sup>rd</sup> Edition, Pearson/PHI, 2007.
2. Supply Chain Management by Janat Shah Pearson Publication 2008.

**REFERENCE BOOKS:**

1. A Logistic approach to Supply Chain Management – Coyle, Bardi, Longley, Cengage Learning, 1/e
2. Donald J Bowersox, Dand J Closs, M Bixby Coluper, “Supply Chain Logistics Management”, 2<sup>nd</sup> edition, TMH, 2008.
3. Wisner, Keong Leong and Keah-Choon Tan, “Principles of Supply Chain Management A Balanced Approach”, Cengage Learning, 1/e
4. David Simchi-Levi et al, “Designing and Managing the Supply Chain” – Concepts

**Course Objectives:**

- Students can learn the basics of using DSP chips to perform real-time digital signal processing.
- Ability to apply knowledge of mathematics, science and engineering: Construction of tools for visualizing the basic concepts of discrete signal representation such as Fourier transforms, discrete time representations.
- Students will learn numerous programming tools for design and implementations of filtering algorithms.
- Understand the concept of Multi-rate signal processing and sample rate conversion.
- Develop and Implement DSP algorithms in software using CCS with DSP floating point Processor.

**Conduct any eight experiments from part-A and any four experiments from part-B**

**List of Experiments:**

**PART-A**

**The following experiments shall be conducted using MATLAB / Lab View / C Programming/ Equivalent software.**

1. Generation of sinusoidal waveform / signal based on recursive difference equations.
2. Find DFT / IDFT of given discrete time signal.
3. Find frequency response of a system given in transfer function/ differential equation form.
4. Implementation of FFT of given Sequence.
5. Design and implementation of IIR filter using bilinear transformation and impulse invariant method.
6. Design and implementation of IIR Butterworth (LP/HP) filter.
7. Design and implementation of IIR Chebyshev (LP/HP) filter.
8. Design and implementation of FIR with low pass filter using any three windowing techniques. Plot its magnitude and phase responses.
9. Design and implementation of FIR filter with high pass filter using any three windowing techniques. Plot its magnitude and phase responses.
10. Design and implementation of FIR filter with band pass / band stop filter using any three windowing techniques. Plot its magnitude and phase responses.

**PART-B**

**The following experiments shall be conducted using (TI / Analog Devices / Motorola / Equivalent DSP processors).**

11. Study the architecture of DSP chips – TMS 320C 5X/6X Instructions.
12. Find DFT / IDFT of given discrete time signal.
13. Implementation of FFT of given Sequence.
14. Design and implementation of IIR Butterworth / Chebyshev (LP/HP) filter.
15. Design and implementation of FIR with low pass / high pass filter using any three windowing techniques. Plot its magnitude and phase responses.

### **Course Outcomes**

- Ability to design-test, to verify, to evaluate, and to benchmark a real-time DSP system.
- Ability to calculate discrete time domain and frequency domain of signals using discrete Fourier series and Fourier transform.
- Ability to design, using MATLAB-based filter design techniques, FIR and IIR digital filters and Determine the frequency response of filters.
- Implementation of basic signal processing algorithms such as convolution, difference equation implementation and application of them in the construction of FIR and IIR filters.
- Design DSP based real time processing systems to meet desired needs of the society.

**(19A04601P) MICROPROCESSORS AND MICROCONTROLLERS LAB**

**Course Objectives:**

- Write ALP for arithmetic and logical operations in 8086
- Familiarize with MASM, Embedded C & Code composer studio
- Write and execute programs in 8086, 8051 and ARM Cortex M0

**Conduct all the experiments:**

**List of Experiments:**

Intel 8086 (16 bit Micro Processor)

1. Perform simple arithmetic operations using different addressing modes.
2. Sort an array of binary numbers.
3. Code Conversion (Eg. ASCII to Packed BCD form).
4. Addition of an array of BCD numbers stored in packed form.
5. Multiplying two 3x3 matrices and print on DOS
6. Identification & displaying the activated key using DOS & BIOS function calls.

Intel 8051 (8 bit Microcontroller)

1. Detection of key closure (connected to a port line) by polling technique.
2. Delay generation using i) Nested loop & ii) Timers.
3. Counting of external event occurrence through port line

ARM Cortex M0 – NXP LPC Xpress/1115

1. Introduction to the Keil MDK-ARM tool, C and Assembly coding - Processing text in assembly language
2. Configure GPIO for Digital input and output
3. Study of mixed assembly and C programming – Calling a C function from assembly and Calling an assembly function from C

**Course Outcomes:**

- Execution of different programs for 8086, 8051 in Assembly Level Language using MASM Assembler
- Design and implement some specific real time applications.

**(19A99501) MANDATORY COURSE: CONSTITUTION OF INDIA**

**COURSE OBJECTIVES :** The objective of this course is

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and Election Commission of India.
- To understand the central-state relation in financial and administrative control

**Syllabus**

**UNIT-I**

Introduction to Indian Constitution – Constitution -Meaning of the term - Indian Constitution- Sources and constitutional history - Features– Citizenship – Preamble - Fundamental Rights and Duties - Directive Principles of State Policy.

**Learning Outcomes:-**

After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History and features of Indian constitution
- Learn about Preamble, Fundamental Rights and Duties

**UNIT-II**

Union Government and its Administration Structure of the Indian Union - Federalism - Centre-State relationship – President’s Role, power and position - PM and Council of ministers - Cabinet and Central Secretariat –Lok Sabha - Rajya Sabha - The Supreme Court and High Court - Powers and Functions

**Learning Outcomes:-**

After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister

- Know the Structure of supreme court and High court

### **UNIT-III**

State Government and its Administration - Governor - Role and Position -CM and Council of ministers - State Secretariat-Organization Structure and Functions

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the structure of state government
- Analyze the role of Governor and Chief Minister
- Explain the role of State Secretariat
- Differentiate between structure and functions of state secretariat

### **UNIT-IV**

Local Administration - District's Administration Head - Role and Importance - Municipalities - Mayor and role of Elected Representatives -CEO of Municipal Corporation Pachayati Raj - Functions- PRI -Zilla Parishath - Elected officials and their roles - CEO,Zilla Parishath - Block level Organizational Hierarchy - (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy

#### **Learning Outcomes:-**

After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration's role and importance
- Analyze the role of Mayor and elected representatives of Municipalities
- Learn about the role of Zilla Parishath block level organization

### **UNIT-V**

Election Commission - Election Commission- Role of Chief Election Commissioner and Election Commissionerate - State Election Commission -Functions of Commissions for the welfare of SC/ST/OBC and Women

#### **Learning Outcomes:-**

After completion of this unit student will

- Know the role of Election Commission
- Contrast and compare the role of Chief Election commissioner and Commissionerate
- Analyze the role of state election commission
- Evaluate various commissions viz SC/ST/OBC and women

#### **Course Outcomes:**

At the end of the course, students will be able to

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government i.e., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

### **TEXT BOOKS**

1. Durga Das Basu, “Introduction to the Constitution of India”, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. Subash Kashyap, “Indian Constitution”, National Book Trust

### **REFERENCES:**

1. J.A. Siwach, “Dynamics of Indian Government & Politics”.
2. H.M.Sreevai, “Constitutional Law of India”, 4<sup>th</sup> edition in 3 volumes (Universal Law Publication)
3. J.C. Johari, “Indian Government and Politics”, Hans India
4. M.V. Pylee, “Indian Constitution”, Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi

### **E-RESOURCES:**

1. [nptel.ac.in/courses/109104074/8](https://nptel.ac.in/courses/109104074/8)
2. [nptel.ac.in/courses/109104045/](https://nptel.ac.in/courses/109104045/)
3. [nptel.ac.in/courses/101104065/](https://nptel.ac.in/courses/101104065/)
4. [www.hss.iitb.ac.in/en/lecture-details](http://www.hss.iitb.ac.in/en/lecture-details)
5. [www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution](http://www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**B.Tech (ECE)– IV-I Sem** **L T P C**  
**3 0 0 3**  
**(19A04701T) MICROWAVE ENGINEERING AND OPTICAL COMMUNICATIONS**

**Course Objectives:**

- To understand the wave propagation in waveguides, principle of operation of optical sources, detectors, microwave active and passive devices.
- To apply the boundary conditions of the waveguides to solve for field expressions in waveguides.
- To derive the field expressions for different modes of the waveguides, and Scattering matrix for passive microwave devices.
- To differentiate Linear beam tubes and crossed field tubes in terms of operation and performance.
- To remember various types of fibers, modes, configurations and signal degradations.
- To analyze signal degradation in optical fibers and compare the performance of various optical sources and detectors.

**UNIT I:**

Waveguides (Microwave Transmission lines): Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation, Circular waveguide – TE and TM modes, Wave propagation, waveguide resonators – problem solving.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Know the importance of waveguides (L1)
- Derive field expressions for different modes of propagation in the waveguides(L3).
- Understand the concept of wave propagation in the guides (L1)
- Problem solving to find the parameters like cutoff frequency, phase and group velocities etc. in waveguides (L2)

**UNIT II:**

Passive Microwave Devices: Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Hybrid ring, Directional Couplers – Bethe hole and Two hole Couplers, Microwave propagation in Ferrites, Microwave devices employing Faraday rotation – Isolator, Circulator, Deriving Scattering matrix for Microwave passive devices.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand principle of operation of all passive microwave devices (L1)
- Know the importance of Scattering parameters and their properties (L1)
- Derive the Scattering matrix for the microwave devices (L3)
- Apply the Scattering matrix to understand the working of passive devices and solve problems (L2)

### **UNIT III:**

Microwave Amplifiers and Oscillators:

Microwave Tubes: (i) Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification process (Qualitative treatment only).

(ii) Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition, Mode jumping in Magnetron, Principle of operation of Cross Field Amplifier (CFA).

Microwave Semiconductor Devices: Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes, Parametric Amplifier.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understand principle of operation of Microwave Tubes and semiconductor devices (L1)
- Derive the expressions power output and efficiency of all microwave devices (L3)
- Differentiate Linear beam tubes and crossed field tubes in terms of operation and performance (L5)

### **UNIT IV:**

#### **Optical Communications:**

Overview of Optical Fiber Communications, optical fibers – Structures, Optical fiber modes and configurations, Signal degradation in optical fibers – Signal attenuation, absorption, scattering losses, Bending Losses, Core and Cladding losses, Signal distortion in optical waveguides, Information capacity determination, Group delay, waveguide dispersion, Inter modal dispersion.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Remember the optical fiber types, modes, configurations, and signal degradation types (L1)
- Analyze the signal degradation in optical fibers (L4)

### **UNIT V:**

Optical Sources and Detectors: Introduction, LEDs – structure – Light source, Quantum efficiency, Modulation of an LED, LASER diodes, Source to Fiber power launching, LASER diode to fiber coupling, LED coupling to single mode fibers, Fiber, Splicing, Optical Fiber connectors, Photo diodes – Principle of Photo diodes, Avalanche Photodiodes, Photo detector noise, detector response time, Comparison of Photo diodes.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the working principle of optical sources, detectors and power coupling (L2)
- Compare the performance of various optical source and detectors (L4)

### **Course Outcomes:**

- Understand the wave propagation in waveguides, principle of operation of optical sources, detectors, microwave active and passive devices. Also remember various types of fibers, modes, configurations and signal degradations
- Apply the boundary conditions of the waveguides to solve for field expressions in waveguides.
- Derive the field expressions for different modes of the waveguides, and Scattering matrix for passive microwave devices. Analyze signal degradation in optical fibers and compare the performance of various optical sources and detectors
- Differentiate Linear beam tubes and crossed field tubes in terms of operation and performance.

### **TEXT BOOKS:**

1. Matthew N. O. Sadiku, “Elements of Electromagnetics”, Oxford Publications, Third Edition, 2003. (For Unit 1)
2. R. E. Collin, “Foundations for Microwave Engineering”, Wiley Student Edition, Second Edition, 2009. (For Units 2, and 3)
3. Samuel Y. Liao, “Microwave Devices and Circuits”, PHI publications, Third Edition, 1997. (For Units 2, and 3)
4. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill, Third Edition, 2000. (For Units 4, and 5)

### **REFERENCES:**

1. Om. P. Gandhi, “Microwave: Engineering and Applications”, Kai Fa Book Company, 1981.
2. Reich H. J., et al, “Microwave Principles”, MIT Press, 1972.
3. F E Terman, “Electronic and Radio Engineering”, McGraw Hill, 4<sup>th</sup> Edition, 1984.

(19A04702T) VLSI DESIGN

**Course Objectives:**

- To identify the design for testability methods for combinational & sequential CMOS Circuits.
- To understanding of CMOS fabrication flow, technology scaling, sheet resistance, square capacitance and propagation delays in CMOS circuits.
- To apply the design Rules and draw layout of a given logic circuit and basic circuit concepts to MOS circuits.
- To analyze the behaviour of amplifier circuits with various loads. Analyze the behaviour of static and dynamic logic circuits. Analyze the various test generation methods for static and dynamic CMOS circuits.
- To Design MOSFET based logic circuit, Amplifier circuits using MOS transistors and MOSFET based logic circuits using various logic styles like static and dynamic CMOS.

**UNIT-I:**

**Introduction and Basic Electrical Properties of MOS Circuits:** VLSI Design Flow, Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS.  $I_{ds}$  versus  $V_{ds}$  Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology. MOS Layers, Stick Diagrams, Design Rules and Layout, Layout Diagrams for MOS circuits

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand CMOS fabrication flow and technology scaling (L1).
- Apply the design Rules and draw layout of a given logic circuit (L2).
- Design MOSFET based logic circuits (L4).

**UNIT-II:**

**Basic Circuit Concepts:** Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, Some area Capacitance Calculations, The Delay Unit, Inverter Delays, Driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers.

**Scaling of MOS Circuits:** Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise and current density. Switch logic, Gate logic.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Apply basic circuit concepts to MOS circuits (L2).
- Estimate the sheet resistance, square capacitance and propagation delays in CMOS circuits (L3)

**UNIT-III:**

**Basic building blocks of Analog IC design**

Regions of operation of MOSFET, Modelling of transistor, body bias effect, biasing styles, single stage amplifier with resistive load, single stage amplifier with diode connected load, Common Source amplifier, Common Drain amplifier, Common Gate amplifier, current sources and sinks.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Analyze the behavior of amplifier circuits with various loads (L3).
- Design amplifier circuits using MOS transistors (L4).

**UNIT-IV:**

**CMOS Combinational and sequential logic circuit design**

**Static CMOS Design:** Complementary CMOS, Ratioed Logic, Pass-Transistor Logic, **Dynamic CMOS Design:** Dynamic Logic-Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates, Choosing a Logic Style, Gate Design in the Ultra Deep-Submicron Era, Latch Versus Register, Latch based design, timing decimation, positive feedback, instability, Metastability, multiplexer based latches, Master-Slave Based Edge Triggered Register, clock to q delay, setup time, hold time, reduced clock load master slave registers, Clocked CMOS register. Cross coupled NAND and NOR, SR Master Slave register, Storage mechanism, pipelining

**Learning Outcomes:**

After completing this Unit, students will be able to

- Analyze the behaviour of static and dynamic logic circuits (L3).
- Design MOSFET based logic circuits using various logic styles like static and dynamic CMOS (L4)

## **UNIT-V:**

CAD Tools for Design and Simulation, Aspects of Design Tools, Test and Testability-System Partitioning, Layout and Testability, Reset/Initialization, Design for Testability, Testing Combinational Logic, Testing Sequential Logic, Practical Design for Test (OFT) Guidelines, Scan Design Techniques, Built-In-Self-Test (BIST), Future Trends.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Identify the design for testability methods for combinational & sequential CMOS circuits (L1).
- Analyze the various test generation methods for static and dynamic CMOS circuits (L3).

### **Course Outcomes:**

- Identify the design for testability methods for combinational & sequential CMOS circuits. Understand CMOS fabrication flow, technology scaling, sheet resistance, square capacitance and propagation delays in CMOS circuits.
- Apply the design Rules and draw layout of a given logic circuit and basic circuit concepts to MOS circuits.
- Analyze the behavior of amplifier circuits with various loads, static and dynamic logic circuits, various test generation methods for static and dynamic CMOS circuits.
- Design MOSFET based logic circuit, Amplifier circuits using MOS transistors and MOSFET based logic circuits using various logic styles like static and dynamic CMOS

### **TEXT BOOKS:**

1. Kamran Eshraghian, “Essentials of VLSI Circuits and Systems”, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2003
3. Jan M. Rabaey, “Digital Integrated Circuits”, AnanthaChandrakasan and Borivoje Nikolic, Prentice-Hall of India Pvt.Ltd, 2<sup>nd</sup> edition, 2009.

### **REFERENCES:**

1. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, reprint 2009.

**(19A04703a) SATELLITE COMMUNICATIONS**  
**(Professional Elective III)**

**Course Objectives:**

- To understand the basic concepts of satellite communications, orbital mechanics and launchers, various subsystems of a satellite and earth station, multiple access techniques, low earth orbit and geo-stationary satellite systems.
- To apply frequency allocation standards, reliability techniques, multiple access techniques power test methods to satellite systems.
- To analyze satellite navigation and global positioning system.
- To design Uplink and Downlink of a satellite.

**UNIT- I**

Introduction: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

Orbital Mechanics and Launchers: Orbital Mechanics, Look Angle determination, Orbital Perturbations, Orbit determination, Launches and Launch vehicles, Orbital Effects in Communication Systems Performance.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the basic concepts of satellite communications, orbital mechanics and launchers (L1).
- Excel in basic knowledge of orbital mechanics and launches for the satellite communication (L1).
- Apply the standards pertaining to frequency allocation for satellites (L2).

**UNIT- II**

Satellite Subsystems: Altitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand various subsystems of a satellite (L1).
- Describe the electronic hardware systems associated with the satellite subsystem and earth station (L1)

- Apply reliability techniques to check the reliability for space qualification of equipment (L2).

### UNIT- III

**Satellite Link Design:** Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design of Satellite Links for Specified C/N, System Design Examples.

**Multiple Access:** Frequency Division Multiple Access (FDMA), Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA), Frame Structure, Examples, Satellite Switched TDMA Onboard Processing, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception.

#### Learning Outcomes:

After completing this Unit, students will be able to

- Understand various multiple access techniques (L1)
- Apply various multiple access techniques for satellite communications (L2)
- Apply frequency allocation standards, reliability techniques, multiple access techniques(L2)
- Analyze link budget of satellite signal for proper communication(L3)
- Design Uplink and Downlink of a satellite (L4)

### UNIT- IV

**Earth Station Technology:** Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods.

#### Learning Outcomes:

After completing this Unit, students will be able to

- Understand various subsystems of an earth station (L1).
- Apply power test methods to earth stations (L2).
- Choosing different kinds of transmitter and receiver antennas to provide Uplink and Down Link Frequency(L5)

### UNIT- V

**Low Earth Orbit and Geo-Stationary Satellite Systems:** Orbit Considerations, Coverage and Frequency Consideration, Delay & Throughput Considerations, System Considerations, Operational NGSO Constellation Designs.

**Satellite Navigation & Global Positioning System:** Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS



Navigation Message, GPS Signal Levels, GPS Receiver Operation, GPS C/A Code Accuracy, Differential GPS.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the concepts of low earth orbit and geo-stationary satellite systems (L1).
- Demonstrate the impacts of GPS, Navigation, NGSO constellation design for tracking and launching (L3).
- Analyze satellite navigation and global positioning system (L3).

### **Course Outcomes**

- Understand the basic concepts of satellite communications, orbital mechanics and launchers, various subsystems of a satellite and earth station, multiple access techniques  
low earth orbit and geo-stationary satellite systems
- Apply frequency allocation standards, reliability techniques, multiple access techniques power test methods to satellite systems
- Analyze satellite navigation and global positioning system
- Design Uplink and Downlink of a satellite
- Choosing different kinds of transmitter and receiver antennas to provide Uplink and Down Link Frequency.

### **Text Books:**

1. Timothy Pratt, Charles Bostian and Jeremy Allnut, WSE, “Satellite Communications”, Wiley Publications, 2nd Edition, 2003.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G. Snyderhoud, “Satellite Communications Engineering” , 2<sup>nd</sup> Edition, Pearson Publications, 2003.

### **References:**

1. M. Richharia, “Satellite Communications: Design Principles” –BS Publications, 2<sup>nd</sup> Edition, 2003.
2. D.C Agarwal, “Satellite Communication”, Khanna Publications, 5th Ed.
3. K.N. Raja Rao, “Fundamentals of Satellite Communications”, PHI, 2004
4. Dennis Roddy, “Satellite Communications”, McGraw Hill, 4th Edition, 2009.

(19A04703b) DIGITAL TV ENGINEERING  
(Professional Elective III)

**Course Objectives:**

- To understand standards, principles of transmitters, radio-frequency systems, antennas and antenna patterns, process of radio-wave propagation and measurement techniques for digital TV transmission.
- To apply channel coding and modulation techniques, fundamentals of transmission lines, principles of antennas and radio-wave propagation to digital TV transmission.
- To analyse noise and interference effects on signals, power combiners, transmission line parameters, antenna parameters, and perturbations signals undergo in radio-wave propagation in digital TV transmission.

**UNIT-I:**

**Digital Television Transmission Standards:** ATSC terrestrial transmission standard, vestigial sideband modulation, DVB-T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2.

**Performance Objectives for Digital Television:** System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, cochannel interference, adjacent channel interference, analog to digital TV, transmitter requirements.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understanding various digital TV standards followed world-wide (L2).
- Analysing noise and interference effects on TV signals (L4).

**UNIT-II:**

**Channel Coding and Modulation for Digital Television:** Data synchronization, randomization/scrambling, forward error correction, interleaving, inner code, frame sync insertion, quadrature modulation, 8 VSB, bandwidth, error rate, COFDM, flexibility, bandwidth.

**Transmitters for Digital Television:** Precorrection and equalization, up conversion, precise frequency control, RF amplifiers, solid-state transmitters, RF amplifier modules, power supplies, power combiners, Wilkinson combiner, ring combiner, Starpoint combiner, cooling, automatic gain or level control, ac distribution, transmitter control, tube transmitters, tube or solid-state transmitters, performance quality, retrofit of analog transmitters for DTV.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understanding the principles of digital T V transmitters (L2).
- Applying channel coding and modulation techniques to digital T V transmission (L3).
- Analysing various types of power combiners (L4).

### **UNIT-III:**

**Radio-Frequency Systems for Digital Television:** Constant-impedance filter, output filters, elliptic function filters, cavities, channel combiners.

**Transmission Line for Digital Television:** Fundamental parameters, efficiency, effect of VSWR, system AERP, rigid coaxial transmission lines, dissipation, attenuation, and power handling, higher-order modes, peak power rating, frequency response, standard lengths, corrugated coaxial cables, wind load, waveguide, bandwidth, waveguide attenuation, power rating, frequency response, size trade-offs, waveguide or coax pressurization.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understanding various types of radio-frequency systems for digital T V transmission (L2).
- Applying fundamentals of transmission lines for digital T V transmission (L3).
- Analysing transmission line parameters for digital T V transmission (L4).

### **UNIT-IV:**

**Transmitting Antennas for Digital Television:** Antenna patterns, elevation pattern, mechanical stability, null fill, azimuth pattern, slotted cylinder antennas, gain and directivity, power handling, antenna impedance, bandwidth and frequency response, multiple-channel operation, types of digital television broadcast antennas, antenna mounting.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understanding various types of antennas and patterns (L2).
- Applying principles of antennas for digital T V transmission (L3).
- Analysing antenna parameters for digital T V transmission (L4).

### **UNIT-V:**

**Radio-Wave Propagation:** Free-space propagation, distance to the radio horizon, refraction, multipath, ground reflections, surface roughness, effect of earth's curvature, Fresnel zones, linear distortions, diffraction, fading, desired signal, field tests, Charlotte, North Carolina,

Chicago, Illinois, Raleigh, North Carolina.

**Test and Measurement for Digital Television:** Power measurements, average power measurement, calorimetry, power meters, peak power measurement, measurement uncertainty, testing digital television transmitters.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understanding the process of radio-wave propagation and measurement techniques as applied to digital T V systems (L2).
- Applying the principles of radio-wave propagation for digital T V transmission (L3).
- Analyzing perturbations signals undergo in radio-wave propagation (L4).

**Course Outcomes:**

- Understanding standards, principles of transmitters, radio-frequency systems, antennas and antenna patters, process of radio-wave propagation and measurement techniques for digital T V transmission (L2).
- Applying channel coding and modulation techniques, fundamentals of transmission lines, principles of antennas and radio-wave propagation to digital T V transmission (L3).
- Analysing noise and interference effects on signals, power combiners, transmission line parameters, antenna parameters, and perturbations signals undergo in radio-wave propagation in digital T V transmission(L4).

**Text Book:**

1. Gerald W. Collins, “Fundamentals of Digital Television Transmission”, John Wiley, 2001.

**Reference Book:**

1. R. R. Gulati, “Modern Television Practice, Principles, Technology and servicing”, 2<sup>nd</sup> edition, New Age International Publishers, 2001.

**(19A04703c) EMBEDDED SYSTEMS**  
(Professional Elective III)

**Course Objectives:**

- To introduce major components of an embedded system
- To expose role of firmware, operating systems in correlation with hardware systems.
- To explain interfacing of various communication and I/O devices to an embedded system
- To demonstrate implementation of embedded systems for different applications

**UNIT –I**

Introduction to Embedded Systems: Definition of embedded system, embedded systems vs general computing systems, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, Processor and OS trends in embedded system.

Embedded hardware units and devices in a system, embedded software in a system and an overview of programming languages, skills required for an embedded system designer, examples of the embedded systems.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Differentiate embedded system and general computing system (L2)
- Classify embedded systems based on performance, complexity and era in which they are evolved (L4)
- Discuss basic hardware and software units used in embedded systems (L3)

**UNIT –II**

Core of the embedded system, memory, sensors and actuators, communication interface, embedded firmware, other system components, Characteristics of an embedded system, Quality attributes of embedded systems.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Summarize different factors to be considered in the selection of memory for an embedded system (L2)
- Describe role of sensors, actuators and their interfacing with I/O subsystems(L2)
- Explain role of embedded firmware in embedded system (L2)
- Understand characteristics describing an embedded system (L2)

- Discuss important quality attributes of the embedded system for online and offline modes (L5)

### **UNIT- III**

I/O, Communication devices and Interrupt Service Mechanism: I/O types and examples, serial communication devices, parallel device ports, wireless devices, timer and counting devices, Interrupt-driven input and output, interrupt service routine concept, interrupt sources, hardware interrupts, software interrupts, interrupt-servicing mechanism, multiple interrupts, interrupt service threads as second-level interrupt handlers, context and the periods for context switching, interrupt latency, interrupt-service deadline, interrupt service mechanism form context-saving angle, direct memory access driven I/O, Device driver programming.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Summarize pros and cons of interrupt driven data transfer (L2)
- Discuss hardware and software interrupts with examples (L3)
- Know how interrupts can be used to minimize latency (L3)
- Differentiate ISRs & device driver functions (L2)
- Describe uses of hardware and software assigned priorities in an interrupt service mechanism (L2)

### **UNIT –IV**

Inter-process Communication (IPC): Multiple processes in an application, multiple threads in an application, tasks, task and thread states, tasks and data, distinction between function, ISR, IST and task by their characteristics, inter-process communication and synchronization, signals, concept of semaphores, disabling and enabling functions, shared data problem, queues and mailboxes, pipe and socket functions, remote procedure call functions.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Describe mechanism to create multiple tasks (processes & threads), control task states and allocate system resources to the tasks (L2)
- Explain IPC functions to enable communication of signals, semaphores and messages from ISRs and tasks (L2)
- Discuss IPC functions for pipes, sockets and RPCs (L3)

### **UNIT –V**

REAL-TIME OPERATING SYSTEMS - Operating System Overview, Operating System - Functions, Types and Services of Operating Systems, Real-Time Operating System, RTOS overview, RTOS Task Scheduling, Keil RTX RTOS, RTOS on **Mbed** platform, **Mbed**RTOSAPI, Using **Mbed** RTOS API for your Project, Thread, Mutex and Semaphore.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Explain about operating system and RTOS (L2)
- Summarize different features of RTOS (L2)
- Build RTOS based embedded system using Keil RTX mbed platform (L6)

### **Course Outcomes:**

- Identify hardware and software components of an embedded system.
- Choose appropriate embedded system architecture for the given application.
- Discuss quality attributes and characteristics of an embedded system.
- Illustrate different Inter Process Communication (IPC) mechanisms used by tasks/process/tasks to communicate in multitasking environment.
- Design an RTOS based embedded system.

### **Text Books:**

1. Shibu K V, "Introduction to Embedded Systems", 2<sup>nd</sup> edition, McGraw Hill Education, 2017.
2. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", 3<sup>rd</sup> edition, McGraw Hill Education, 2017.

### **References:**

1. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 2<sup>nd</sup> edition, Pearson Education India, 2007
2. Jonathan W. Valvano, "Embedded Microcomputer Systems Real Time Interfacing", 3<sup>rd</sup> Edition Cengage Learning, 2012.
3. David. E. Simon, "An Embedded Software Primer" 1<sup>st</sup> Edition, Fifth Impression, Addison-Wesley Professional, 2007.

**(19A04703d) IMAGE PROCESSING**  
(Professional Elective III)

**Course Objectives:**

- To introduce fundamentals of Image Processing.
- To expose various intensity transformations in spatial and frequency domains.
- To impart concepts of wavelets and various coding techniques for image compression.
- To dissimilate various segmentation techniques for images.
- To teach various color models and to introduce the concepts of color image segmentation.

**UNIT I**

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighbourhood, adjacency, connectivity, distance measures.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the basic building blocks of image processing(L2)
- Define image processing parameters such as adjacency and distance measures (L1)

**UNIT II**

Image Enhancements and Filtering- Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Compare image enhancement methods in spatial and frequency domains (L5)
- Apply frequency Domain filtering techniques for image enhancement (L3)

**UNIT-III**

Image Segmentation, Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.



### **Learning Outcomes:**

After completing this Unit, students will be able to

- Describe various Image segmentation techniques (L2)
- Illustrate detection of discontinuities in an image (L2)

### **UNIT-IV**

Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks.

Image Compression, -Redundancy, inter-pixel and psycho-visual; Loss less compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Describe various transform techniques for lossy compression (L2)
- Apply various coding techniques for lossless compression (L3)

### **UNIT V**

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Describe various color models for color image processing (L2)
- Apply various techniques for color image smoothing, sharpening and segmentation (L3)

### **Course Outcomes:**

- Analyze various types of images mathematically.
- Compare image enhancement methods in spatial and frequency domains.
- Demonstrate various segmentation algorithms for given image.
- Justify DCT and wavelet transform techniques for image compression.
- Describe various color models for color image processing.

**Text Books:**

1. R.C. Gonzalez and R.E. Woods, “Digital Image Processing”, 2<sup>nd</sup> Edition, Pearson Education, 2008.
2. Anil Kumar Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 2<sup>nd</sup> edition 2004.

**References:**

1. Rafael C. Gonzalez, Richard E woods and Steven L. Eddins, “Digital Image processing using MATLAB”, Tata McGraw Hill, 2010.
2. Milan Sonka, Vaclav Hlavac, Roger Boule, “ Image Processing, Analysis, and Machine Vision”, 3<sup>rd</sup> Edition, Cengage Learning, 2016.
3. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image processing”, Tata McGraw Hill.
4. William K. Pratt, “Digital Image Processing”, John Wiley, 3rd Edition, 2004.

(19A04703e) **ADVANCED DIGITAL SIGNAL PROCESSING**  
(Professional Elective III)

**Course Objectives:**

- To understand the sampling rate conversion and summarize multirate DSP.
- To describe the various linear filtering techniques and its applications to DSP.
- To apply and estimate parametric and non-parametric power spectrum estimation.
- To analyze the finite word length effects in fixed- and floating-point DSP systems.
- To acquire the knowledge on applications of multi rate digital signal processing.

**UNIT I:**

**Multirate Digital Signal Processing:** Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for Sampling-Rate Conversion, Direct-Form FIR Filter Structures, Polyphase Filter Structures, Time-Variant Filter Structures, Multistage Implementation of Sampling-Rate Conversion, Sampling-Rate Conversion of Bandpass Signals, Decimation and Interpolation by Frequency Conversion, Modulation-Free Method for Decimation and Interpolation, Sampling-Rate Conversion by an Arbitrary Factor, First-Order Approximation, Second-Order Approximation (Linear Interpolation).

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the conversion of multiple sampling rates and Multirate signal processing in the digital domain. (L2)
- Design a sampling rate conversion by interpolation and decimation and their effects on frequency spectrum. (L6)

**UNIT II:**

**Linear Prediction and Optimum Linear Filters:**

Innovations Representation of a Stationary Random Process, Relationships Between the Filter Parameters and the Autocorrelation Sequence, Forward Linear Prediction, Backward Linear Prediction, The Optimum Reflection Coefficients for the Lattice Forward and Backward Predictors, Relationship of an AR Process to Linear Prediction, The Levinson-Durbin Algorithm, AR Lattice Structure, ARMA Processes and Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction, FIR Wiener Filter, IIR Wiener Filter, Noncausal Wiener Filter.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the concepts and design of optimum filters for linear prediction. (L2)
- Solve the linear equations and analyze the optimum filters to estimate the signals corrupted by noise. (L4)

### **UNIT III:**

**Nonparametric Methods for Power Spectrum Estimation:** Estimation of Spectra from Finite-Duration Observations of Signals, Estimation of the Autocorrelation and Power Spectrum of Random Signals, Use of the DFT in Power Spectrum Estimation, Bartlett Method, Welch Method, Blackman and Tukey Method, Performance Characteristics of Nonparametric Power Spectrum Estimators.

**Parametric Methods for Power Spectrum Estimation:** Relationships Between the Autocorrelation and the Model Parameters, The Yule-Walker Method for the AR Model Parameters, The Burg Method for the AR Model Parameters, Unconstrained Least-Squares Method for the AR Model Parameters, Sequential Estimation Methods for the AR Model Parameters, Selection of AR Model Order, MA Model for Power Spectrum Estimation, ARMA Model for Power Spectrum Estimation.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Analyze various methods for estimating the power spectrum of discrete-time signals. (L4)
- Differentiate parametric and non-parametric methods for power spectrum estimation. (L5)

### **UNIT IV:**

**Analysis of Finite Word length Effects:** Quantization Process and Errors, Quantization of Fixed-point Numbers, Quantization of Floating-point Numbers, Analysis of Coefficient Quantization Effects, Dynamic Range Scaling, Limit cycles in IIR digital filters, Round off errors in FFT algorithms.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Ability to understand the finite word length effects in filter design, effect of quantization errors. (L3)
- Differentiate in fixed- and floating-point numbers. (L5)

## **UNIT V:**

**Applications of Digital Signal Processing:** Dual Tone Multi-Frequency Signal Detection, Spectral Analysis of Sinusoidal Signals, Spectral Analysis of Non stationary Signals, Spectral Analysis of Random Signals, Musical Sound Processing, Discrete-Time Analytic Signal Generation, Subband Coding of Speech and Audio Signals, Over Sampling A/D Converter, Over Sampling D/A Converter.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Apply the knowledge and implement different applications of sampling rate conversion in multirate signal processing systems. (L3)
- Describe the applications of DSP to real-time requirements. (L5)

### **Course Outcomes:**

- Understand the sampling rate conversion, interpolation and decimation for signal processing applications also need of optimum linear filtering and its applications.
- Apply and explore the real-time applications to multirate DSP systems.
- Analyze the parametric and non-parametric methods for power spectrum estimation.
- Evaluate the finite word length effects in filter design such as FIR, IIR.

### **Text books:**

1. J G Proakis, D G Manolakis, "Digital Signal Processing Principles, Algorithms and Applications" 3<sup>rd</sup> Edition, Prentice Hall.
2. Sanjit K Mitra, "Digital Signal Processing – A Computer Based Approach", 2<sup>nd</sup> Edition, Tata Mc graw Hill Publications.

### **References:**

1. A V Oppenheim, R W Schaffer, "Discrete-Time Signal Processing", Pearson Education.
2. S. M .Kay, "Modern spectral Estimation Techniques" PHI, 1997.

**(19A01704a) AIR POLLUTION AND CONTROL**  
**OPEN ELECTIVE-III**

**Course Objectives:**

- To identify the sources of air pollution
- To know the composition and structure of atmosphere
- To know the pollutants dispersion models
- To understand the working of air pollution control equipments
- To identify the sources of noise pollution and their controlling methods

**UNIT I**

Introduction: sources, effects on – ecosystems, characterization of atmospheric pollutants, air pollution episodes of environmental importance. Indoor Air Pollution– sources, effects.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand the character of atmospheric pollutants and their effects

**UNIT II**

Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Wind rose diagram.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the composition and structure and structure of atmosphere
- To understand the maximum mixing depth and windrose diagram

**UNIT III**

General characteristics of stack emissions, plume behaviour, heat island effect. Pollutants dispersion models – description and application of point, line and areal sources. Monitoring of particulate matter and gaseous pollutants –respirable, non-respirable and nano - particulate matter. CO, CO<sub>2</sub>, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the general characteristics of stack emissions and their behavior
- To understand the monitoring of particulate matter and gaseous pollutants

#### **UNIT IV**

Air Pollution Control equipment for particulate matter & gaseous pollutants– gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP). – Adsorption, Absorption, Scrubbers, Condensation and Combustion.

##### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the various air pollution control equipments

#### **UNIT V**

Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

##### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the noise sources, mapping, prediction equations etc.,

##### **Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Identify the sources of air pollution
- Understand the composition and structure and structure of atmosphere.
- Know about the general characteristics of stack emissions and their behavior
- Know about the general characteristics of stake emission and their behavior
- Know about the noise sources, mapping, prediction equations etc.,

#### **REFERENCES:**

1. WarkK ., Warner C.F., and Davis W.T., “Air Pollution - Its Origin and Control”, Harper & Row Publishers, New York.
2. Lee C.C., and Lin S.D., “Handbook of Environmental Engineering Calculations”, McGraw Hill, New York.
3. Perkins H.C., “Air Pollution”, McGraw Hill.
4. Crawford M., “Air Pollution Control Theory”, TATA McGraw Hill.
5. Stern A.C., “Air Pollution”, Vol I, II, III.
6. Seinfeld N.J., “Air Pollution”, McGraw Hill.
7. Stern A.C. Vol. V, “Air Quality Management”.
8. M N Rao and HVN Rao, Air Pollution” Tata McGraw Hill publication

**(19A01704b) BASICS OF CIVIL ENGINEERING**  
**OPEN ELECTIVE-III**

**Course Objectives:**

- To identify the traditional materials that are used for building constructions
- To know the principles of building planning
- To know the causes of dampness in structures and its preventive measures
- To know about the low cost housing techniques
- To know the basic principles of surveying

**UNIT I**

Traditional materials: Stones- Types of stone masonry -Brick-types of brick masonry- lime Cement – Timber – Seasoning of timber - their uses in building works

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand the characteristics of different building materials.

**UNIT II**

Elements of building planning- basic requirements-orientation-planning for energy efficiency-planning based on utility-other requirements.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand the principles of planning in buildings

**UNIT III**

Dampness and its prevention: Causes of dampness- ill effects of dampness-requirements of an ideal material for damp proofing-materials for damp proofing –methods of damp proofing.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the causes of dampness in buildings and its ill effects
- To know about the general characteristics of ideal material for damp proofing

**UNIT IV**



Cost effective construction techniques in mass housing schemes: Minimum standards – Approach to cost effective mass housing schemes- cost effective construction techniques.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the various cost effective techniques in mass housing schemes.

**UNIT V**

Introduction to Surveying: Object and uses of surveying- Primary divisions in surveying- Fundamental principles of surveying- Classification of surveying-plans and maps-scales-types of graphical scales- units and measurements

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the objects of surveying and its classification.

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Identify the traditional building materials that are used in building construction.
- Plan the buildings based on principles of planning.
- Identify the sources of dampness and its ill effects on buildings and its prevention.
- Know the cost effective construction in mass housing schemes.
- Know the importance of surveying in planning of the buildings.

**Text books:**

1. S.S.Bhavikatti, “Basic civil engineering”, New age international publishers.
2. S.S.Bhavikatti, “Building Construction:”, Vikas Publishing house, New Delhi.
3. G.C.Sahu and Joygopal jena, “Building materials and Construction”, McGraw Hill Education.

**Reference books:**

1. N.Subramanian, “Building Materials testing and sustainability”, Oxford university press.

**(19A02704a) RENEWABLE ENERGY SYSTEMS**

**OPEN ELECTIVE-III**

**Course Objectives:**

At the end of the course the student will be able to

- Identify various sources of Energy and the need of Renewable Energy Systems.
- Understand the concepts of Solar Radiation, Wind energy and its applications.
- Distinguish between solar thermal and solar PV systems
- Interpret the concept of geo thermal energy and its applications.
- Understand the use of biomass energy and the concept of Ocean energy and fuel cells.

**UNIT -I**

**Solar Energy**

Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

**Learning Outcomes:**

At the end of the course the student will be able to

- To understand about solar thermal parameters
- To distinguish between flat plate and concentrated solar collectors
- To know about thermal storage requirements
- To know about measurement of solar radiation

**UNIT – II**

**PV Energy Systems**

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the concept of PV effect in crystalline silicon and their characteristics
- Understand other PV technologies
- To know about electrical characteristics of PV cells & modules
- To know about grid connected PV systems

## **UNIT - III**

### **Wind Energy**

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To understand basics of wind energy conversion and system
- To distinguish between VAWT and HAWT systems
- To understand about design considerations
- To know about site selection considerations of WECS

## **UNIT - IV**

### **Geothermal Energy**

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Understand the Geothermal energy and its mechanism of production and its applications
- Analyze the concept of producing Geothermal energies
- To learn about disadvantages and advantages of Geo Thermal Energy Systems
- To know about various applications of GTES

## **UNIT -V**

### **Miscellaneous Energy Technologies**

**Ocean Energy:** Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.

**Bio mass Energy:** Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration

**Fuel cell:** Principle of working of various types of fuel cells and their working, performance and limitations.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Analyze the operation of tidal energy
- Analyze the operation of wave energy
- Analyze the operation of bio mass energy
- Understand the principle, working and performance of fuel cell technology
- Apply these technologies to generate power for usage at remote centres

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- To distinguish between various alternate sources of energy for different suitable application requirements
- To differentiate between solar thermal and PV system energy generation strategies
- To understand about wind energy system
- To get exposed to the basics of Geo Thermal Energy Systems
- To know about various diversified energy scenarios of ocean, biomass and fuel cells

**Text Books:**

1. Stephen Peake, “Renewable Energy Power for a Sustainable Future”, Oxford International Edition, 2018.
2. G. D. Rai, “Non-Conventional Energy Sources”, 4<sup>th</sup> Edition, Khanna Publishers, 2000.

**References:**

1. S. P. Sukhatme, “Solar Energy”,3<sup>rd</sup> Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
2. B H Khan , “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
3. S. Hasan Saeed and D.K.Sharma,“Non-Conventional Energy Resources”,3<sup>rd</sup> Edition, S.K.Kataria & Sons, 2012.
4. G. N. Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles and Applications”, Narosa Publishing House, 2004.

**(19A02704b) ELECTRIC VEHICLE ENGINEERING**  
**OPEN ELECTIVE-III**

**Course Objectives:**

After completing this Unit, students will be able to

- To get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles
- To get exposed to EV system configuration and parameters
- To know about electro mobility and environmental issues of EVs
- To understand about basic EV propulsion and dynamics
- To understand about fuel cell technologies for EV and HVEs
- To know about basic battery charging and control strategies used in electric vehicles

**UNIT-I**

**Introduction to EV Systems and Parameters**

Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about past, present and latest technologies of EV
- To understand about configurations of EV systems
- To distinguish between EV parameters and performance parameters of EV systems
- To distinguish between single and multiple motor drive EVs
- To understand about in-wheel EV

**UNIT-II**

**EV and Energy Sources**

Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about various types of EV sources
- To understand about e-mobility
- To know about environmental aspects of EV
- To distinguish between conventional and recent technology developments in EV systems

### **UNIT-III**

#### **EV Propulsion and Dynamics**

Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about what is meant by propulsion system
- To understand about single and multi motor EV configurations
- To get exposed to current and recent applications of EV
- To understand about load factors in vehicle dynamics
- To know what is meant acceleration in EV

### **UNIT-IV**

#### **Fuel Cells**

Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.

Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about fuel cell technology of EV
- To know about basic operation of FCEV
- To know about characteristics and sizing of EV with suitable example
- To get exposed to concept of Hybrid Electric Vehicle using fuel cells
- To know about the comparison of various hybrid EV systems

### **UNIT-V**

#### **Battery Charging and Control**

**Battery charging:** Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.

**Control:** Introduction, modelling of electro mechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To understand about basic requirements of battery charging and its architecture
- To know about charger functions
- To get exposed to wireless charging principle
- To understand about block diagram, modelling of electro mechanical systems of EV
- To be able to design various compensation requirements

**Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- To understand and differentiate between conventional and latest trends in Electric Vehicles
- To know about various configurations in parameters of EV system
- To know about propulsion and dynamic aspects of EV
- To understand about fuel cell technologies in EV and HEV systems
- To understand about battery charging and controls required of EVs

**TEXT BOOKS:**

1. C.C Chan, K.T Chau: “Modern Electric Vehicle Technology”, Oxford University Press Inc., New York 2001.
2. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 2003.

**REFERENCE BOOKS:**

1. Iqbal Husain,, “Electric and Hybrid Vehicles Design Fundamentals”, CRC Press 2005.
2. Ali Emadi, “Advanced Electric Drive Vehicles”, CRC Press, 2015.

(19A03704a) FINITE ELEMENT METHODS  
OPEN ELECTIVE-III

**Course Objectives:**

- Familiarize basic principles of finite element analysis procedure.
- Explain theory and characteristics of finite elements that represent engineering structures.
- Apply finite element solutions to structural, thermal, dynamic problem.
- Learn to model complex geometry problems and solution techniques.

**UNIT – I**

Introduction to finite element methods for solving field problems, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Potential energy and equilibrium, The Rayleigh-Ritz method, Formulation of Finite Element Equations.

**One dimensional problems:** Finite element modeling coordinates and shape functions. Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

**Learning Outcomes:**

At the end of the unit, the student will be able to

- Understand the concept of nodes and elements.(12)
- Understand the general steps of finite element methods.(12)
- Understand the role and significance of shape functions in finite element formulations (12)
- Formulate and solve axially loaded bar problems. (16)

**UNIT - II**

**Analysis of trusses:** Stiffness Matrix for plane truss element. Stress Calculations and Problems.

**Analysis of beams:** Element Stiffness Matrix for two noded, two degrees of freedom per node beam element and simple problems.

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**Learning Outcomes:**

At the end of the unit, the student will be able to

- Explain the use of the basic finite elements for structural applications using truss and beam. (12)



- Formulate and analyze truss and beam problems. (16)

### UNIT - III

Finite element modeling of two dimensional stress analysis - constant strain triangles-quadrilateral element-treatment of boundary conditions. Estimation of load Vector, Stresses. Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements. Two dimensional four noded Isoparametric elements and problems.

#### Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the formulation of two – dimensional elements (Triangular and Quadrilateral Elements). (L2)
- Apply the formulation techniques to solve two – dimensional problems using triangle and quadrilateral elements. (L3)
- Formulate and solve axisymmetric problems. (L6)

### UNIT - IV

**Steady state heat transfer analysis:** One dimensional analysis of slab and fin, two dimensional analysis of thin plate.

Analysis of a uniform shaft subjected to torsion loading.

#### Learning Outcomes:

At the end of the unit, the student will be able to

- Explain the application and use of the Finite Element Methods for heat transfer problems. (L2)
- Formulate and solve heat transfer problems. (L6)
- Analyse the

### UNIT V

**Dynamic analysis:** Formulation of finite element model, element –mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar truss.

**3D Problems:** Finite Element formulation- Tetrahedron element-Stiffness matrix.

#### Learning Outcomes:

At the end of the unit, the student will be able to

- Understand problems involving dynamics using Finite Element Methods.
- Evaluate the Eigen values and Eigen Vectors for stepped bar.
- Develop the stiffness matrix for tetrahedron element.

## **Course Outcomes:**

Upon successful completion of this course you should be able to

- Understand the concepts behind variational methods and weighted residual methods in FEM.
- Identify the application and characteristics of FEA elements such as bars, beams, and isoparametric elements, and 3-D element.
- Develop element characteristic equation procedure and generation of global stiffness equation will be applied.
- Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
- Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer and fluid flow.

## **TEXT BOOKS**

1. Chandraputla, Ashok & Belegundu, “Introduction to Finite Element in Engineering”, Prentice Hall.
2. S.S.Rao, “The Finite Element Methods in Engineering”, 2<sup>nd</sup> Edition, Elsevier Butterworth - Heinemann 2011.

## **REFERENCE BOOKS**

1. J N Reddy, “An introduction to the Finite Element Method”, McGraw – Hill, New York, 1993.
2. R D Cook, D S Malkus and M E Plesha, “Concepts and Applications of Finite Element Analysis”, 3<sup>rd</sup> Edition, John Wiley, New York, 1989.
3. K J Bathe, “Finite Element Procedures in Engineering Analysis”, Prentice-Hall, Englewood Cliffs, 1982.
4. T J R Hughes, “the Finite Element Method, Prentice”, Hall, Englewood Cliffs, NJ, 1986.
5. C Zienkiewicz and R L Taylor, “the Finite Element Method”, 3<sup>rd</sup> Edition. McGraw-Hill, 1989.

**(19A03704b) PRODUCT MARKETING**  
**OPEN ELECTIVE-III**

**Course Objectives:**

- Introduce the basic concepts of Product marketing.
- Familiarize with market information systems and research
- Understand the nature and importance of industrial market
- Discuss the major stages in new product development
- Identify the factors affecting pricing decisions

**UNIT I:**

**Introduction (7 Hours)**

Historical development of marketing management, Definition of Marketing, Core marketing concepts, Marketing Management philosophies, Micro and Macro Environment, Characteristics affecting Consumer behaviour, Types of buying decisions, buying decision process, Classification of consumer products, Market Segmentation Concept of Marketing Myopia. Importance of marketing in the Indian Socio economic system.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Define Marketing. (L1)
- Discuss marketing philosophies. (L2)
- Sketch the buying decision process. (L3)
- Understand the importance of marketing in the Indian socio economic system. (L2)

**UNIT II:**

**Marketing of Industrial Products (6 Hours)**

Components of marketing information system–benefits & uses marketing research system, marketing research procedure, Demand Estimation research, Test marketing, Segmentation Research - Cluster analysis, Discriminate analysis. Sales forecasting: objective and subjective methods. Nature and importance of the Industrial market, classification of industrial products, participants in the industrial buying process, major factors influencing industrial buying behavior, characteristics of industrial market demand. Determinants of industrial market demand Buying power of Industrial users, buying motives of Industrials users, the industrial buying process, buying patterns of industrial users.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Identify the components of marketing information system. (L2)
- List the advantages and uses of marketing research system. (L1)
- Demonstrate sales forecasting. (L3)
- Explain the major factors influencing industrial buying behaviour. (L2)

### **UNIT III:**

#### **Product Management And Branding (7 Hours)**

The concept of a product, features of a product, classification of products, product policies – product planning and development, product line, product mix – factors influencing change in product mix, product mix strategies, meaning of “New – product; major stages in new – product development product life cycle. Branding: Reasons for branding, functions of branding features of types of brands, kinds of brand name.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Identify the factors influencing change in product mix. (L2)
- Sketch various stages in product life cycle. (L2)
- Recall the features of a product and product policies. (L1)
- Demonstrate on features, functions and reasons of branding. (L3)

### **UNIT IV:**

#### **Pricing And Pacakaging (7Hours)**

Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions Labeling: Types, functions advantages and disadvantages, Packaging: Meaning, growth of packaging, function of packaging, kinds of packaging.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- List the factors affecting pricing decisions. (L1)
- Explain the procedure for price determination. (L2)
- Employ Pricing strategies and decisions. (L3)
- Understand the functions of labelling and packaging. (L2)

## **UNIT V:**

### **Product Promotion (6Hours)**

Importance of Price, pricing objectives, factors affecting pricing decisions, procedure for price determination, kinds of pricing, pricing strategies and decisions. Advertising and sales promotion: Objectives of advertisement function of advertising, classification of advertisement copy, advertisement media – kinds of media, advantages of advertising. Objectives of sales promotion, advantages sales promotion. Personal Selling : Objectives of personal selling, qualities of good salesman, types of salesman, major steps in effective selling

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Discuss the procedures for price determination. (L2)
- Explain the objectives of advertisement function of advertising. (L2)
- List the advantages and disadvantages of advertising. (L1)
- Describe the major steps in effecting selling. (L2)

### **Course Outcomes:**

At the end of the course, the student will be able to

- Understand basic marketing management concepts and their relevance to business development. (L2)
- Prepare a questionnaire for market research. (L5)
- Design marketing research plan for business organizations. (L5)
- Optimize marketing mix to get competitive advantage. (L4)

### **Text Books:**

1. Philip Kotler, “Principles of Marketing”, Prentice – Hall.
2. Philip Kotler, “Marketing Management”, Prentice – Hall.

### **Reference Books:**

1. Wiliam J Stanton, “Fundamentals of Marketing”, McGraw Hill
2. R.S.N. Pillai and Mrs.Bagavathi, “Marketing”, S. Chand & Co. Ltd
3. Rajagopal, “Marketing Management Text & Cases”, Vikas Publishing House

**(19A04704a) INTRODUCTION TO MICROCONTROLLERS & APPLICATIONS**  
**OPEN ELECTIVE-III**

**Course Objectives:**

This course will enable students to:

- Describe the Architecture of 8051 Microcontroller and Interfacing of 8051 to external memory.
- Write 8051 Assembly level programs using 8051 instruction set.
- Describe the Interrupt system, operation of Timers/Counters and Serial port of 8051.
- Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to 8051.

**UNIT – I**

**8051 Microcontroller:**

Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the importance of Microcontroller and acquire the knowledge of Architecture of 8051 Microcontroller. (L1)
- Analyze interface required memory of RAM & ROM. (L3)

**UNIT – II**

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Explain different types instruction set of 8051. (L1)
- Develop the 8051 Assembly level programs using 8051 instruction set. (L3)

**UNIT – III**

**8051 Stack, Stack and Subroutine instructions.** Simple Assembly language program examples to use subroutine instructions. 8051 Timers and Counters – Operation and Assembly

language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Describe Stack and Subroutine of 8051. (L1)
- Design Timer /counters using of 8051. (L4)

### **UNIT –IV**

**8051 Serial Communication-** Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.**8051 Interrupts.** 8051 Assembly language programming to generate an external interrupt using a switch.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Acquire knowledge of Serial Communication and develop serial port programming. (L1)
- Develop an ALP to generate an external interrupt using a switch. (L3)

### **UNIT – V**

8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Interfacing with relays and opto isolators, Stepper Motor Interfacing, DC motor interfacing, PWM generation using 8051.

### **Learning Outcomes:**

At the end of this student, the student will be able to

- Apply and Interface simple switches, simple LEDs, ADC 0804 and LCD to using 8051 I/O ports. (L2)
- Design Stepper Motor and f motor interfacing of 8051. (L4)

### **Course outcomes:**

- Understand the importance of Microcontroller and Acquire the knowledge of Architecture of 8051 Microcontroller.
- Apply and Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to using 8051 I/O ports.
- Develop the 8051 Assembly level programs using 8051 instruction set.
- Design the Interrupt system, operation of Timers/Counters and Serial port of 8051.

**TEXT BOOKS:**

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; “The 8051 Microcontroller and Embedded Systems – using assembly and C”, PHI, 2006 / Pearson, 2006.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition, Thomson/Cengage Learning.

**REFERENCE BOOKS:**

1. Manish K Patel, “The 8051 Microcontroller Based Embedded Systems”, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. Raj Kamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Pearson Education, 2005.



(19A04704b) PRINCIPLES OF DIGITAL SIGNAL PROCESSING  
OPEN ELECTIVE-III

**Course Objectives:**

- To explain about signals and perform various operations on it.
- To understand discrete time signals and systems.
- To solve Laplace transforms and z-transforms for various signals.
- To find Discrete Fourier Transform of a sequence by using Fast Fourier Transform.
- To design and realize IIR and FIR filters.

**UNIT- I:**

**INTRODUCTION TO SIGNALS**

Classification of Signals: Analog, Discrete, Digital, Deterministic & Random, Periodic & Aperiodic, Even & Odd, Energy & Power signals. Basic operations on signals: Time shifting, Time scaling, Time reversal, Amplitude scaling and Signal addition. Elementary Signals: Unit step, Unit ramp, Unit parabolic, Impulse, Sinusoidal function, Exponential function, Gate function, Triangular function, Sinc function and Signum function.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Define basic signals and its operations, Classify discrete time signals and systems. (L1)
- Understand various basic operations on signals (L1)

**UNIT – II:**

**DISCRETE TIME SIGNALS AND SYSTEMS**

**Discrete Time Signals:** Elementary discrete time signals, Classification of discrete time signals: power and energy signals, even and odd signals. Simple manipulations of discrete time signals: Shifting and scaling of discrete-time signals.

**Discrete Time Systems:** Input-Output description of systems, Block diagram representation of discrete time systems, Linear Constant Coefficient Difference Equations, Classification of discrete time systems: linear and nonlinear, time-invariant and variant systems, causal and non causal, stable and unstable systems.

**Learning Outcomes:**

At the end of this student, the student will be able to

- Define basic signals and its operations, Classify discrete time signals and systems. (L1)
- Understand various basic operations on signals (L1)

### **UNIT- III:**

#### **LAPLACE TRANSFORMS AND Z- TRANSFORMS**

**Laplace Transforms:** Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of Region of Convergence (ROC), Constraints on ROC for various classes of signals, Properties of Laplace transforms.

**Z-Transforms:** Concept of Z-transform of a discrete sequence, Region of convergence in Z-Transform, constraints on ROC for various classes of signals, inverse Z-transform, properties of Z-Transforms.

#### **Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the basic concepts of Laplace and Z transforms (L1)
- Apply the transform techniques to solve the problems (L2)

### **UNIT – IV:**

#### **FAST FOURIER TRANSFORMS**

Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Radix-2 Fast Fourier Transforms (FFT), Decimation in Time and Decimation in Frequency FFT Algorithms: radix-2 DIT-FFT, DIF-FFT, and Inverse FFT: IDFT-FFT.

#### **Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the importance of DTFT, DFT, FFT and their inverse transforms with respect to signals and systems (L1)
- Analyze the Decimation in time and frequency algorithms (L3)

### **UNIT – V:**

#### **IIR AND FIR DIGITAL FILTERS**

**IIR DIGITAL FILTERS:** Analog filters approximations: Butterworth and Chebyshev, Design of IIR digital filters from analog filters. Realization of IIR filters: Direct form-I, Direct form-II, cascade form and parallel form.

**FIR DIGITAL FILTERS:** Characteristics of FIR digital filters, frequency response. Design of FIR digital filters using window techniques: Rectangular window, Triangular or Bartlett window, Hamming window, Hanning window, Blackman window. Realization of FIR filters: Linear phase and Lattice structures.

## **Learning Outcomes:**

At the end of this student, the student will be able to

- Understand the importance of IIR and FIR digital Filters (L1)
- Realize IIR filters and analyze various windowing techniques in FIR filters (L2)
- Design IIR and FIR filters (L4)

## **Course outcomes:**

- Define basic signals and its operations, Classify discrete time signals and systems.
- Solve Laplace Transform and z-Transform for various signals, Calculate DFT of a given sequence by using Fast Fourier Transform.
- Analyze the continuous and discrete signals and systems
- Design and realize IIR and FIR filters from the given specifications.

## **TEXT BOOKS:**

1. B. P. Lathi, "Signals, Systems and Communications", BS Publications, 2008.
2. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications", 4<sup>th</sup> edition , Pearson Education/PHI, 2007.
3. A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", 2<sup>nd</sup> edition., PHI.

## **REFERENCES:**

1. A.V. Oppenheim, A.S. Will sky and S.H. Nawab, "Signals and Systems", PHI, 2<sup>nd</sup> Edition, 2013.
2. A. Anand Kumar, "Signals and Systems", PHI Publications, Third Edition, 2013
3. P. Ramesh Babu. "Digital Signal Processing".
4. Andreas Antoniou, "Digital signal processing", Tata McGraw Hill, 2006.
5. R S Kaler, M Kulkarni,, Umesh Gupta, "A Text book on Digital Signal processing" –I K International Publishing House Pvt. Ltd.
6. M H Hayes, Schaum's Outlines, "Digital Signal Processing", Tata Mc-Graw Hill, 2007.

**(19A05704a) FUNDAMENTALS OF GAME DEVELOPMENT**

**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Get familiarized with the various components in a game and game engine.
- Explore the leading open source game engine components.
- Elaborate on game physics.
- Introduce to the game animation.
- Expose to network-based gaming issues.

**Unit – 1: Introduction to Game**

What is a Game? The Birth of Games, The Rise of Arcade Games, The Crash and Recovery, The Console Wars, Online Games and Beyond.

**The Game Industry:** Game Industry Overview, Game Concept Basics, Pitch Documentation, pitching a Game to a Publisher, Managing the developer-Publisher Relationship, Legal Agreements, Licenses, Console Manufacturers Approval.

**Roles on the Team:** Production, Art, Engineering, Design, Quality Assurance Testing, Team Organization, Corporate.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Demonstrate online games and beyond. [L2]
- Outline the process carried out in the Game Industry [L2]
- Inspect the roles on the Team[L4]

**Unit – 2: Teams**

Project Leadership, Picking Leads, Team Building, Team Buy-in and Motivation.

**Effective Communication:** Written Communication, Oral Communication, Nonverbal Communication, Establishing Communication Norms, Communication Challenges.

**Game Production Overview:** Production Cycle, Preproduction, Production, Testing, Postproduction.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Build a team and pick a leader. [L6]
- Develop Effective communication. [L3]
- Outline the Game Production cycle [L2]

### **Unit – 3: Game Concept**

Introduction, Beginning the Process, Defining the Concept, Game Programming Basics, Prototyping, Risk Analysis, Pitch Idea, Project Kickoff.

**Characters, setting, and Story:** Story Development, Gameplay, Characters, Setting, Dialogue, Cinematics, Story Documentation.

**Game Requirements:** Define Game Features, Define Milestones and Deliverables, Evaluate Technology, Define Tools and Pipeline, Documentation, Approval, Game Requirements Outline

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Design a game. [L6]
- Demonstrate the game play. [L2]
- Identify the Game requirements [L3]

### **Unit – 4 : Game Plan**

Dependencies, Schedules, Budgets, Staffing, Outsourcing, Middleware, Game Plan Outline.

**Production Cycle:** Design Production Cycle, Art Production Cycle, Engineering Production Cycle, Working Together.

**Voiceover and Music:** Planning for Voiceover, choosing a Sound Studio, Casting Actors, Recording Voiceover, Voiceover Checklist, Planning for Music, Working with a Composer, Licensing Music.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the Game plan. [L2]
- Define the production cycle. [L1]
- Make use of voiceover and music in game development. [L3]

### **Unit – 5 :Localization**

Creating International Content, Localization-Friendly Code, Level of Localization, Localization Plan, Testing, Localization Checklist.

**Testing and Code Releasing:** Testing Schedule, Test Plans, Testing Pipeline, Testing Cycle, External Testing, Determining Code Release, Code Release Checklist, Gold Masters, Postmortems.

**Marketing and Public Relations:** Software Age Ratings, Working with Marketing, Packaging, Demos, Marketing Assets, Game Builds, Working with Public Relations, Asset Deliverable Checklist.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the importance of localization. [L2]
- Summarize Testing and code releasing [L2]
- Illustrate Marketing and public relations. [L2]

**Course Outcomes:**

Upon completion of the course, the students should be able to:

- Design games for commercialization (L6)
- Predict the trends in game development (L5)
- Design Game Plan and production cycle (L6)
- Dramatize the game playing environment (L4)

**Text Book:**

1. Heather Maxwell Chandler, and Rafael Chandler, “Fundamentals of Game Development”, Jones& Bartlett Learning, 2011.

**References:**

1. Flint Dille and John Zuur Platten, The Ultimate guide to Video Game Writing, Loan Eagle publisher, 2008.
2. Adams, Fundamentals of Game Design, 3<sup>rd</sup> edition, Pearson Education India, 2015.

**(19A05704b) CYBER SECURITY**  
**(Common to CSE & IT)**

**Course Objectives:**

This course is designed to:

- Understand essential building blocks and basic concepts of cyber security
- Explore Web security and Network security
- Explain the measures for securing the networks and cloud
- Understand privacy principles and policies
- Describe the legal issues and ethics in computer security

**UNIT I**

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography.

Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain Vulnerabilities, threats and. Counter measures for computer security[L2]
- Interpret the design of the malicious code [L2]

**UNIT II**

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the attacks on browser, Web and email. [L2]
- Explain the security aspects of Operating Systems. [L3]

**UNIT III**

Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses:

Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management .

Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Identify the network security threats and attacks. [L3]
- Design the Counter measures to defend the network security attacks. [L6]
- Analyze the security tools and techniques for Cloud computing [L4]

### **UNIT IV**

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed.

Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Interpret the need for Privacy and its impacts of Emerging Technologies. [L2]
- Explain how to handle incidents and deal with Disaster. [L2]

### **UNIT V**

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics, Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Adapt legal issues and ethics in computer security. [L6]
- Elaborate on the Emerging topics. [L6]

### **Course Outcomes:**

Upon completion of the course, the students should be able to:

- Illustrate the broad set of technical, social & political aspects of Cyber Security and



security management methods to maintain security protection (L2)

- Assess the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure (L5)
- Identify the nature of secure software development and operating systems (L3)
- Demonstrate the role security management in cyber security defense (L2)
- Adapt the legal and social issues at play in developing solutions.(L6)

**Text Books:**

- 1) Pfleeger, C.P., Security in Computing, Prentice Hall, 2010, 5th edition.
- 2) Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996

**Reference Books:**

- 1) Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice, McGraw-Hill, 2013.
- 2) Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.

**(19A27704a) CORPORATE GOVERNANCE IN FOOD INDUSTRIES  
OPEN ELECTIVE III**

**PREAMBLE**

This text focuses on corporate governance, business ethics and emerging trends in food industries.

**Course Objectives**

- To understand the concepts of corporate governance in view of food industry

**UNIT – I**

Corporate Governance- A Conceptual Foundation: Concept, nature, issues and importance of corporate governance, origin and development of corporate governance, concept of corporate management, Different models of corporate governance, corporate governance in family business, corporate governance failure with examples.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Concept, nature, issues and importance of corporate governance
- origin and development of corporate governance, concept of corporate management
- Different models of corporate governance
- corporate governance in family business, corporate governance failure with examples

**UNIT – II**

Role Players: Role of various players viz. Role of shareholders their rights and responsibilities, Role of board of directors in corporate governance- executive and non executive directors, independent and nominee directors, Role of Auditors, audit committee, media.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Role of shareholders their rights and responsibilities
- Role of board of directors in corporate governance- executive and non executive directors, independent and nominee directors

- Role of Auditors, audit committee, media.

### **UNIT – III**

Corporate governance in India and the Global Scenario: Corporate Governance practices /codes in India, UK, Japan, USA. Contributions of CII-recommendations on corporate governance by different committees in India, SEBI guidelines, Kumar Manglam Birla Committee, Naresh Chandra committee Report, OECD Principles, Cadbury Committee

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Corporate Governance practices /codes in India, UK, Japan, USA.
- Contributions of CII-recommendations on corporate governance by different committees in India, SEBI guidelines,
- Have detail study of committees like Kumar Manglam Birla Committee, Naresh Chandra committee Report, OECD Principles, Cadbury Committee

### **UNIT – IV**

Emerging trends: Emerging Trends and latest developments in Corporate Governance. Corporate Governance initiative in India and Abroad, Corporate Governance Rating- Role of rating agencies in corporate governance. ICRA Corporate governance rating method for examining the quality and effectiveness of corporate governance.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Emerging Trends and latest developments in Corporate Governance.
- Corporate Governance initiative in India and Abroad,
- Corporate Governance Rating- Role of rating agencies in corporate governance
- ICRA Corporate governance rating method for examining the quality and effectiveness of corporate governance.

### **UNIT – V**

Business ethics and corporate governance. Social responsibility and corporate governance. Corporate governance and value creation. Political economy of corporate governance.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Business ethics and corporate governance.

- Social responsibility and corporate governance.
- Corporate governance and value creation.
- Political economy of corporate governance.

**Course Outcomes:**

By the end of the course, the students will

- Attain knowledge on system of corporate governance in food industries.
- Get to know about business ethics and values.

**TEXT BOOKS**

1. Subhash Chandra Das, “Corporate Governance in India”, PHI Pvt. Ltd., New Delhi(2008),
2. Dennis Campbell, “Susan Woodley Trends and Developments In Corporate Governance”. (2004)

**REFERENCES**

1. Jayati Sarkar. “Corporate Governance in India”. Sage Publications, New Delhi,2012.
2. Vasudha, Joshi “Corporate Governance The Indian Scenario”. Foundations Books Pvt. Ltd. New Delhi. 2012,

**(19A27704b) PROCESS TECHNOLOGY FOR CONVENIENCE & RTE FOODS**  
**OPEN ELECTIVE III**

**PREAMBLE**

This text focuses on various aspects and technologies involved in processing of convenience and Read-to-eat foods.

**Course Objectives:**

- To understand the importance and demand for convenience foods in present day scenario
- To learn the various technical aspects of convenience and Read-to-eat foods.

**UNIT – I**

Overview of grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes  
Coated grains-salted, spiced and sweetened Flour based snack– batter and dough based products;  
savoury and farsans; formulated chips and wafers, papads.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Role of cereal based ingredients in snacks industries.
- Various technologies and equipments involved in Snacks industries

**UNIT – II**

Technology for fruit and vegetable based snacks: chips, wafers, papads etc. Technology of ready to eat fruits and vegetable based food products like, sauces, fruit bars, glazed candy etc. Technology of ready to eat canned value added fruits/vegetables and mixes and ready to serve beverages etc.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Role of Fruits and vegetables in convenience products.
- Processing of various Fruit and vegetable based products.

### **UNIT – III**

Technology of ready- to- eat baked food products, drying, toasting roasting and flaking, coating, chipping. Extruded snack foods: Formulation and processing technology, colouring, flavouring and packaging. Technology for coated nuts – salted, spiced and sweetened products- chikkis, Sing bhujia.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Various methods involved in processing of ready to eat baked products
- Various methods involved in processing of extruded snack foods
- Technology involved in processing different coated nuts

### **UNIT IV**

Technology for ready-to-cook food products- different puddings and curried vegetables etc. Technology for ready-to-cook and ready to eat meat and meat food products. Technology for preparation of instant cooked rice, carrot and other cereals based food products.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Technology involved in processing different ready to cook food products
- Technology involved in processing different ready to cook and ready to eat meat and meat products
- Technology involved in processing different instant cooked cereal products

### **UNIT – V**

Technology of ready to eat instant premixes based on cereals, pulses etc. Technology for RTE puffed snack- sand puffing, hot air puffing, explosion puffing, gun puffing etc. Technology for preparation of traditional Indian dairy products.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Technology involved in processing different ready to eat instant premixes based on cereals and pulses and etc.
- Technology involved in processing different RTE puffed snacks
- Technology involved in processing different traditional dairy products

## **Course Outcomes:**

By end of the course students will understand

- Technology for processing ready to eat and ready cook different products and equipment used for manufacturing of RTE products

## **TEXT BOOKS**

1. Edmund WL. "Snack Foods Processing". AVI Publ.
2. Kamaliya M.K and Kamaliya K.B. 2001. Vol.1 and 2, "Baking Science and Industries", M.K.Kamaliya Publisher, Anand.

## **REFERENCES**

1. Frame ND . "Technology of Extrusion Cooking". Blackie Academic1994. .
2. Gordon BR. "Snack Food", AVI Publ, 1997.
3. Samuel AM. "Snack Food Technology", AVI Publ. 1976.

(19A54704a) NUMERICAL METHODS FOR ENGINEERS  
OPEN ELECTIVE-III  
(ECE , CSE, IT & CIVIL)

**Course objectives:**

This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.

**UNIT-I:**

**Solution of Algebraic & Transcendental Equations:**

Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method. System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

**Learning Outcomes:**

Students will be able to

- Calculate the roots of equation using Bisection method and Iterative method.
- Calculate the roots of equation using Regula falsi method and Newton Raphson method.
- Solve the system of algebraic equations using Gauss Jordan method and Gauss Siedal method.

**UNIT-II:**

**Curve Fitting**

Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves.

**Learning Outcomes:**

Students will be able to

- understand curve fitting
- understand fitting of several types of curves

**UNIT-III:**

**Interpolation**

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.



### **Learning Outcomes:**

Students will be able to

- Understand the concept of interpolation.
- Derive interpolating polynomial using Newton's forward and backward formulae.
- Derive interpolating polynomial using Lagrange's formulae.
- Derive interpolating polynomial using Gauss forward and backward formulae.

### **UNIT-IV:**

#### **Numerical Integration**

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

### **Learning Outcomes:**

Students will be able to

- Solve integral equations using Simpson's 1/3 and Simpson's 3/8 rule.
- Solve integral equations using Trapezoidal rule.

### **UNIT-V:**

#### **Solution of Initial value problems to Ordinary differential equations**

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

### **Learning Outcomes:**

Students will be able to

- Solve initial value problems to ordinary differential equations using Taylor's method.
- Solve initial value problems to ordinary differential equations using Euler's method and Runge Kutta methods.

### **Course Outcomes:**

After the completion of course, students will be able to

- Apply numerical methods to solve algebraic and transcendental equations.
- Understand fitting of several kinds of curves.
- Derive interpolating polynomials using interpolation formulae.
- Solve differential and integral equations numerically.

### **Text Books:**

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers.
2. Ronald E. "Probability and Statistics for Engineers and Scientists", Walpole, PNIE.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India

**Reference Books:**

1. B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hill publishers.
2. Alan Jeffrey, "Advanced Engineering Mathematics", Elsevier.

**(19A51704a) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS**

Course Objectives:

- To understand synthetic principles of Nanomaterials by various methods
- And also characterise the synthetic nanomaterials by various instrumental methods
- To enumerate the applications of nanomaterials in engineering

**Unit I:**

**Introduction:** Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.

**Synthetic Methods: Bottom-Up approach:-** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Classify the nanostructure materials (L2)
- Describe scope of nano science and technology (L2)
- Explain different synthetic methods of nano materials (L2)
- Identify the synthetic methods of nanomaterial which is suitable for preparation of particular material (L3)

UNIT-II

**Top-Down approach:-** Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe the top down approach (L2)
- Explain aerosol synthesis and plasma arc technique (L2)
- Differentiate chemical vapour deposition method and electrodeposition method (L2)
- Discuss about high energy ball milling (L3)

### UNIT-III

**Techniques for characterization:** Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Discuss different techniques for characterization of nanomaterial (L3)
- Explain electron microscopy techniques for characterization of nanomaterial (L3)
- Describe BET method for surface area analysis (L2)
- Apply different spectroscopic techniques for characterization (L3)

### UNIT-IV

**Studies of Nano-structured Materials:** Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self-assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Explain synthesis and properties and applications of nanomaterials (L2)
- Discuss about fullerenes and carbon nanotubes (L3)
- Differentiate nanomagnetic materials and thermoelectric materials (L2)
- Describe liquid crystals (L2)

### UNIT.V

Engineering Applications of Nanomaterials

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Illustrate applications of nanomaterials (L2)
- Discuss the magnetic applications of nanomaterials (L3)
- List the applications of non-linear optical materials (L1)

- Describe the applications fullerenes, carbon nanotubes (L2)

### **Course Outcome**

At the end of the course, the student will be able to:

- Understand the state of art synthesis of nano materials
- Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
- Analyze nanoscale structure in metals, polymers and ceramics
- Analyze structure-property relationship in coarser scale structures
- Understand structures of carbon nano tubes

### **TEXT BOOKS:**

1. **NANO: The Essentials** : T Pradeep, MaGraw-Hill, 2007.
2. **Textbook of Nanoscience and nanotechnology:** B S Murty, P Shankar, Baldev Rai, BB Rath and James Murday, Univ. Press, 2012.

### **REFERENCE BOOKS:**

1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.
2. **Nanostructures & Nanomaterials; Synthesis, Properties & Applications:** Guozhong Cao, Imperial College Press, 2007.
3. **Nanomaterials Chemistry**, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

**HUMANITIES ELECTIVE-II**

**(19A52701a) ORGANISATIONAL BEHAVIOUR**

**Course Objectives :**

The objectives of this course are

- To make the student understand about the organizational behavior
- To enable them to develop self motivation, leadership and management
- To facilitate them to become powerful leaders
- Impart knowledge about group dynamics
- To make them understand the importance of change and development

**Syllabus**

**UNIT-I**

Organizational Behavior - Introduction to OB - Meaning and definition, scope - Organizing Process – Making organizing effective - Understanding Individual Behavior – Attitude - Perception - Learning - Personality Types

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of Organizational Behavior
- Contrast and compare Individual & Group Behavior and attitude
- Analyze Perceptions
- Evaluate personality types

**UNIT-II**

Motivation and Leading - Theories of Motivation - Maslow's Hierarchy of Needs - Herzberg's Two Factor Theory - Leading - Leading Vs Managing

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of Motivation
- Understand the Theories of motivation
- Explain how employees are motivated according to Maslow's Needs Hierarchy
- Compare and contrast leading and managing

### **UNIT-III**

Leadership and Organizational Culture and Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader - Conflict Management - Evaluating Leader - Women and Corporate leadership.

#### **Learning Outcomes:**

After completion of this unit student will

- Know the concept of Leadership
- Contrast and compare Traits theory and Managerial Grid
- Know the difference between Transactional and Transformational Leadership
- Evaluate the qualities of good leaders
- Emerge as the good leader

### **UNIT – IV**

Group Dynamics - Types of groups - Determinants of group behavior - Group process – Group Development - Group norms - Group cohesiveness - Small Groups - Group decision making - Team building - Conflict in the organization – Conflict resolution

#### **Learning Outcomes:**

After completion of this unit student will

- Know the concept of Group Dynamics
- Contrast and compare Group behavior and group development
- Analyze Group decision making
- Know how to resolve conflicts in the organization

### **UNIT - V**

Organizational Change and Development - Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development

#### **Learning Outcomes:**

- After completion of this unit student will
- Know the importance of organizational change and development
- Apply change management in the organization
- Analyze work stress management
- Evaluate Managerial implications of organization

#### **Course outcomes:**

At the end of the course, students will be able to

- Understand the nature and concept of Organizational behavior
- Apply theories of motivation to analyze the performance problems
- Analyze the different theories of leadership
- Evaluate group dynamics
- Develop as powerful leader

**TEXT BOOKS:**

1. Luthans, Fred, “Organisational Behaviour” , McGraw-Hill, 12 Th edition 2011
2. P Subba Rao, Organisational Behaviour, Himalya Publishing House 2017

**REFERENCES BOOKS:**

1. McShane, “Organizational Behaviour”, TMH 2009
2. Nelson, “Organisational Behaviour”, Thomson, 2009.
3. Robbins, P.Stephen, Timothy A. Judge, “Organisational Behaviour”, Pearson 2009.
4. Aswathappa, “Organisational Behaviour”, Himalaya, 2009



(19A52701b) MANAGEMENT SCIENCE

**Course objectives :**

The objectives of this course are

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in management

**Syllabus**

**UNIT- I**

**INTRODUCTION TO MANAGEMENT**

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

**Learning Outcomes:**

At the end if the Unit, the learners will be able to

- Understand the concept of management and organization
- Apply the concepts & principles of management in real life industry.
- Analyze the organization chart & structure for an enterprise.
- Evaluate and interpret the theories and the modern organization theory.

**UNIT II**

**OPERATIONS MANAGEMENT**

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control - Deming's contribution to Quality. **Material**

**Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management** - Concept - Meaning - Nature- Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand the core concepts of Management Science and Operations Management
- Apply the knowledge of Quality Control, Work-study principles in real life industry.
- Evaluate Materials departments & Determine EOQ
- Analyze Marketing Mix Strategies for an enterprise.
- Create and design advertising and sales promotion

## **UNIT III**

### **HUMAN RESOURCES MANAGEMENT (HRM)**

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

### **Learning Outcomes:**

At the end if the Unit, the learners will

- Understand the concepts of HRM in Recruitment, Selection, Training & Development
- Apply Managerial and operative Functions
- Analyze the need of training
- Evaluate performance appraisal
- Design the basic structure of salaries and wages

## **UNIT IV STRATEGIC & PROJECT MANAGEMENT**

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management** - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

### **Learning Outcomes:**

At the end of the Unit, the learners will be able to

- Understand Mission, Objectives, Goals & strategies for an enterprise
- Apply SWOT Analysis to strengthen the project
- Analyze Strategy formulation and implementation
- Evaluate PERT and CPM Techniques
- Creative in completing the projects within given time

## **UNIT V**

### **CONTEMPORARY ISSUES IN MANAGEMENT**

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

#### **Learning Outcomes:**

At the end if the Unit, the learners will be able to

- Understand modern management techniques
- Apply Knowledge in Understanding in modern
- Analyze CRM, MRP, TQM
- Evaluate Six Sigma concept and SCM

#### **Course Outcomes:**

At the end of the course, students will be able to

- Understand the concepts & principles of management and designs of organization in a practical world
- Apply the knowledge of Work-study principles & Quality Control techniques in industry
- Analyze the concepts of HRM in Recruitment, Selection and Training & Development.
- Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
- Create Modern technology in management science.

#### **TEXT BOOKS:**

1. A.R Aryasri, "Management Science", TMH, 2013

2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

**REFERENCES:**

1. Koontz & Weihrich, “Essentials of Management”, 6<sup>th</sup> edition, TMH, 2005.
2. Thomas N.Duening & John M.Ivancevich, “Management Principles and Guidelines”, Biztantra.
3. Kanishka Bedi, “Production and Operations Management”, Oxford University Press, 2004.
4. Samuel C.Certo, “Modern Management”, 9<sup>th</sup> edition, PHI, 2005

**(19A52701c) BUSINESS ENVIRONMENT**

**Course Objectives :**

The objectives of this course are

- To make the student understand about the business environment
- To enable them in knowing the importance of fiscal and monetary policy
- To facilitate them in understanding the export policy of the country
- Impart knowledge about the functioning and role of WTO
- Encourage the student in knowing the structure of stock markets

**Syllabus**

**UNIT – I**

**An Overview of Business Environment** – Types of Environment - Internal & External - Micro and Macro environment - Competitive structure of industries - Environmental analysis - Scope of business - Characteristics of business - Process & limitations of environmental analysis.

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of Business environment
- Explain various types of business environment
- Know about the environmental analysis of business
- Understand the business process

**UNIT – II**

**FISCAL POLICY** - Public Revenues - Public Expenditure - Public debt - Development activities financed by public expenditure - Evaluation of recent fiscal policy of Government of India - Highlights of Budget - **MONETARY POLICY** - Demand and Supply of Money – RBI -Objectives of monetary and credit policy - Recent trends - Role of Finance Commission.

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of public revenue and public Expenditure
- Explain the functions of RBI and its role
- Analyze the Monetary policy in India
- Know the recent trends and the role of Finance Commission in the development of our country
- Differentiate between Fiscal and Monetary Policy

### **UNIT – III**

**INDIA'S TRADE POLICY** - Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank - **BALANCE OF PAYMENTS** – Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the role of Indian international trade
- Understand and explain the need for Export and EXIM Policies
- Analyze causes for Disequilibrium and correction measure
- Differentiate between Bilateral and Multilateral Trade Agreements

### **UNIT – IV**

**WORLD TRADE ORGANIZATION** - Nature and Scope - Organization and Structure - Role and functions of WTO in promoting world trade - Agreements in the Uruguay Round – TRIPS, TRIMS, and GATT - Disputes Settlement Mechanism - Dumping and Anti-dumping Measures.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the role of WTO in trade
- Analyze Agreements on trade by WTO
- Understand the Dispute Settlement Mechanism
- Compare and contrast the Dumping and Anti-dumping Measures.

### **UNIT – V**

**MONEY MARKETS AND CAPITAL MARKETS** - Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI - Stock Exchanges - Investor protection and role of SEBI.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the components of Indian financial system
- Know the structure of Money markets and Capital markets
- Analyze the Stock Markets

- Apply the knowledge in future investments
- Understand the role of SEBI in investor protection.

### **Course Outcomes:**

At the end of the course, students will be able to

- Understand various types of business environment.
- Understand the role of WTO
- Apply the knowledge of Money markets in future investment
- Analyze India's Trade Policy
- Evaluate fiscal and monetary policy
- Develop a personal synthesis and approach for identifying business opportunities

### **TEXT BOOKS:**

1. Francis Cherunilam (2009), "International Business": Text and Cases, Prentice Hall of India.
2. K. Aswathappa, "Essentials of Business Environment": Texts and Cases & Exercises 13th Revised Edition. HPH 2016.

### **REFERENCE BOOKS:**

1. K. V. Sivayya, V. B. M Das (2009), Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black (2009), International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N (2009), International Business, Wiley India.
4. E. Bhattacharya (2009), International Business, Excel Publications, New Delhi.

**(19A52701d) STRATEGIC MANAGEMENT**

**Course objectives :**

The objectives of this course are

- To introduce the concepts of strategic management and understand its nature in
- competitive and organizational landscape
- To provide an understanding of internal and external analysis of a firm/individual
- To provide understanding of strategy formulation process and frame work
- Impart knowledge of Corporate culture
- Encourage the student in understanding SWOT analysis BCG Matrix

**Syllabus**

**UNIT: I**

**Introduction of Strategic Management:** meaning, nature, importance and relevance. The Strategic Management Process: – Corporate, Business and Functional Levels of strategy. Vision, mission and purpose –Business definition, objectives and goals – Stakeholders in business and their roles in strategic management. Balance scorecard.

**Learning Outcomes:**

After completion of this unit student will

- Understand the meaning and importance of strategic management
- Explain Strategic Management Process and Corporate, Business
- Know about the Business definition, objectives and goals
- Understand Stakeholders their roles in strategic management

**UNIT: II**

**External and Internal Analysis:** The Strategically relevant components of a Company's External Environment Analysis, Industry Analysis - Porter's Five Forces model – Industry driving forces – Key Success Factors. Analyzing a company's resources and competitive position

**Learning Outcomes:**

After completion of this unit student will

- Understand the components of a Company's environment
- Explain External Environment Analysis, Industry Analysis
- Know how to analyze industry competition through the Porter's Five Forces model



- Analyze Key Success Factors in a company's competitive position

### **UNIT: III**

**Competitive Strategies:** Generic Competitive Strategies: Low cost, Differentiation, Focus. Grand Strategies: Stability, Growth (Diversification Strategies, Vertical Integration Strategies, Mergers, Acquisition & Takeover Strategies, Strategic Alliances & Collaborative Partnerships), Retrenchment, Outsourcing Strategies. Tailoring strategy to fit specific industry – Life Cycle Analysis - Emerging, Growing, Mature & Declining Industries.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the Competitive Strategies
- Explain Stability, Growth Mergers, Acquisition & Takeover Strategies
- Know about the Retrenchment, Outsourcing Strategies
- Differentiate Life Cycle Analysis, Mature & Declining Industries

### **UNIT: IV**

**Strategy Implementation and control** - Strategy implementation; Organization Structure – Matching structure and strategy. Behavioral issues in implementation – Corporate culture – Mc Kinsey's 7s Framework. Functional issues – Functional plans and policies – Financial, Marketing, Operations, Personnel, IT.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the Organization Structure
- Explain Matching structure and strategy
- Know about the Corporate culture
- Analyze Functional plans and policies

### **Unit: V**

**Strategy Evaluation:** Strategy Evaluation – Operations Control and Strategic Control- Relationship between a Company's Strategy and its Business Model.- SWOT analysis – Value Chain Analysis – Benchmarking- Portfolio Analysis: BCG Matrix – GE 9 Cell Model.

#### **Learning Outcomes:**

After completion of this unit student will

- Understand the Operations Control and Strategic Control
- Explain Company's Strategy and its Business Model
- Know about the SWOT analysis
- Analyze BCG Matrix and GE 9 Cell Model

## **Course Outcomes:**

At the end of the course, students will be able to

- Understand the relevance and importance of strategic management
- Explain industry driving forces
- Analyze the competitive strategy
  
- Evaluate strategy implementation and control
- Create SWOT Analysis

## **Suggested Text Books and References**

### **TEXT BOOKS:**

1. Arthur A. Thompson Jr., AJ Strickland III, John E Gamble, “Crafting and Executing Strategy”, 18th edition, Tata McGraw Hill, 2012.
2. Subba Rao P, “Business Policy and Strategic Management” –HPH

### **REFERENCES:**

1. Robert A. Pitts & David Lei, “Strategic Management: Building and Sustaining Competitive Advantage” 4th edition, Cengage Learning.
2. Hunger, J. David, “Essentials of Strategic Management” 5<sup>th</sup> edition, Pearson.
3. Ashwathappa, “Business Environment for Strategic Management”, HPH.

(19A52701e) E-BUSINESS

**Course Objectives:**

- To provide knowledge on emerging concept on E-Business related aspect.
- To understand various electronic markets models which are trending in India
- To give detailed information about electronic payment systems net banking.
- To exact awareness on internet advertising, market research strategies and supply chain management.
- To understand about various internet protocols-security related concept.

**SYLLABUS**

**UNIT – I**

**Electronic Business:** Definition of Electronic Business - Functions of Electronic Commerce (EC) - Advantages of E-Commerce – E-Commerce and E-Business Internet Services Online Shopping-Commerce Opportunities for Industries.

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of E-Business
- Contrast and compare E-Commerce E-Business
- Analyze Advantages of E-Commerce
- Evaluate opportunities of E-commerce for industry

**UNIT – II**

**Electronic Markets and Business Models:**E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals - Business Models-Business to Business(B2B)-Business to Customers(B2C)-Business to Government(B2G)-Auctions-B2B Portals in India

**Learning Outcomes:**

After completion of this unit student will

- Understand the concept of business models
- Contrast and compare Vertical portal and Horizontal portals
- Analyze Advantages of portals
- Explain the B2B,B2C and B2G model

## UNIT – III

**Electronic Payment Systems:** Digital Payment Requirements-Designing E-payment System-Electronic Fund Transfer (EFT)-Electronic Data Interchange (EDT)-Credit Cards-Debit Cards-E-Cash-Electronic Cheques -Smart Cards-Net Banking-Digital Signature.

### Learning Outcomes:

After completion of this unit student will

- Understand the Electronic payment system
- Contrast and compare EFT and EDT
- Analyze debit card and credit card
- Explain the on Digital signature

## UNIT – IV

**E-Security:** Internet Protocols - Security on the Internet –Network and Website Security – Firewalls –Encryption – Access Control – Secure Electronic transactions.

### Learning Outcomes:

After completion of this unit student will

- Understand E-Security
- Contrast and compare security and network
- Analyze Encryption
- Evaluate electronic transitions

## UNIT – V

**E-Marketing:** Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Online Market Research– Data mining and Marketing Research Marketing Strategy On the Web – E-Customer Relationship Management(e-CRM) –E- Supply Chain Management.(e-SCM) –New Trends in Supply Chain Management.

### Learning Outcomes:

After completion of this unit student will

- Understand the concept of online marketing
- Analyze advantages of online marketing
- Compare the e-CRM and e-SCM
- Explain the New trends in supply chain management

**Course Outcomes:**

- They will be able to identify the priority of E-Commerce in the present globalised world.
- Will be able to understand E-market-Models which are practicing by the organization
- Will be able to recognize various E-payment systems & importance of net banking.
- By knowing E-advertisement, market research strategies, they can identify the importance of customer role.
- By understanding about E-security, they can ensure better access control to secure the information.

**TEXT BOOKS:**

3. C.S.V Murthy “E-Commerce”, Himalaya publication house, 2002.
4. P.T.S Joseph, “E-Commerce” , 4<sup>th</sup> Edition, Prentice Hall of India 2011

**REFERENCES:**

5. KamaleshKBajaj,DebjaniNa, “E-Commerce”, 2<sup>nd</sup> Edition TataMcGrwHills 2005
6. Dave Chaffey – “E-Commerce E-Management”, 2<sup>nd</sup> Edition, Pearson, 2012.
7. Henry Chan, “E-Commerce Fundamentals and Application”, Raymond Lee,Tharm Wiley India 2007
8. S. Jaiswall “E-Commerce”, Galgotia Publication Pvt Ltd 2003.

(19A04701P) MICROWAVE AND OPTICAL COMMUNICATIONS LAB

**Note: All the experiments shall be conducted and there is no choice.**

**Microwave Engineering:**

1. Set up the Full Microwave bench and know the importance of each block. Identify the pin configuration of Reflex Klystron with the help of its power supply cable connected from the power supply unit. Also identify the Microwave signal coupling from Klystron Oscillator to the waveguide.
2. Make use of the bench set up and conduct the experiment to find mode characteristics of Reflex Klystron: (i) Repeller voltage vs output power (ii) Repeller voltage vs Frequency.
3. Measurement of Frequency and wavelength of generated Microwave signal using Reflex Klystron oscillator.
4. Verify the negative resistance characteristics of Gunn oscillator using the Microwave bench set up with Gunn oscillator set up.
5. Find the Scattering matrix of E-plane, H-plane, and Magic Tees experimentally.
6. Make use of Microwave bench setup to find VSWR and impedance of an unknown load that is connected at the end of the bench set up. Make use of VSWR meter for the measurement of VSWR of a given load.
7. Determine directivity, insertion loss and coupling factor of a given Directional Coupler experimentally.
8. Making use of Microwave bench set up, find the radiation characteristics in both the planes and determine HPBW and directivity of a pyramidal horn antenna.

**Optical Communication:**

9. Conduct the experiment to draw the DC characteristics of LED and Photo diode.
10. Make use of Fiber optic kit to determine the **numerical aperture** and **bending losses** of a given optical fiber (transmission line).
11. Establish an optical link between transmitter and receiver and determine the signal strength at the receiver. Give the comments about the experiment by transmitting (i) **analog signal** (ii) **digital signal**.
12. Attenuation measurement in Fibers for various lengths.

**Course Outcomes:**

- Understand the mode characteristics of Reflex Klystron oscillator and negative resistance characteristics of Gunn Oscillator.
- Determine the Scattering matrix of given passive device experimentally and verify the same theoretically. Also determine numerical aperture and bending losses of a given optical fiber
- Analyze the radiation characteristics to find the directivity and HPBW of a given antenna.
- Establish optical link between transmitter and receiver **experimentally** to find attenuation and signal strength of the received signal.

**(19A04702P) VLSI DESIGN LABORATORY**

**Objectives:**

- To understand and develop HDL source code for the given problem/experiment
- To analyze the obtained results of the given experiment/problem
- To simulate the given circuit with suitable simulator and verify the results
- To understand how to use FPGA/CPLD hardware tools in the lab
- To design and implement the experiments using FPGA/CPLD hardware tools

**List of Experiments:**

**PART (A): FPGA Level Implementation (Any Seven Experiments)**

**Note 1:** The students need to develop VHDL Source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary synthesizer.

**Note 2:** All the experiments need to be implemented on the latest FPGA/CPLD Hardware in the Laboratory.

1. Realization of Logic gates

**Design and Implementation of the following**

2. 4-bit ripple carry and carry look ahead adder using behavioral, dataflow and structural modelling
  - a) 16:1 mux through 4:1 mux
  - b) 3:8 decoder realization through 2:4 decoder
3. 8:3 encoder
4. 8-bit parity generator and checker
5. Flip-Flops
6. 8 bit synchronous up-down counter
7. 4bit sequence detector through Mealy and Moore state machines.

**EDA Tools/Hardware Required:**

1. EDA Tool that supports FPGA Programming including Xilinx Vivado / Altera (Intel) / Cypress / Equivalent Industry Standard tool along with corresponding FPGA Hardware.
2. Desktop Computer with appropriate Operating system that supports the EDA tools.

**PART (B): Back-end Level Design and Implementation (Any Five Experiments)**

Note: The students need to design the following experiments at schematic level using CMOS logic and verify the functionality. Further students need to draw the corresponding layout and verify the functionality including parasites. Available state of the art technology libraries can be used while simulating the design using Industry standard EDA Tools.



## **Design and Implementation of the following**

1. Universal Gates
2. an Inverter
3. Full Adder
4. Full Subtractor
5. Decoder
6. D-Flip-Flop

### **EDA Tools/Hardware Required:**

1. Mentor Graphics Software / Cadence/Synopsys/Tanner or Equivalent Industry Standard Software/CAD Tool.
2. Desktop Computer with appropriate Operating system that supports the EDA tools.

### **Course Outcomes:**

- Understand how to use FPGA/CPLD hardware tools in the lab.
- Develop HDL source code for the given problem/experiment, and simulate the given circuit with suitable simulator and verify the results.
- Analyze the obtained results of the given experiment/problem.
- Design and implement the experiments using FPGA/CPLD hardware tools.

## **List of Experiments**

### **PART (A): Any Seven Experiments**

**Note 1:** The students need to develop VHDL Source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary synthesizer.

**Note 2:** All the experiments need to be implemented on the latest FPGA/CPLD Hardware in the Laboratory.

1. Realization of Logic gates
2. Design and Implementation of 4-bit ripple carry and carry look ahead adder using behavioral, dataflow and structural modelling
3. Design and Implementation of
  - a. 16:1 mux through 4:1 mux
  - b. 3:8 decoder realization through 2:4 decoder
4. Design and Implementation of 8:3 encoder
5. Design and Implementation of 8-bit parity generator and checker
6. Design and Implementation of different Flip-Flops
7. Design and Implementation of 8 bit synchronous up-down counter
8. Design and Implementation of 4bit sequence detector through Mealy and Moore state machines.

### **Equipment/Software required:**

1. FPGA Programming Software like Xilinx Vivado / Altera (Intel) / Cypress / Equivalent Industry Standard Software
2. FPGA Hardware like Xilinx / Altera (Intel) / Cypress / Equivalent Industry Standard Hardware
3. Personal computer system with necessary software to run the programs and Implement.

**PART (B): Any Five Experiments**

**Note:** The students need to design the schematic diagrams using CMOS logic and to draw the layout diagrams, to perform the following experiments using 130nm technology with the Industry standard EDA Tools.

1. Design and Implementation of Universal Gates
2. Design and Implementation of an Inverter
3. Design and Implementation of Full Adder
4. Design and Implementation of Full Subtractor
5. Design and Implementation of Decoder
6. Design and Implementation of D-Latch

**Software Required:**

1. Mentor Graphics Software / Cadence/Synopsys/Tanner or Equivalent Industry Standard Software/CAD Tool.
- b. Personal computer system with necessary software to run the programs and to implement.

(19A04801a) ADVANCED 3G AND 4G WIRELESS MOBILE COMMUNICATIONS  
Professional Elective - IV

**Course Objectives:**

- To understand the concepts of wireless communications and standards (L1).
- To apply a wireless technique to solve engineering problem (L2).
- To analyze working of wireless technologies (L3).
- To evaluate a wireless technique in a given situation (L4).
- To plan a wireless system for deployment (L5).

**UNIT-I:**

Introduction to 3G and 4G standards.

**Teletraffic Theory:**

Introduction to teletraffic theory, Cellular traffic modelling and blocking probability.

**Large Scale Path Loss:**

Introduction to wireless propagation models, Ground reflection model, Okumura model, Hata model, Link budget analysis, Log normal shadowing.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand the concept of a standard, teletraffic and signal loss model (L1).
- Apply a model to study the signal losses (L2).
- Analyze the suitability of a model to a given situation (L3).
- Evaluate a model in a given situation (L4).
- Plan a wireless system for deployment (L5).

**UNIT-II:**

**Small Scale Fading and Multipath:**

Fading in wireless channel, Rayleigh fading, BER in wired and wireless channels. Wireless channel and delay spread, Coherence bandwidth of wireless channel, ISI and Doppler in wireless channel, Doppler spectrum and Jake's model.

**Diversity Techniques:**

Introduction to diversity techniques, MRC for multi-antenna system, BER with diversity, Spatial diversity and diversity order.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand the concept of fading and diversity (L1).
- Apply a diversity technique to improve BER (L2)
- Compare various diversity techniques (L3)
- Evaluate channel model in a given situation (L4)

### **UNIT-III:**

#### **Code Division Multiple Access**

Introduction to CDMA, spread spectrum and LFSR. Generation and properties of PN sequences, Correlation of PN sequences and Jammer margin, CDMA advantages and RAKE receiver, Multiuser CDMA downlink, Multiuser CDMA uplink and asynchronous CDMA, CDMA near-far problem.

#### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand the concept of PN sequence (L1).
- Apply CDMA in a multiuser environment (L2).
- Analyze near-far problem (L3).
- Evaluate CDMA technique in a multiuser environment (L4).

### **UNIT-IV:**

#### **Multiple Input Multiple Output Systems:**

Introduction to MIMO, MIMO system model, Zero-forcing receiver, MIMO MMSE receiver, Introduction to SVD, SVD based optimal MIMO transmission and capacity, OSTBCs, V-blast receiver, MIMO beam forming.

#### **Orthogonal Frequency Division Multiplexing:**

Introduction to OFDM, Multicarrier modulation, IFFT sampling for OFDM, OFDM schematic, Cyclic prefix, OFDM based parallelization, OFDM examples.

#### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand the concept of MIMO and OFDM (L1).
- Apply MIMO/ OFDM techniques in a given situation (L2).
- Analyze working of MIMO/ OFDM systems (L3).
- Evaluate aMIMO/ OFDM techniques in a given situation (L4).

### **UNIT-V:**

#### **MIMO-OFDM:**

Introduction to MIMO-OFDM, Impact of carrier frequency offset in OFDM, PAPR in OFDM systems, Introduction to SC-FDMA.

### **3G and 4G Standards:**

WCDMA, LTE/ LTE Advanced and WiMAX.

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand 3G and 4G standards and the combined concept of MIMO-OFDM (L1).
- Apply MIMO-OFDM techniques in a given situation (L2).
- Analyze working of MIMO-OFDM systems (L3).
- Evaluate aMIMO-OFDM techniques in a given situation (L4).

### **Course Outcomes:**

At the end of the course, the student should be able to

- Understand the concepts of wireless communications and standards (L1).
- Apply a wireless technique to solve engineering problem (L2).
- Analyze working of wireless technologies (L3).
- Evaluate a wireless technique in a given situation (L4).
- Plan a wireless system for deployment (L5).

### **REFERENCES:**

3. Aditya K. Jagannatham, “Principles of Modern Wireless Communications Systems – Theory and Practice”, McGraw-Hill International, 2015.
4. Theodore S. Rappaport, “Wireless Communications – Principles and Practice”, 2<sup>nd</sup>Edition, PHI, 2004.
5. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communications”, Cambridge University Press.
6. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press.
7. Ezio Biglieri, “MIMO Wireless Communications”, Cambridge University Press.

**(19A04801b) INTRODUCTION TO INTERNET OF THINGS**

Professional Elective – IV

**Course Objectives:**

- To present interconnection and integration of the physical world and the cyber space.
- To demonstrate applications of Internet of Things
- To educate building blocks and characteristics of Internet of Things
- To introduce communication protocols used in Internet of Things
- To impart knowledge on design & develop IoT devices

**UNIT-I**

Introduction & Concepts: Introduction to Internet of Things, physical design of IoT, logical design of IoT, IoT enabling Technologies, IoT levels.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Explain characteristics, protocols, functional blocks of IoT (L2)
- Explain physical and logical design of IoT (L2)
- Categorize different levels of IoT (L4)

**UNIT –II**

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Categorize different domains where IoT can be applied (L4)
- Select physical design components for real time applications (L3)

**UNIT –III**

M2M & System Management with NETCONF-YANG: M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software defined Networking, Network Function Virtualization, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Describe concept of M2M and differentiate it with IoT (L2)
- Explain about SDN and NFV for IoT (L2)
- Examine NETCONF and YANG modelling language for IoT (L4)

#### **UNIT –IV**

Internet of Things Systems - Logical Design using Python: Introduction, Motivation for using Python, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages of Interest for IoT.

#### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Explain the data manipulation and file handling using Python (L2)
- Apply various Python packages of interest for IoT (L3)

#### **UNIT-V**

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces, and Programming with Python; Python web application framework – Django, Designing a Restful web API.

#### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Discuss about Django and RESTful web API with respect to IoT (L5)
- Design IoT applications using Raspberry Pi (L6)

#### **Course Outcomes:**

- Examine the application areas of IoT (L4)
- Illustrate revolution of Internet in Mobile Devices, Cloud & Sensor Networks (L2)
- Examine communication protocols used in IoT (L4)
- Make use of python programming to implement Internet of Things (L3)
- Design IoT applications using Raspberry Pi (L6)

#### **TEXT BOOKS:**

1. Vijay Madiseti, ArshdeepBahga, “Internet of Things A Hands-On- Approach”,2014.

**REFERENCES:**

1. Matt Richardson & Shane Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.
2. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013
3. Daniel Kellmerit, "The Silent Intelligence: The Internet of Things", 2013



**(19A04801c) FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS**  
(Professional Elective IV)

**Course Objectives:**

- To introduce fuzzy sets, logic and systems from an engineering perspective.
- To provide solid foundation of fundamental concepts of fuzzy logic, systems and its applications.
- To teach about the concept of fuzziness involved in various systems.
- To expose to the concepts of neural networks.
- To explain how neuro-fuzzy concepts can be used for solving real world problems.

**UNIT – I**

Introduction to Neuro-Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and parameterization, Fuzzy set properties, Arithmetic operations on fuzzy numbers, complement, T-norm and S-norm on fuzzy sets, parameterized T-norm and parameterized S-norm.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Explain important features of Neuro – Fuzzy and Soft Computing (L2)
- Familiarize with basic definitions, notations and operations of fuzzy sets(L2)

**UNIT – II**

Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems – Introduction, Mamdani Fuzzy Models, – Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy modeling

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand concepts of Extension Principle and Fuzzy Relations (L2)
- Investigate different schemes of fuzzy reasoning(L3)
- Compare strengths and weaknesses of different fuzzy inference systems(L4)
- Compare different ways of partitioning the input space(L4)
- Understand features and problems of fuzzy modelling(L2)

**UNIT – III**

Neural networks: Adaptive networks, Introduction, architecture, backpropagation for feedforward networks, perceptrons, adaline, backpropagation for multilayer perceptrons, radial basis function networks, unsupervised learning, introduction, competitive learning networks, kohonen self-organizing networks

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Explain architectures and learning procedures for adaptive networks(L2)
- Differentiate supervised and unsupervised learning (L2)
- Modelling problems with desired input-output data sets using supervised learning rules(L3)
- Analyze data without desired outputs using unsupervised learning(L4)

### **UNIT – IV**

Neuro fuzzy modeling: Adaptive Neuro-Fuzzy Inference Systems (ANFIS), Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Coactive Neuro Fuzzy Modeling, Framework, Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Explain architecture & features of ANFIS (L2)
- Demonstrate RBFN is functionally equivalent to ANFIS(L2)
- Understand the nature of Coactive neuro fuzzy inference system from neural network perspective(L2)
- Characterize neuro fuzzy models using neuro fuzzy spectrum(L4)

### **UNIT- V**

ANFIS Applications: Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Nonlinear system identification, Channel equalization.

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Examine several applications of ANFIS to a variety of domains viz., pattern recognition, robotics, nonlinear systems and adaptive signal processing (L4)

### **Course Outcomes:**

After completion of the course students will be able to

- Identify and describe Fuzzy Logic and Neural Network techniques in building intelligent machines(L3)
- Apply Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems (L3)
- Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem(L5)

**TEXT BOOKS:**

1. Neuro-“Fuzzy and Soft Computing”, J.S.R.Jang, C.T.Sun and E.Mizutani, PHI, 2004, Pearson Education.

**REFERENCE BOOKS:**

1. T.J. Ross: “Fuzzy Logic with Engineering Applications”, 3<sup>rd</sup> Ed., Wiley India Pvt. Ltd., 2011.
2. Neural Networks, “Fuzzy Logic and Genetic Algorithms”, S. Rajasekaran and G.A.V.Pai, PHI, 2003.
3. H.J. Zimmerman: Fuzzy Set Theory and its Application, 3rd Ed., Springer India Pvt. Ltd., 2006.
4. Kosko, B, “Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence”, Prentice Hall, NewDelhi, 2004.

**(19A04801d) BIOMEDICAL SIGNAL PROCESSING**  
(Professional Elective IV)

**Course Objectives:**

- Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
- Interrelate the students mathematical and computational skills relevant to the field of biomedical signal processing.
- Introduce students to basic signal processing techniques in analyzing biological signals.
- Develop a thorough understanding on basics of ECG signal compression algorithms.
- Increase the student's awareness of the complexity of various biological phenomena and cultivate an understanding of the promises, challenges of the biomedical engineering.

**UNIT- I:**

**Preliminaries:**

Concept of Biological signals – Electrical, Mechanical, Chemical, Magnetic, Optical etc. Origin of electrical signal from Biological cell – Structure of Biological cell, Characteristics of Cell membrane, Distribution and movement of ions across the cell membrane, Generation of Biological cell Action Potential. Concept of Electrocardiogram (ECG), Electroencephalogram (EEG), Phonocardiogram (PCG), Electromyogram (EMG), Electroneurogram (ENG), Electrooculogram (EOG), Respiratory signals etc.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand the origin, properties of biomedical signals like ECG, EEG, PCG, ENG and EOG signals. (L1)
- Analyze the structure and characteristics of various signals. (L3)

**UNIT -II:**

**Signal Conditioning:**

Band limiting of different Biological signals, Representation of biological signals in analog, discrete and digital forms. **Filtering for Removal of artifacts** - Statistical Preliminaries, Time domain filtering - Synchronized Averaging, Moving Average Filter to Integration, Derivative-based operator, **Frequency Domain Filtering** – FIR and IIR methods for implementing Notch, band selective filters, Weiner, Adaptive Filtering concepts.

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand classical and modern filtering and compression techniques required for biomedical signal processing. (L1)
- Compare different filtering techniques. (L3)

### **Unit -III:**

#### **Electrocardiogram (ECG) Analysis:**

Concepts of morphological and rhythm analysis, Different types of arrhythmias, Derivative based Approaches for QRS Detection, Pan Tompkins Algorithm, Concepts of detecting the P, T waves, PR, ST intervals, QRS duration, etc. Heart Rate Variability (HRV) study and its importance.

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Apply filters to remove noise, signal compression techniques & averaging technique on biomedical signals and extract the features of ECG signals. (L2)
- Analyze the nature of biomedical signals and related concepts, and event detection techniques for ECG signals(L3)

### **UNIT -IV:**

#### **EEG, EMG signals Analysis:**

Basics of EEG and EMG signals. Signal strength, Signal entropy in time and frequency domain, Correlation coefficient, Envelop Extraction, Root Mean Square value, Zero-crossing rate, Form factor, Periodogram, Minimum phase correspondent, Power Spectral Density concepts in analyzing EEG and EMG signals.

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Apply filters to remove noise, signal compression techniques and averaging technique on biomedical signals and extract the features of EEG and EMG signals. (L2)
- Analyze the nature of biomedical signals and related concepts, and event detection techniques for EEG and EMG signals. (L3)

### **UNIT -V:**

#### **Modelling of Biomedical Systems:**

Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modelling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters, Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients, ARMA model, Sequential estimation of poles and zeros.

### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Demonstrate an ability to integrate different concepts to develop new models that suits current trends of Industries and analyze its performance. (L2)
- Develop an interest to simulate the models and validate its functionality in real time systems. (L5)

### **Course Outcomes:**

- Understand the origin, properties of biomedical signals like ECG, EEG, PCG, ENG, EOG signals, modern filtering techniques.
- Apply filters to remove noise, signal compression techniques & averaging technique on biomedical signals to extract the features of ECE, EEG and EMG signals.
- Analyze the nature of biomedical signals and related concepts, and event detection techniques for ECG, EEG, and EMG signals. Also compare different filtering techniques.
- Develop an interest to simulate the models and validate its functionality in real time systems.

### **TEXT BOOKS**

1. R M Rangayyan “Biomedical Signal Analysis: A case Based Approach”, IEEE Press, John Wiley & Sons. Inc, 2002.
2. Willis J. Tompkins, “Biomedical Digital Signal Processing”, EEE, PHI, 2004.
3. D C Reddy “Biomedical Signal Processing: Principles and Techniques”, Tata McGraw-Hill Publishing Co. Ltd, 2005.

### **REFERENCES:**

1. Suresh R Devasahayam, “Signals and Systems in Biomedical Engineering: Physiological Systems Modeling and Signal Processing”, Springer, 3<sup>rd</sup> Edition, 2019.
2. J G Webster “Medical Instrumentation: Application & Design”, John Wiley & Sons Inc., 2001.

**(19A04801e) ANALOG IC DESIGN**  
(Professional Elective IV)

**Course Objectives:**

The student will be able to

- Understand the behaviour of MOS Devices and Small-Signal & Large-Signal Modelling of MOS Transistor and Analog Sub-Circuits.
- Learn and understand CMOS Amplifiers like Differential Amplifiers, Cascode Amplifiers, Output Amplifiers, and Operational Amplifiers.
- Design and Develop the Analog CMOS Circuits for different Analog operations.

**UNIT -I:**

**MOS Devices and Modelling:** The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modelling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Understand the behaviour of MOS Devices (L1)
- Analyze Small-Signal and Large-Signal Modelling of MOS Transistor (L3)

**UNIT -II:**

**Analog CMOS Sub-Circuits:** MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Design current mirror circuits using MOSFETs (L4)
- Compare different Current mirror Circuits. (L5)

**UNIT -III:**

**CMOS Amplifiers:** Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

**Learning Outcomes:**

At the end of the unit, student shall be able to

- Analyze Analog circuits like Differential amplifiers, current amplifiers, inverters (L3)
- Design Amplifier circuits using MOSFETs (L4)

#### **UNIT -IV:**

CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

#### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Implement Analog Circuits using Op Amps in real time applications. (L3)
- Model and simulate different MOS Devices using small signal Model. (L4)

#### **UNIT -V:**

Comparators: Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

#### **Learning Outcomes:**

At the end of the unit, student shall be able to

- Characterize two stage and open loop Comparators (L2)
- Design Comparator circuits using MOSFET (L4)

#### **Course Outcomes:**

- Understand the behaviour of MOS Devices.
- Characterize two stage and open loop Comparators.
- Analyze and derive Small-Signal and Large-Signal Modelling of MOS Transistors for analog applications like Differential amplifiers, current amplifiers, inverters.
- Design current mirror circuits using MOSFETs and CMOS amplifier circuits for real time amplification applications.
- Develop Op-Amp based analog circuits.

#### **TEXT BOOKS:**

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, Second Edition.
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.



**REFERENCES:**

1. Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley India, Fifth Edition, 2010.
2. David A. Johns, Ken Martin, "Analog Integrated Circuit Design", Wiley Student Edition, 2013.

**(19A01802a) DISASTER MANGEMENT**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

The objective of this course is to:

- Develop an understanding of why and how the modern disaster manager is involved with pre-disaster and post-disaster activities.
- Develop an awareness of the chronological phases of natural disaster response and refugee relief operations. Understand how the phases of each are parallel and how they differ.
- Understand the ‘relief system’ and the ‘disaster victim.’
- Describe the three planning strategies useful in mitigation.
- Identify the regulatory controls used in hazard management.
- Describe public awareness and economic incentive possibilities.
- Understand the tools of post-disaster management.

**SYLLABUS**

**UNIT-I:**

Natural Hazards And Disaster Management: Introduction of DM – Inter disciplinary -nature of the subject– Disaster Management cycle – Five priorities for action. Case study methods of the following: floods, draughts – Earthquakes – global warming, cyclones & Tsunamis – Post Tsunami hazards along the Indian coast – landslides.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the natural hazards and its management
- To understand about the global warming, cyclones and tsunamis

**UNIT-II:**

Man Made Disaster And Their Management Along With Case Study Methods Of The Following: Fire hazards – transport hazard dynamics – solid waste management – post disaster – bio terroritism -threat in mega cities, rail and air craft’s accidents, and Emerging infectious diseases & Aids and their management.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the fire hazards and solid waste management
- To understand about the emerging infectious diseases and aids their management.

### **UNIT-III:**

Risk and Vulnerability: Building codes and land use planning – social vulnerability – environmental vulnerability – Macroeconomic management and sustainable development, climate change risk rendition – financial management of disaster – related losses.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the regulations of building codes and land use planning related to risk and vulnerability.
- To understand about the financial management of disaster and related losses

### **UNIT-IV:**

Role Of Technology In Disaster Managements: Disaster management for infra structures, taxonomy of infra structure – treatment plants and process facilities-electrical substations- roads and bridges- mitigation programme for earth quakes –flowchart, geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training- transformable indigenous knowledge in disaster reduction.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the technological aspects of disaster management
- To understand about the factors for disaster reduction

### **UNIT-V:**

Education and Community Preparedness: Education in disaster risk reduction-Essentials of school disaster education-Community capacity and disaster resilience-Community based disaster recovery -Community based disaster management and social capital-Designing resilience- building community capacity for action.

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To impart the education related to risk reduction in schools and communities

#### **Course Outcomes:**

Upon the successful completion of this course, the students will be able to:

- Affirm the usefulness of integrating management principles in disaster mitigation work
- Distinguish between the different approaches needed to manage pre- during and post-disaster periods
- Explain the process of risk management
- Relate to risk transfer

### **TEXT BOOKS**

1. Rajib shah & R R Krishnamurthy “Disaster Management” – Global Challenges and Local Solutions’ Universities press. (2009),
2. Tushar Bhattacharya, “Disaster Science & Management” Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Jagbir Singh “Disaster Management” – Future Challenges and Opportunities’ I K International Publishing House Pvt. Ltd. (2007),

### **REFERENCE BOOKS**

1. Harsh. K . Gupta “Disaster Management edited”, Universities press, 2003.

**(19A01802b) GLOBAL WARMING AND CLIMATE CHANGES**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

The objective of this course is to:

- To know the basics, importance of global warming.
- To know the concepts of mitigation measures against global warming
- To know the impacts of climate changes

**UNIT I**

**EARTH'S CLIMATE SYSTEM:**

Introduction to environment, Ozone, ozone layer and its functions, Ozone depletion and ozone hole, Vienna convention and Montreal protocol, Green house gases and green house effect, Hydrological cycle and Carbon cycle, Global warming and its impacts

**Learning Outcomes:**

After completing this Unit, students will be able to

- To identify the importance of Ozone and effect of green house gases
- To know the effect of global warming

**UNIT II**

**ATMOSPHERE & ITS COMPONENTS:** Atmosphere and its layers-Characteristics of Atmosphere - Structure of Atmosphere - Composition of Atmosphere - Atmospheric stability - Temperature profile of the atmosphere - Temperature inversion and effects of inversion on pollution dispersion.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the layers of atmosphere and their characteristics

**UNIT III**

**IMPACTS OF CLIMATE CHANGE :** Causes of Climate change - Change of Temperature in the environment - Melting of ice and sea level rise - Impacts of Climate Change on various sectors - Projected impacts for different regions, uncertainties in the projected impacts and risk of irreversible changes.

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the causes of climate change and its effects on various sectors.

#### **UNIT IV**

**OBSERVED CHANGES AND ITS CAUSES:** Climate change and Carbon credits-Clean Development Mechanism (CDM), CDM in India - Kyoto Protocol - Intergovernmental Panel on Climate Change (IPCC) - Climate Sensitivity - Montreal Protocol - United Nations Framework Convention on Climate Change (UNFCCC) - Global change in temperature and climate and changes within India

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the causes of climate change and carbon credits, effect of change in temperature and climate on india.

#### **UNIT V**

**CLIMATE CHANGE AND MITIGATION MEASURES:** CDM and Carbon Trading - Clean Technology, biodiesel, compost, biodegradable plastics - Renewable energy usage as an alternative - Mitigation Technologies and Practices within India and around the world - Non-renewable energy supply to all sectors - Carbon sequestration - International and regional cooperation for waste disposal biomedical wastes, hazardous wastes, e-wastes, industrial wastes, etc.,

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about the clean technology, use of renewable energy, mitigation technologies and their practices.

#### **Course Outcomes**

Upon the successful completion of this course, the students will be able to:

- An ability to apply knowledge of mathematics, science, and engineering
- Design a system, component or process to meet desired needs with in realistic constraints such as economic ,environmental ,social ,political ,ethical ,health and safety , manufacturability and sustainability
- An ability to identify, formulate, and solve engineering problems

## REFERENCE BOOKS

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Private limited 2007.
2. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press ,Cambridge,2006.
3. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.
4. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge university press ,2003.
5. David Archer, Global Warming: Understanding the Forecast, 2 nd ed. (Wiley, 2011
6. John Houghton, Global Warming: The Complete Briefing, 5th Edition, 2015, Cambridge Univ. Press. Useful

**(19A02802a) IoT APPLICATIONS IN ELECTRICAL ENGINEERING**

**(OE-IV)**

**Course Objectives:**

- To learn about a few applications of Internet of Things
- To distinguish between motion less and motion detectors as IoT applications
- To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- To understand about applications of IoT in smart grid
- To introduce the new concept of Internet of Energy for various applications

**UNIT-I:**

**Sensors**

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about basic principles of sensors and their classification
- To learn about various motion less sensors
- To understand about Piezoelectric sensor applications to detect temperature, pressure etc.
- To understand about Capacitive sensors to detect temperature, force and pressure etc.
- To know about concepts of tactile sensors, for a few applications

**UNIT-II:**

**Occupancy and Motion detectors**

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors



### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about Capacitive occupancy
- To understand about Motion detectors
- To distinguish between Potentiometric, inductive and capacitive sensors for a few applications
- To learn about a few velocity and acceleration sensors
- To know about various flow sensors

### **UNIT-III:**

#### **MEMS**

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To understand about the basic concept of MEMS
- To know about electrostatic actuation
- To learn about process design of MEMS based sensors
- To learn about process design of MEMS based actuators
- To distinguish between RF switches with respect to electric and magnetic sensors

### **UNIT-IV:**

#### **IoT for Smart grid**

Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To get exposure fundamental applications of IoT to Smart grid
- To learn about driving factors of IoT in Generation level
- To learn about driving factors of IoT in Transmission level
- To learn about driving factors of IoT in Distribution level
- To distinguish between metering level and monitoring applications
- To get introduced to the concept of Smart home

## **UNIT-V:**

**IoE:** Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid

### **Learning Outcomes:**

After completing this Unit, students will be able to

- To get exposed the new concept of internet of energy
- To learn about architecture of IoE
- To know about energy routines
- To learn about information sensing and processing issues
- To understand the use of energy internet as smart grid

### **Course Outcomes:**

- To get exposed to recent trends in few applications of IoT in Electrical Engineering
- To understand about usage of various types of motionless sensors
- To understand about usage of various types of motion detectors
- To get exposed to various applications of IoT in smart grid
- To get exposed to future working environment with Energy internet

### **TEXT BOOKS:**

1. Jon S. Wilson, "Sensor Technology Hand book", Newnes Publisher, 2004
2. Tai Ran Hsu, "MEMS and Microsystems: Design and manufacture", 1<sup>st</sup> Edition, Mc Grawhill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, "From Smart grid to Internet of Energy", 1<sup>st</sup> Edition, Academic Press, 2019

### **REFERENCE BOOKS:**

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, "Energy Harvesting Systems for IoT Applications": Generation, Storage and Power Management, 1<sup>st</sup> Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, "Internet of Things", Wiley, 2019

(19A02802b) SMART ELECTRIC GRID

(OE-IV)

**Course Objectives:**

- To learn about recent trends in grids as smart grid
- To understand about smart grid architecture and technologies
- To know about smart substations
- To learn about smart transmission systems
- To learn about smart distribution systems

**UNIT-I:**

**Introduction to Smart Grid**

Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid

**Smart Grid Architecture:** Components and Architecture of Smart Grid Design – Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation – Distribution Automation – Renewable Integration

**Learning Outcomes:**

After completing this Unit, students will be able to

- To understand basic definitions and architecture of Smart grid
- To learn about new technologies for smart grid
- To know about fundamental components of smart grid
- To understand key challenges of smart grid
- To understand the need for integration of Renewable energy sources

**UNIT-II:**

**Smart grid Technologies**

Characteristics of Smart grid, Micro grids, Definitions, Drives, benefits, types of Micro grid, building blocks, Renewable energy resources, needs in smart grid, integration impact, integration standards, Load frequency control, reactive power control, case studies and test beds

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about basic characteristic features of smart grid technologies
- To understand about definition, types, building blocks of Microgrids

- To know about integration requirements, standards of renewable energy sources in Microgrids
- To understand Load frequency and reactive power control of Microgrid
- To understand about Microgrid through a case study

### **UNIT-III:**

#### **Smart Substations**

Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about protection, monitor and control devices in Smart substations
- To know about the importance of SCADA in substations
- To understand about interoperability and IEC 61850
- To know about role of substations in Smart grid
- To understand about Volt/VAR control equipment inside substation

### **UNIT-IV:**

#### **Smart Transmission**

Energy Management systems, History, current technology, EMS for the smart grid, Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid, Synchro Phasor Measurement Units (PMUs)

#### **Learning Outcomes:**

After completing this Unit, students will be able to

- To know about Energy Management Systems in smart transmission systems
- To understand about WAMPC
- To know about role of transmission systems in Smart grid
- To know about Synchro Phasor Measurement units

### **UNIT-V:**

#### **Smart Distribution Systems**

DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization,

FDIR - Fault Detection Isolation and Service restoration (FDIR), faults, objectives and benefits, equipment, implementation

**Learning Outcomes:**

After completing this Unit, students will be able to

- To know about DSCADA in Smart Distribution Systems
- To distinguish between current and advanced DMSs
- To know about occurrence of voltage fluctuations
- To understand about VAR control and equipment on distribution feeders
- To know about FDIR objectives and benefits

**Course Outcomes:**

- To be able to understand trends in Smart grids
- To understand the needs and roles of Smart substations
- To understand the needs and roles of Smart Transmission systems
- To understand the needs and roles of Smart Distribution systems
- To distinguish between SCADA and DSCADA systems in practical working environment

**Text Books:**

1. Stuart Borlase, “Smart Grids - Infrastructure, Technology and Solutions”, 1<sup>st</sup> edition, CRC Press, 2013
2. Gil Masters, “Renewable and Efficient Electric Power System”, 2<sup>nd</sup> edition, Wiley–IEEE Press, 2013.

**Reference Books:**

1. A.G. Phadke and J.S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer Edition, 2e, 2017.
2. T. Ackermann, “Wind Power in Power Systems”, Hoboken, NJ, USA, John Wiley, 2e, 2012.

(19A03802a) ENERGY CONSERVATION AND MANAGEMENT  
OPEN ELECTIVE-IV

**Course Objective:**

- Familiarize present energy scenario, and energy auditing methods.
- Explain components of electrical systems, lighting systems and improvements in performance.
- Demonstrate different thermal systems, efficiency analysis, and energy conservation methods.
- Train on energy conservation in major utilities.
- Instruct principles of energy management and energy pricing.

**UNIT I**

**Introduction:** Energy – Power – Past & Present Scenario Of World; National Energy Consumption Data – Environmental Aspects Associated With Energy Utilization –Energy Auditing: Need, Types, Methodology And Barriers. Role Of Energy Managers. Instruments For Energy Auditing.

**Learning Outcomes**

At the end of this unit, the student will be able to

- Infer energy consumption patterns and environmental aspects of energy utilization. (I2)
- Outline energy auditing requirements, tools and methods. (I2)
- Identify the function of energy manager. (I3)

**UNIT II**

**Electrical Systems:** Components Of EB Billing – HT And LT Supply, Transformers, Cable Sizing, Concept Of Capacitors, Power Factor Improvement, Harmonics, Electric Motors – Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types Of Lighting, Efficacy, LED Lighting And Scope Of Economy In Illumination.

**Learning Outcomes**

At the end of this unit, the student will be able to

- Outline components of electricity billing, transmission and distribution. (I2)
- Analyze performance characteristics of transformers, capacitors, and electric motors. (I4)
- Examine power factor improvements, and electric motor efficiency. (I4)
- Evaluate lighting systems. (I4)

**UNIT III**

**Thermal Systems:** Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency Computation and Encon Measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

### **Learning Outcomes**

At the end of this unit, the student will be able to

- Determine efficiency of boilers, furnaces and other thermal systems. (15)
- Recommend energy conservation measures in thermal systems. (15)
- Justify steam systems in energy conservation. (14)

## **UNIT IV**

**Energy Conservation In Major Utilities:** Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration And Air Conditioning Systems – Cooling Towers – D.G. Sets.

### **Learning Outcomes**

At the end of this unit, the student will be able to

- Explain energy conservation measures in major utilities. (12)
- Apply performance test criteria for fans, pumps, compressors, hvac systems. (13)
- Assess energy conservation in cooling towers and d.g. sets. (15)

## **UNIT V**

**Energy Management:** Principles of Energy Management, Energy demand estimation, Organising and Managing Energy Management Programs, Energy pricing.

### **Learning Outcomes**

At the end of this unit, the student will be able to

- Describe principles of energy management. (12)
- Assess energy demand and forecast. (15)
- Organize energy management programs. (16)
- Design elements of energy pricing. (16)

### **Course Outcomes:**

At the end of this course, the student will be able to:

- Explain energy utilization and energy auditing methods.(12)
- Analyze electrical systems performance of electric motors and lighting systems.(14)
- Examine energy conservation methods in thermal systems.(14)
- Estimate efficiency of major utilities such as fans, pumps, compressed air systems, hvac and d.g. Sets. (14)
- Elaborate principles of energy management, programs, energy demand and energy pricing. (16)

**TEXT BOOKS:**

1. Energy Manager Training Manual (4 Volumes) Available At [www.energymanagertraining.com](http://www.energymanagertraining.com), A Website Administered By Bureau Of Energy Efficiency (BEE), A Statutory Body Under Ministry Of Power, Government Of India, 2004.

**REFERENCES:**

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design And Management For Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use Of Energy" Butterworths, London, 1982
4. Murphy. W.R. And G. Mc KAY, "Energy Management", Butterworths, London 1987.
5. Turner, W. C., Doty, S. and Truner, W. C., "Energy Management Hand book", 7th edition, Fairmont Press, 2009.
6. De, B. K., "Energy Management audit & Conservation", 2<sup>nd</sup> Edition, Vrinda Publication, 2010.
7. Smith, C. B., "Energy Management Principles", Pergamon Press, 2007.



(19A03802b) NON-DESTRUCTIVE TESTING  
OPEN ELECTIVE-IV

**Course Objectives**

- Introduce basic concepts of non destructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.
- Impart NDE and its applications in pressure vessels, casting and welded constructions.

**UNIT I**

**Introduction to non-destructive testing:** Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

**Learning outcomes:**

At the end of this unit, the student will be able to

- Explain non destructive testing techniques (L2)
- Summarize the basic concepts of Radiographic test ( L2)
- Outline the concepts of sources of X and Gamma Rays ( L2)
- Explain the radiographic techniques ( L2)
- Discuss the safety aspects of industrial radiography. ( L4)

**UNIT II**

**Ultrasonic test:** Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect , Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

**Learning outcomes:**

At the end of this unit, the student will be able to

- Explain the principle of ultrasonic test. ( l2)
- Analyze the performance of wave propagation, reflection, refraction, diffraction and sound field in ultrasonic test. (14 )

- Discuss the characteristics of ultrasonic transducers. (14)
- Outline the limitations of ultrasonic testing. (12 )

### UNIT III

**Liquid Penetrant Test:** Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

**Eddy Current Test:** Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.

**Magnetic Particle Test:** Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Illustrate the procedure of Liquid Penetrant, eddy current and magnetic particle tests.( L2)
- Outline the limitations of Penetrant, eddy current and magnetic particle tests. (L2 )
- Explain the effectiveness of Penetrant, eddy current and magnetic particle tests. ( L2)
- Apply the applications of Magnetic particle test. ( L3)

### UNIT IV

**Infrared And Thermal Testing:** Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Discuss the fundamentals of thermal testing. (16 )
- Explain the techniques of liquid crystals, active and passive. (12)
- Illustrate thermal inspection methods. ( 12)
- Outline the limitations of thermal testing. (12 )
- Explain the applications of honey comb and sandwich structures. (12)

## UNIT V

**Industrial Applications of NDE:** Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions

### Learning Outcomes:

At the end of this unit, the student will be able to

- Illustrate applications of NDE. ( L2)
- Explain the applications of Railways, Nuclear and chemical industries. ( L2)
- Outline the limitations and disadvantages of NDE. (L2 )
- Explain the applications of NDA of pressure vessels, casting and welding constructions ( L2)

### Course Outcomes

At the end of the course, student will be able to

- Explain various methods of non-destructive testing. (13)
- Apply relevant non-destructive testing method different applications. (13)
- Explain the applications of railways, nuclear and chemical industries. ( 12)
- Outline the limitations and disadvantages of nde. (12 )
- Explain the applications of nda of pressure vessels, casting and welding constructions ( 12)

### TEXT BOOKS:

1. J Prasad, GCK Nair , “Non destructive test and evaluation of Materials”, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, “Ultrasonic testing of materials”, 3<sup>rd</sup> edition, Springer-Verlag, 1983.
3. X. P. V. Maldague, “Non destructive evaluation of materials by infrared thermography”, 1<sup>st</sup> edition, Springer-Verlag, 1993.

### REFERENCES:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, “Non-destructive, Hand Book, Ultrasonic Testing”, 3<sup>rd</sup> edition, Amer Society for Nondestructive, 2007.
2. ASTM Standards, Vol 3.01, Metals and alloys

### Social Relevant Projects

1. Solid waste conversion into energy (Gasification)
2. Plastic waste into fuel.
3. Bio-gas digester.
4. Development of mechanisms for farmers.

5. Smart irrigation for saving water.
6. Mechanized water segregation.
7. Applications of solar technologies for rural purpose.
8. Power generation from wind turbine.
9. Applications of drones for agriculture.
10. Solar drying.

(19A04802a) INTRODUCTION TO IMAGE PROCESSING

OPEN ELECTIVE-IV

**Course Objectives:**

- To interpret fundamental concepts of digital image processing.
- To exemplify image enhancement.
- To interpret fundamental concepts of color image processing.
- To assess image compression techniques for digital images.
- To summarize segmentation for digital images.

**UNIT-I:**

**INTRODUCTION TO DIGITAL IMAGE PROCESSING**

**Introduction:** Digital image representation, Fundamental steps in image processing, Elements of digital image processing, Elements of visual perception, Simple image model, Sampling and Quantization, Basic relationships between pixels, Image transformations.

**Applications:** Medical imaging, Robot vision, Character recognition, Remote sensing.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the fundamental concepts of image processing, Sampling process and basis relationships between pixels (L1)
- Explain the elements of Digital Image Processing (L2)

**UNIT-II:**

**IMAGE ENHANCEMENT**

Need for image enhancement, Point processing, Histogram processing, Spatial filtering- Smoothing and Sharpening.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the need for enhancement process (L1)
- Explain the terminology involved in enhancement process (L2)

### **UNIT-III:**

#### **COLOR IMAGE PROCESSING**

Colour fundamentals, Colour models, Color transformations, Pseudo colour image processing, Full colour image processing.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the need for enhancement process (L1)
- Explain the terminology involved in enhancement process (L2)

### **UNIT-IV:**

#### **IMAGE COMPRESSION**

Redundancies, Fidelity criteria, Image compression model, Lossless compression: Huffman coding, Arithmetic coding. Lossy compression: Lossy Predictive Coding, JPEG Compression Standard.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the need for image compression (L1)
- Explain the image compression and various types of compression techniques (L2)

### **UNIT-V:**

#### **IMAGE SEGMENTATION**

Detection of discontinuities: point, line and edge detection, Edge linking and Boundary detections: Local Processing, Global processing via Hough transform, Thresholding, Region oriented segmentation: Region growing, Region splitting and merging.

#### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the principle of image segmentation and its importance (L1)
- Explain the image compression and various types of compression techniques (L2)
- Analyze the various terminologies involved in image segmentation like edge, boundary detection etc. (L3)

**Course Outcomes:**

- Interpret fundamental concepts of digital and color image processing.
- Exemplify image enhancement.
- Analyze the various terminologies involved in image segmentation like edge, boundary detection etc. Assess image compression techniques for digital images.
- Summarize segmentation techniques for digital images.

**TEXT BOOKS:**

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, 3<sup>rd</sup> Edition, Pearson Education, 2011.

**REFERENCE BOOKS:**

1. S Jayaraman, S Esakkirajan and T Veerakumar, “Digital Image Processing”, TMH, 2011.
2. S. Sridhar, “Digital Image Processing”, 2<sup>nd</sup> Edition, Oxford Publishers, 2016.

**(19A04802b) PRINCIPLES OF CELLULAR AND MOBILE COMMUNICATIONS**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

- To understand the concepts and operation of cellular systems.
- To apply the concepts of cellular systems to solve engineering problems.
- To analyse cellular systems for meaningful conclusions.
- To evaluate suitability of a cellular system in real time applications.
- To design cellular patterns based on frequency reuse factor.

**UNIT-I:**

**Introduction to Cellular Mobile Systems**

Why cellular mobile communication systems? A basic cellular system, Evolution of mobile radio communications, Performance criteria, Characteristics of mobile radio environment, Operation of cellular systems. Examples for analog and digital cellular systems.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concepts and operation of cellular systems (L1).
- Analyze the characteristics of mobile radio environment (L3).

**UNIT-II:**

**Cellular Radio System Design**

General description of the problem, Concept of frequency reuse channels, Cochannel interference reduction, Desired C/I ratio, Cell splitting and sectoring.

**Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand the concept of frequency reuse and cochannel interference in cellular systems (L1).
- Apply the concept of cellular systems to solve engineering problems (L2).
- Analyze the design problems of cellular systems (L3).
- Design of cellular patterns based frequency reuse factor (L5).



### **UNIT-III:**

#### **Handoffs and Dropped Calls**

Why handoffs and types of handoffs, Initiation of handoff, Delaying a handoff, Forced handoffs, Queuing of handoffs, Power-difference handoffs, Mobile assisted handoff and soft handoff, Cell-site handoff, Intersystem handoff. Introduction to dropped call rate.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand why handoff is required (L1).
- Apply handoff techniques to solve engineering problems (L2).
- Compare various types of handoffs (L3).

### **UNIT-IV:**

#### **Multiple Access Techniques for Wireless Communications**

Introduction, Frequency Division Multiple Access, Time Division Multiple Access, Code Division Multiple Access and Space Division Multiple Access.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand various types of multiple access techniques (L1).
- Apply the concept of multiple access to solve engineering problems (L2).
- Compare various types of multiple access techniques (L3).

### **UNIT-V:**

#### **Digital Cellular Systems**

Global System for Mobile Systems, Time Division Multiple Access Systems, Code Division Multiple Access Systems. Examples for 2G, 3G and 4G systems. Introduction to 5G system.

#### **Learning Outcomes:**

At the end of the unit, the student should be able to

- Understand operation of various types of digital cellular systems (L1).
- Compare various types of digital cellular systems (L3).
- Evaluate suitability of a cellular system in real time applications (L4).

Note: The main emphasis is on qualitative treatment. Complex mathematical treatment may be avoided.

## **Course Outcomes:**

At the end of the course, the student should be able to

- Understand the concepts and operation of cellular systems (L1)
- Apply the concepts of cellular systems to solve engineering problems (L2).
- Analyse cellular systems for meaningful conclusions, Evaluate suitability of a cellular system in real time applications (L3).
- Design cellular patterns based on frequency reuse factor (L4).

## **TEXT BOOKS:**

2. William C. Y. Lee, “Mobile Cellular Telecommunications”, 2<sup>nd</sup>Edition, McGraw-Hill International, 1995.
3. Theodore S. Rappaport, “Wireless Communications – Principles and Practice”, 2<sup>nd</sup>Edition, PHI, 2004.

## **REFERENCES:**

8. Aditya K. Jagannatham “Principles of Modern Wireless Communications Systems – Theory and Practice”, McGraw-Hill International, 2015.

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## **Blooms’ Learning levels:**

L1: Remembering and Understanding

L2: Applying

L3: Analyzing, Evaluating

L4: Designing, Creating

(19A04802c) **INDUSTRIAL ELECTRONICS**  
**OPEN ELECTIVE-IV**

**Course Objectives:**

This course will enable students to:

- Describe semi-conductor devices (such as PN junction diode & Transistor) and their switching characteristics.
- Understand the characteristics of AC to DC converters.
- Understand about the practical applications Electronics in industries
- Describe the Ultrasonics and its application.

**UNIT I**

Scope of industrial Electronics, Semiconductors, Merits of semiconductors, crystalline structure, Intrinsic semiconductors, Extrinsic semiconductors, current flow in semiconductor, Open-circuited p-n junction, Diode resistance, Zener diode, Photoconductors and junction photo diodes, Photo voltaic effect, Light emitting diodes(LED).

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the importance of Electronics and semiconductor devices in industry, operation of semiconductor devices (L1)
- Describe the working of semiconductor diodes (L1)

**UNIT II**

Introduction, The junction transistor, Conventions for polarities of voltages and currents, Open circuited transistor, Transistor biased in the active region, Current components in transistors, Currents in a transistor, Emitter efficiency, Transport factor and transistor- $\alpha$ , Dynamic emitter resistance, Transistor as an amplifier, Transistor construction, Lettersymbols for semiconductor Devices, Characteristic curves of junction transistor in common configuration, static characteristic curves of PNP junction transistor in common emitter configuration, The transistor in common collector Configuration.

**Learning Outcomes:**

At the end of this unit, the student will be able to

- Understand the working of Transistor and its different configurations (L1)
- Describe the working of CE, CC, CB configurations (L1)

### UNIT III

**AC to DC converters-** Introduction, Classification of Rectifiers, Half wave Rectifiers, Fullwave Rectifiers, Comparison of Half wave and full wave rectifiers, Bridge Rectifiers, Bridge Rectifier meter, Voltage multiplying Rectifier circuits, Capacitor filter, LC Filter, Metal Rectifiers, Regulated Power Supplies, Classification of Voltage Regulators, Shortperiod Accuracy of Regulators, Long period .Accuracy of Voltage Regulator, Principle of automatic voltage Regulator, Simple D.C. Voltage stabilizer using Zener diode, D.C. Voltage Regulators, Series Voltage Regulators, Complete series voltage regulator circuit, Simple series voltage regulator.

### UNIT IV

**Resistance welding controls:** Introduction, Resistance welding process, Basic Circuit for A.C. resistance welding, Types of Resistance welding, Electronic welding control used in Resistance welding, Energy storage welding. **Induction heating:** Principle of induction heating, Theory of Induction heating merits of induction heating, Application of induction heating, High frequency power source of induction heating. **Dielectric heating:** Principle of dielectric heating, theory of dielectric heating, dielectric properties of typical materials, electrodes used in dielectric heating, method of coupling of electrodes to the R.F. generator, Thermal losses in Dielectric heating, Applications.

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the principle of operation of Resistance welding, Induction heating and Dielectric heating (L1)
- Apply the process of Resistance welding, Induction heating and Dielectric heating in the industry (L2)

### UNIT V:

**Ultrasonics:** Introduction, Generation of Ultrasonic waves, Application of Ultrasonic waves, Ultrasonic stroboscope, ultrasonic as means of communication, ultrasonic flaw detection, Optical image on non-homogeneities, ultrasonic study of structure of matter, Dispersive study of structure of matter, Dispersive and colloidal effect of Ultrasonic, Coagulating action of Ultrasonic, separation of mixtures by ultrasonic waves, cutting and machining of hard materials by ultrasonic vibrations, Degassing of liquids by ultrasonic waves, Physio-chemical effects of ultrasonics, chemical effects of ultrasonics, Thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying

#### Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the principle of operation of Ultrasonics and its applications (L1)

- Analyze the thermal effects of Ultrasonics, soldering and welding by ultrasonics,Ultrasonic Drying in the industry (L3)

**Course Outcome:**

- Understand the semi-conductor devices and their switching characteristics.
- Apply the Ultrasonic waves with different applications
- Analyze the thermal effects of Ultrasonics, soldering and welding by ultrasonics,Ultrasonic Drying in the industry, Interpret the characteristics of AC to DC converters,
- Develop the practical applications Electronics in industries.

**TEXT BOOKS:**

1. G. K. Mithal, “Industrial Electronics”, Khanna Publishers, Delhi, 2000.
2. J.Gnanavadivel, R.Dhanasekaran, P.Maruthupandi, “Industrial Electronics”,Anuradha Publications, 2011.

**REFERENCE BOOKS:**

1. F. D. Petruzulla, “Industrial Electronics”, McGraw Hill, Singapore, 1996.
2. M. H. Rashid, “power Electronics Circuits, Devices and Application”, PHI, 3<sup>rd</sup>edition, 2004.
3. G. M. Chute and R. D. Chute, “Electronics in Industry”, McGraw Hill Ltd,Tokyo, 1995.

(19A04802d) ELECTRONIC INSTRUMENTATION  
OPEN ELECTIVE-IV

Course Objectives:

This course will enable students to:

- To introduce various measuring instruments and their functionality
- To teach various measurement metrics for performance analysis
- To explain principles of operation and working of different electronic instruments
- To familiarize the characteristics, operations, calibrations and applications of the different oscilloscopes and signal generators.
- To provide exposure to different types of transducers

UNIT – I

**Measurement and Error:** Definitions, Accuracy, Precision, Resolution and Significant Figures, Types of Errors, Measurement error combinations. (Text 2)

**Ammeters:** DC Ammeter, Multi-range Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple. (Text 1)

**Voltmeters and Multi-meters:** Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multi range Voltmeter, Extending Voltmeter Ranges, Loading, AC Voltmeter using Rectifiers. True RMS Voltmeter, Multi-meter. (Text 1)

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the importance of measurement system (L1)
- Examine the characteristics of different Instruments (L2)
- Illustrate different types of errors that may occur in instruments during measurements (L2)

UNIT – II

**Digital Voltmeters:** Introduction, RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, -Digit, Resolution and Sensitivity of Digital Meters, General Specifications of DVM, (Text 1)

**Digital Instruments:** Introduction, Digital Multi-meters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter, (Text 1)

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain working of digital measuring Instruments (L2)
- Compare the various measuring techniques for measuring voltage (L4)

### **UNIT – III**

**Oscilloscopes:** Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Measurement of Frequency by Lissajous Method, Digital Storage Oscilloscope. (Text 1)

**Signal Generators:** Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, Laboratory Type Signal Generator, AF sine and Square Wave Generator, Function Generator, (Text 1)

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Describe functions of basic building of CRO (L1)
- Measure parameters viz. Amplitude, frequency and time period using CRO (L2)
- Classify signal generators and describe its characteristics (L2)

### **UNIT – 4**

**Measuring Instruments:** Field Strength Meter, Stroboscope, Phase Meter, Q Meter, Megger. (Text 1)

**Bridges:** Introduction, Wheatstone's bridge, Kelvin's Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge, Wien's bridge. (Text 1)

### **Learning Outcomes:**

At the end of this unit, the student will be able to

- Describe function of various measuring Instruments. (L1)
- Describe how unknown capacitance and inductance can be measured using bridges (L1)
- Select appropriate bridge for measuring R, L and C parameters (L2)

### **UNIT – 5**

**Transducers:** Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, LVDT, Piezoelectric transducer, Photo cell, Photo voltaic cell, Semiconductor photo diode and transistor. (Text 1)

## **Learning Outcomes:**

At the end of this unit, the student will be able to

- Explain the importance of transducer (L1)
- Illustrate different measuring techniques in transducers to measure physical quantities.(L2)
- Select the appropriate transducer for the measurement of physical parameters (L2)

## **Course outcomes:**

- Learn different types of errors in measurement, calibration process and standards, various methods for measurement of non-electrical quantities, Understand the different methods for measurement of various electrical quantities.
- Familiarize the dynamics of instrument systems, various passive and active transducers
- Compare the various measuring techniques for measuring voltage (L4)

## **TEXT BOOKS:**

- H. S. Kalsi, “Electronic Instrumentation”, McGraw Hill, 3rd Edition, 2012, ISBN:9780070702066.
- A. D. Helfrick and W.D. Cooper, “Modern Electronic Instrumentation and Measuring Techniques”, Pearson, 1st Edition, 2015, ISBN: 9789332556065.

## **REFERENCE BOOKS:**

- David A. Bell, “Electronic Instrumentation & Measurements”, Oxford University Press PHI 2nd Edition, 2006 ISBN 81-203-2360-2.
- A. K. Sawhney, “Electronics and Electrical Measurements”, Dhanpat Rai & Sons. ISBN -81-7700-016-0



(19A05802a) BLOCKCHAIN TECHNOLOGY

**Course Objectives:**

This course is designed to:

- Understand the philosophy of Blockchain and the cutting edge technology behind its functions
- Illustrate how to setup Ethereum tools
- Explain the key vocabulary and concepts used in Blockchain for Business

UNIT-I

**Blockchain concepts:** Blockchain, Blockchain application example: Escrow, Blockchain stack, from web 2.0 to the next generation decentralized web, domain specific Blockchain application, Blockchain benefits and challenges.

**Blockchain application templates:** Blockchain application components, design methodology for Blockchain applications, Blockchain applications templates

**Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the benefits and challenges of Block chain(L2)
- Design the Blockchain applications(L6)

UNIT-II

**Setting up Ethereum development tools:** Ethereum clients,Ethereum languages, TestRPC, Mist Ethereumwalle, meta mask, web3 JavaScript API, truffle.

**Ethereum Accounts:** Ethereum Accounts, keypairs, working with EOA Accounts, working with contract accounts.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Illustrate the use of Ethereum development tools(L2)
- Create Ethereum accounts and work with them (L6)

UNIT-III

**Smart contracts:** Smart contract, structure of a contract, setting up and interacting with a contract using Geth client, setting up and interacting with a contract using Mist Wallet

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Make use of smart contracts(L3)
- Distinguish setting up and interacting with a contract using Geth client and Mist Wallet.(L4)

### UNIT-IV

**Smart contracts (continued):** Smart contract examples, Smart contract patterns.

**Decentralized Applications:** implementing Dapps, case studies,

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Illustrate the Smart contract examples and patterns(L2)
- Develop Decentralized applications.(L6)

### UNIT-V

**Mining:** Consensus on Blockchain network, mining, Block validation, state storage in Ethereum.

### **Learning Outcomes:**

After completing this Unit, students will be able to

- Define Consensus on Blockchain network(L1)
- Demonstrate State Storage in Ethereum(L2)

### **Course outcomes:**

Upon completion of the course, the students should be able to:

- Create customized blockchain solutions (L6)
- Make use of the specific mechanics of Ethereum(L3)
- Experiment with Smart contracts (L3)
- Develop Enterprise applications using Blockchain(L6)

### **Text book:**

1. Arshadeepbahga, Vijay madiseti, “Blockchain Applications A hands-on approach”, VPT 2017.

2. Chandramouli Subramanian, Asha A George, Abhilash K A and MeenaKarthikeyan, "Blockchain Technology", Universty Press, 2021

**References:**

1. Imran Bashir, "Mastering Blockchain" Packt Publishing Ltd, March 2017.
2. Melanie swan, "Blokchain blueprint for a new economy", O'REILLY

**(19A05802b) MEAN STACK TECHNOLOGIES**

**Course Objectives:**

This course is designed to:

- Translate user requirements into the overall architecture
- Implement new systems and manage the projects
- Write optimized front end code using HTML and JavaScript
- Monitor the performance of web applications & its infrastructure
- Design and implement Robust and Scalable Front End Applications

**UNIT I**

Introduction to Web: Internet and World Wide Web, Domain name service, Protocols: HTTP, FTP, SMTP. Html5 concepts, CSS3, Anatomy of a web page. XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Summarize the protocols related to Internet & WWW(L2)
- Compare and contrast XML and HTML(L5)

**UNIT II**

JavaScript: The Basic of JavaScript: Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions. Angular Java Script Angular JS Expressions: ARRAY, Objects, \$eval, Strings, Angular JS Form Validation & Form Submission, Single Page Application development using Angular JS.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Illustrate the importance of JavaScript(L2)
- Develop applications using Angular JS(L6)

**UNIT III**

Node.js: Introduction, Advantages, Node.js Process Model, Node JS Modules. Express.js: Introduction to Express Framework, Introduction to Nodejs , What is

Nodejs, Getting Started with Express, Your first Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling , API Handling , Debugging, Developing Template Engines, Using Process Managers, Security & Deployment.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the Node JS modules(L2)
- Make use of MVC in Express(L3)

**UNIT IV**

RESTful Web Services: Using the Uniform Interface, Designing URIs, Web Linking, Conditional Requests. React Js: Welcome to React, Obstacles and Roadblocks, React's Future, Keeping Up with the Changes, Working with the Files, Pure React, Page Setup, The Virtual DOM, React Elements, ReactDOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Outline the RESTful Web Services(L2)
- Assess the future of React Js(L5)

**UNIT V**

Mongo DB: Introduction, Architecture, Features, Examples, Database Creation & Collection in Mongo DB. Deploying Applications: Web hosting & Domains, Deployment Using Cloud Platforms.

**Learning Outcomes:**

After completing this Unit, students will be able to

- Explain the features and architecture of Mongo DB (L2)
- Create and collect Database in MongoDB(L6)

**Course Outcomes**

After the completion of the course, student will be able to

- List the Basic Concepts of Web & Markup Languages(L1)
- Develop web Applications using Scripting Languages & Frameworks(L6)
- Make use of Express JS and Node JS frameworks(L3)
- Illustrate the uses of web services concepts like restful, react js (L2)

- Deploying applications using Cloud Platforms (L6)

Text Books:

- 1) Programming the World Wide Web, Robert W Sebesta, 7ed, Pearson.
- 2) Web Technologies, Uttam K Roy, Oxford
- 3) Pro Mean Stack Development, Elad Elrom, Apress
- 4) Restful Web Services Cookbook, Subbu Allamraju, O'Reilly
- 5) JavaScript & jQuery the missing manual, David Sawyer McFarland, O'Reilly
- 6) Web Hosting for Dummies, Peter Pollock, John Wiley Brand

**Reference Books:**

- 1) Ruby on Rails up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, O'Reilly (2006).
- 2) Programming Perl, 4ed, Tom Christiansen, Jonathan Orwant, O'Reilly (2012).
- 3) Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech.
- 4) An Introduction to Web Design, Programming, Paul S Wang, Sanda S Katila, Cengage Learning.
- 5) Express.JS Guide, The Comprehensive Book on Express.js, Azat Mardan, Lean Publishing.

**e-Resources:**

- 1) <http://www.upriss.org.uk/perl/PerlCourse.html>

**(19A27802a) FOOD PLANT UTILITIES & SERVICES**  
**OPEN ELECTIVE - IV**

**PREAMBLE**

This subject focuses on different utilities like water, steam, electricity and its properties, production of consumption of these sources in the food plant.

**OBJECTIVES**

- To give brief idea about the utilities that are required/used in food industry and their sources and importance.

**UNIT – I**

Introduction Classification of various utilities and services in food industry. Water use in Food Processing Industry Water supply system: Pumps of different types, operational aspects, piping system for fresh water, chilled water etc., fittings and control, water requirement for cleaning and processing, water quality, water purification and softening Unit

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Water use in Food Processing Industry
- Water supply system: Pumps of different types, operational aspects, piping system for fresh water, chilled water etc.,
- fittings and control, water requirement for cleaning and processing,
- water quality, water purification and softening Unit

**UNIT – II**

Water use in food processing: Different types of water requirements in food processing plants, types of water use, waste water sources, water wastage minimization, water loadings per unit mass of raw material. Water conservation: Water and waste water management, economic use of water, water filtration and recirculation.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Different types of water requirements in food processing plants,
- types of water use, waste water sources, water wastage minimization,
- water loadings per unit mass of raw material
- Water and waste water management, economic use of water,

- water filtration and recirculation

### **UNIT – III**

Steam uses in Food Industry Steam uses in food industry: Food processing operations in which steam is used, temperature, pressure and quantity of steam required in various food processing operations Steam generation system: Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system, heat loss from boiler system, boiler design consideration.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Food processing operations in which steam is used
- Temperature, pressure and quantity of steam required in various food processing operations
- Components of a boiler system, fuels used in boilers, energy analysis for a steam generation system
- Heat loss from boiler system, boiler design consideration.

### **UNIT – IV**

Waste-Heat Recovery in Food Processing Facilities Quantity and quality of waste heat in food processing facilities, waste heat utilization, heat exchangers for waste heat recovery, heat pumps for waste heat recovery. Waste Disposal and its Utilization Industrial waste, sewage, influent, effluent, sludge, dissolved oxygen, biological oxygen demand, chemical oxygen demand.

#### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Waste-heat recovery in food processing facilities
- Quantity and quality of waste heat in food processing facilities,
- Waste heat utilization, heat exchangers for waste heat recovery, heat pumps for waste heat recovery.
- Waste disposal and its utilization industrial waste, sewage, influent, effluent, sludge,
- Dissolved oxygen, biological oxygen demand, chemical oxygen demand

### **UNIT – V**

Planning and Design of Service Facilities in Food Industry Estimation of utilities requirements: Lighting, ventilation, drainage, CIP system, dust removal, fire protection etc. Maintenance of facilities: Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring, maintenance of the service facilities. Services required in offices,



laboratories, locker and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses etc.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Planning and Design of Service Facilities in Food Industry Estimation of utilities requirements: Lighting, ventilation, drainage, etc.
- Maintenance of facilities: Design and installation of piping system, codes for building, electricity, plumbing, maintenance of the service facilities.
- Services required in offices, laboratories, locker and toilet facilities, canteen, parking lots and roads, repair and maintenance shop, ware houses etc

### **Course Outcomes**

By end of the course, students will understand the following

- Various utilities and services used in food industry and its applications in food industry namely water, steam, electricity and etc.

### **TEXT BOOKS**

1. Lijun Wang. "Energy Efficiency and Management in Food Processing Facilities". CRC Press. 2008,
2. M. E. Casper. "Energy-saving Techniques for the Food Industry". Noyes Data Corporation. 1977,

### **REFERENCES**

1. P.L. Ballaney, "Thermal Engineering in SI Units", 23<sup>rd</sup> Edition, Khanna Publishers, Delhi, 2003.
2. C.P. Arora. "Refrigeration and Air Conditioning". 3<sup>rd</sup> Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi. 2008,
3. W. E. Whitman, "A Survey of Water Use in the Food Industry", S. D. Holdsworth. Published by British Food Manufacturing Industries Research Association.
4. Chilton's Food Engineering. 1979, Chilton Co Publishers.

**(19A27802b) NUTRACEUTICALS AND FUNCTIONAL FOODS**

**OPEN ELECTIVE – IV**

**PREAMBLE**

This course will cover the classification, brief history and the impact of nutraceuticals and functional foods on health and disease prevention. Nutraceuticals to be covered in the course include isoprenoids, isoflavones, flavanoids, carotenoids, lycopene, garlic, omega 3 fatty acids, sphingolipids, vitamin E and antioxidants, herbal products in foods. Also marketing issues related to functional foods and nutraceuticals as well as stability testing will be reviewed.

**Course Objectives:**

- To understand the interrelationship between nutraceuticals and health maintenance.
- Cite the evidence supporting the efficacy and safety of nutraceutical and functional food products
- To explain the metabolic consequences of nutraceuticals and functional foods.
- Describe the physiologic and biochemical changes associated with consumption of nutraceuticals

**UNIT – I**

Introduction, definition, Modification in the definition of nutraceuticals. Classification of nutraceuticals, Nutraceuticals market scenario, formulation considerations. Challenges for Nutraceuticals.

**Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Classification of nutraceuticals,
- Nutraceuticals market scenario and formulation considerations.
- Challenges for Nutraceuticals.

**UNIT – II**

Nutraceuticals value of spices and seasoning – Turmeric, Mustard, Chilli, Cumin, Fenugreek, Black Cumin, Fennel, Asafoetida, Garlic, Ginger, Onion, Clove, Cardamom etc., Nutraceuticals from Fruits And Vegetables – Mango, Apple, Grapes, Bel, Banana, Broccoli, Tomato, Bitter Melon, Bitter Orange etc.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Nutraceuticals value of spices and seasoning – Turmeric, Mustard, Chilli, Etc.
- Nutraceuticals from Fruits and Vegetables – Mango, Apple, Grapes, Tomato etc.

### **UNIT – III**

Omega -3 fatty acids from fish- Typical properties, structural formula, functional category. CLA- typical properties, structural formula, functional category. Application in Nutraceuticals. Calcium, chromium, copper, iodine, iron, magnesium, Zn- mechanism of action, bioavailability, uses and deficiency, dietary sources.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Properties of Omega -3 fatty acids from fish and structures
- Application in Nutraceuticals. Calcium, iodine, iron, Zn- mechanism of action, bioavailability, uses and deficiency, dietary sources.

### **UNIT – IV**

Definition, classification – Type of classification (Probiotics, probiotics and synbiotics: Taxonomy and important features of probiotic microorganisms. Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. Prebiotics. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases, perspective for food applications for the following: Non-digestible carbohydrates/oligosaccharides: Dietary fibre, Resistant starch, Gums.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Probiotics, probiotics and synbiotics: important features of probiotic microorganisms.
- Non-digestible carbohydrates/oligosaccharides: Dietary fibre and etc.

### **UNIT – V**

Phytosterol, Fatty Acids, Carotenoids, Anthocyanins, Carotenoids, Amino Acids, Water Soluble Vitamins, Free radical biology and antioxidant activity of nutraceuticals. Regulations of Nutraceuticals and Functional Foods in India and rest of the world.

### **Learning Outcomes:**

At the end of unit, students will be able to understand the following

- Phytosterol, Fatty Acids, Carotenoids, Anthocyanins, Free radical biology and antioxidant activity of nutraceuticals.
- Regulations of Nutraceuticals and Functional Foods in India and rest of the world.

### **Course Outcomes**

- Students will get know the nutraceuticals and its active components in different foods, regulations on nutraceuticals in India.

### **TEXT BOOKS**

1. “Handbook of Nutraceuticals and Functional Foods. Yashwant Pathak, Vol. 1. (Ingredients, formulations, and applications)” CRC Press 2005.
2. “Handbook of Nutraceuticals and Functional Foods”. Robert Wildman, 2<sup>nd</sup> Edition. CRC Press 2001.

### **REFERENCES**

1. B. Shrilakshmi, “Dietetics”, 5<sup>th</sup> Edition, New Age International (P) Ltd., New Delhi, 2005.
2. A. E. Bender, “Nutrition and Dietetic Foods”, Chem. Pub. Co. New York, 2<sup>nd</sup> Edition, 2004.
3. P. S. Howe, “Basic Nutrition in Health and Disease”, 2<sup>nd</sup> Edition, W. B. Saunders Company, London, 2003.
4. Kramer, “Nutraceuticals in Health and Disease Prevention”, Hoppe and Packer, Marcel Dekker, Inc., NY 2001.
5. Bao and Fenwick, “Phytochemicals in Health and Disease”, Marcel Decker, Inc. NY 2004.

(19A54802a) MATHEMATICAL MODELING & SIMULATION

OPEN ELECTIVE-IV

**Course Objective:**

This course focuses on what is needed to build simulation software environments, and not just building simulations using preexisting packages.

**UNIT-I:**

Simulation Basics-Handling Stepped and Event-based Time in Simulations-Discrete versus Continuous Modeling-Numerical Techniques-Sources and Propagation of Error

**Learning Outcomes:**

Students will be able to

- Understand computer simulation technologies and techniques.

**UNIT-II**

Dynamical, Finite State, and Complex Model Simulations-Graph or Network Transitions Based Simulations-Actor Based Simulations-Mesh Based Simulations-Hybrid Simulations

**Learning Outcomes:**

Students will be able to

- implement and test a variety of simulation and data analysis.

**UNIT-III**

Converting to Parallel and Distributed Simulations-Partitioning the Data-Partitioning the Algorithms-Handling Inter-partition Dependencies

**Learning Outcomes:**

Students will be able to

- Understand concepts of modeling layers of society's critical infrastructure networks.
- Understand partitioning the data.

**UNIT-IV**

Probability and Statistics for Simulations and Analysis-Introduction to Queues and Random Noise-Random Variates Generation-Sensitivity Analysis

**Learning Outcomes:**

Students will be able to

- Understand Queues and Random noise.
- Understand sensitivity analysis.

**UNIT-V**

Simulations Results Analysis and Viewing Tools-Display Forms: Tables, Graphs, and Multidimensional Visualization-Terminals, X and MS Windows, and Web Interfaces-Validation of Model Results

**Learning Outcomes:**

Students will be able to

- Build tools to view and control simulations and their results.

**Course Outcomes:**

After the completion of course, student will be able to

- Understand basic Model Forms.
- Understand basic Simulation Approaches.
- Evaluate handling Stepped and Event-based Time in Simulations.
- Distinguish Discrete versus Continuous Modeling.
- Apply Numerical Techniques.
- Calculate Sources and Propagation of Error.

**TEXT BOOKS:**

1. JN Kapur, "Mathematical modelling", Newage publishers
2. Kai Velten, "Mathematical Modeling and Simulation: Introduction for Scientists and Engineers" Wiley Publishers.

**(19A51802a) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT**

**Course Objectives:**

- Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
- Understand the use of alternatives assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

**UNIT 1: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY**

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Apply the Green chemistry Principles for day to day life as well as synthesis (L3)
- Describe the sustainable development and green chemistry (L2)
- Explain economic and un-economic reactions (L2)
- Demonstrate Polymer recycling (L2)

**UNIT 2: CATALYSIS AND GREEN CHEMISTRY**

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples.

**Learning Outcomes:**

At the end of this unit, the students will be able to

- Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries (L2)
- Differentiate Homogeneous and Heterogeneous catalysis (L2)
- Identify the importance of Bio and Photo Catalysis (L3)
- Discuss Transition metal and Phase transfer Catalysis (L3)

### **UNIT 3: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS**

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Demonstrate Organic solvents and importance of solvent free systems (L3)
- Discuss Super critical carbondioxide (L2)
- Explain Super critical water and water as a reaction solvent (L2)
- Interpret Ionic Liquids as Catalyst and Solvent (L2)

### **UNIT 4: EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES**

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable feedstocks: Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency: Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis. Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions).

#### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Describe importance of Biomass and Solar Power (L2)
- Illustrate Sonochemistry and Green Chemistry ((L2)
- Apply Green Chemistry for Sustainable Development (L3)
- Discuss the importance of Renewable resources (L3)



## **UNIT 5: GREEN PROCESSES FOR GREEN NANOSCIENCE**

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

### **Learning Outcomes:**

At the end of this unit, the students will be able to

- Discuss green Chemistry Principles for practicing Green nano synthesis (L3)
- Illustrate Microwave Assisted Synthesis (L2)
- Differentiate Hydrothermal and Reflux synthesis (L2)
- Demonstrate Green Chemistry applications of Inorganic nanomaterials (L2)

### **Course Outcomes:**

Upon completion of this course the students should recognize and acquire green chemistry concepts and apply these ideas to develop respect for the inter connectedness of our world and an ethic of environmental care and sustainability.

### **Text Books :**

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4<sup>th</sup> Edition, Oxford University Press, USA

### **References :**

1. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and Ackmez Mudhoo, CRC Press, 2010.
2. Edited by Alvis Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH, 2013.

# HONOURS

**(19A04H01) AUTOMOTIVE ELECTRONICS**

**(Honours)**

**Course Learning Objectives:**

This course will enable students to:

- Understand the basics of automobile dynamics and design electronics to complement those features.
- Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts.

**Module -1**

**Automotive Fundamentals Overview** – Evolution of Automotive Electronics, Automobile

Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block,

Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage

circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train -

Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System (Text 1: Chapter1),

Starter Battery –Operating principle: **(Text 2: Pg. 407-410)**

**The Basics of Electronic Engine Control** – Motivation for Electronic Engine Control – Exhaust

Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General

terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark

timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of

intake manifold pressure, Electronic Ignition. (**Text 1: Chapter 5**)

## **Module -2**

**Automotive Sensors** – Automotive Control System applications of Sensors and Actuators – Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O<sub>2</sub>/EGO) Lambda Sensors, Piezoelectric Knock Sensor. (**Text 1: Chapter 6**)

**Automotive Engine Control Actuators** – Solenoid, Fuel Injector, EGR Actuator, Ignition System (**Text 1: Chapter 6**)

## **Module -3**

**Digital Engine Control Systems** – Digital Engine control features, Control modes for fuel Control

(Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark

Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management,

Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics. (**Text**

**1: Chapter 7)**

**Control Units** – Operating conditions, Design, Data processing, Programming, Digital modules in

the Control unit, Control unit software. (**Text 2: Pg. 196-207**)

## **Module -4**

**Automotive Networking** –Bus Systems – Classification, Applications in the vehicle, Coupling of

networks, Examples of networked vehicles

(**Text 2: Pg. 85-91**),

Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.  
(Text 2: Pg.

92-151)

**Vehicle Motion Control** – Typical Cruise Control System, Digital Cruise Control System, Digital

Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics

(Digital only), Antilock Brake System (ABS) (Text 1: Chapter 8)

**Module -5**

**Automotive Diagnostics**–Timing Light, Engine Analyzer, On-board diagnostics, Off-board

diagnostics, Expert Systems, Occupant Protection Systems – Accelerometer based Air Bag

systems. (Text 1: Chapter 10)

**Future Automotive Electronic Systems** – Alternative Fuel Engines, Electric and Hybrid

vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure

warning system, Heads Up display, Speech Synthesis, Navigation – Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control (Text 1: Chapter 11)

**Course Outcomes:**

At the end of the course, students will be able to:

- Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry.
- Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.
- Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.

- Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

**Text Books:**

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
2. Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics System and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007.

**(19A04H02) LOW POWER VLSI DESIGN**

**(Honors)**

**Course Objectives:**

- To impart knowledge on different abstraction levels in VLSI Design and the impact of power reduction methods at higher levels
- To describe leakage control mechanisms to reduce static power consumption in DSM VLSI regime
- To explain technology independent and technology-dependent techniques for Dynamic power reduction in CMOS circuits
- To introduce various software power estimation and optimization techniques for low power VLSI system design
- To demonstrate low power circuit and architectural techniques for reducing power consumption in SRAM designs

**Unit 1**

Introduction to Low Power design: Why worry about power – at global and SOC levels, Emerging zero-power applications (WSN), 20 nm scenario, Design-productivity challenge, Impact of implementation choices, Motivation for LPD, Basic VLSI Design Flow, Optimization examples at various levels (System, Sub-system, RTL, Gate, Circuit and Device levels)

Sources of power dissipation, MOS transistor leakage components, Static Power dissipation, Active Power dissipation, Circuit Techniques for Low Power Design – Standby leakage control using transistor stacks, Multiple  $V_{TH}$  and dynamic  $V_{TH}$  techniques, Supply voltage scaling technique.

**Unit Outcomes:**

- Identify sources of power dissipation in VLSI Circuits (L2)
- Distinguish between static and dynamic power dissipation (L2)
- Distinguish impact of power reduction techniques at various levels of VLSI Design (L2)
- Apply standby leakage reduction techniques for static power reduction in CMOS circuits (L3)

**Unit 2**

Power Optimization Techniques – I: Dynamic Power Reduction Approaches, Circuit Parallelization, Voltage Scaling Based Circuit Techniques, Circuit Technology – Independent Power Reduction, Circuit Technology Dependent Power Reduction; Leakage Power Reduction – Leakage Components, Design Time Reduction Techniques, Run-time Stand-by Reduction

Techniques, Run-time Active Reduction Techniques Reduction in Cache Memories, LVLP Logic Styles, Current-Mode CMOS Adders using multiple-valued logic.

**Unit Outcomes:**

- Distinguish between technology - dependent and technology – independent power reduction techniques (L2)
- Analyze different power reduction techniques for VLSI systems at Design time, Run-time and Stand-by modes (L4)
- Compare Current Mode and Voltage Mode CMOS circuits w.r.t power consumption (L5)

**Unit 3**

Power Optimization Techniques – II: Low Power Very Fast Dynamic Logic Circuits, Low Power Arithmetic Operators, Energy Recovery Circuit Design, Adiabatic – Charging Principle and its implementation issues (Ref-2)

Software Design for Low Power: Sources of Software Power Dissipation, Software Power Estimation, Software Power Optimizations, Automated Low-Power Code Generation, Co-design for Low Power.

**Unit Outcomes:**

- Identify implementation issues in adiabatic/ energy recovery circuit design (L2)
- Identify sources of software power dissipation (L2)
- Apply simple software estimation and optimization techniques for low power VLSI system design (L3)

**Unit 4**

Low Voltage Low Power Static Random Access memories:

Basics, Race between 6T and 4T memory cells, LVLP SRAM Cell designs- Shared bit-line SRAM cell configuration, Power efficient 7T SRAM cell with current mode read and write, Loadless CMOS 4T SRAM cell, The 1T SRAM cell, Pre-charge and Equalization Circuit, Dynamic and static decoders, Voltage Sense amplifier, Output Latch,

Low Power SRAM Techniques: Sources of SRAM Power, Low Power Circuit techniques such as capacitance reduction, Leakage current reduction.

**Unit Outcomes:**

- Compare different SRAM structures for power efficiency (L5)
- Apply capacitance and leakage current reduction techniques for SRAM structures to reduce power dissipation (L3)



## Unit 5

Large LP VLSI System design and Applications:

Architecture-driven Voltage Scaling, Power optimization using operation reduction and operation substitution, Pre-computation based optimization, Multiple and Dynamic supply voltage design, Choice of supply voltages, Varying the clock speed, varying the  $V_{DD}$  of RAM structures, Gated Clocking. Leakage current reduction in medical devices.

### Unit Outcomes:

- Apply simple architectural level power reduction techniques in CMOS VLSI designs (L3)
- Apply low power circuit techniques such as Gated clocking, varying clock speed and  $V_{DD}$  for RAM structures (L3)

### Contents beyond Syllabus:

Low Power Design for safety Critical applications: safe operation constraints vs low-power techniques, Unsuitable low power design techniques for safety critical applications, Low-power and safe-operating circuits. (4 hours)

### Course Outcomes:

- Distinguish impact of various power reduction techniques at different levels of VLSI Design (L2)
- Identify sources of power dissipation and apply leakage reduction techniques to reduce static power consumption in CMOS circuits (L2)
- Analyze different power reduction techniques for VLSI systems at Design time, Run-time and Stand-by modes (L4)
- Apply simple software power estimation and optimization techniques for low power VLSI system design (L3)
- Apply low power circuit and architectural techniques such as capacitance reduction, gated clocking,  $V_{DD}$  and  $V_{th}$  scaling, DVS etc in digital systems and SRAM designs (L3)

### Text Books:

1. Kiat-Seng Yeo and Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems, Tata McGrawhill Edition, 2005.
2. Christian Piguet, “Low Power CMOS Circuits Technology, Logic Design and CAD Tools”, 1<sup>st</sup> Indian Reprint, CRC Press, 2010.

**References:**

1. Kaushik Roy and Sharat Prasad, “ Low-Power CMOS VLSI Circuit Design” , Wiley Pub., 2000.
2. Dimitrios Soudris, Christian Pigué and Coostas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer Academic Pub, 2002
3. J. Rabaey, Low Power Design Essentials, 1<sup>st</sup> Edition, Springer Publications, 2010.

**(19A04H03) PATTERN RECOGNITION**  
**(Honors)**

**Course Objectives:**

- To convey methods for learning from data, with an emphasis on pattern classification.
- To expose various pattern recognition algorithms.
- To present pattern recognition algorithms to solve the real world problems in various fields.

**Unit 1**

Introduction - Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Examples of Automatic Pattern recognition systems, Simple pattern recognition model.

**Unit Outcomes:**

- Summarize basic concepts of pattern recognition (L2)
- Formulate simple pattern recognition model (L6)

**Unit 2**

Statistical Decision Making - Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations. Baye's classifier for normal patterns.

**Unit Outcomes:**

- Describe statistical decision-making algorithms (L2)
- Predict different error rates in data analysis of patterns (L3)

**Unit 3**

Non Parametric Decision Making: Histogram, kernel and window estimation, nearest neighbor classification techniques. Adaptive decision boundaries, adaptive discriminant functions, Minimum squared error discriminant functions, choosing a decision making techniques.

**Unit Outcomes:**

- Describe non-parametric decision-making algorithms in pattern recognition (L2)
- Compare and contrast different decision-making algorithms (L5)

**Unit 4**

Clustering and Partitioning: Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single-linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering-Forg's algorithm, K-means's algorithm, Isodata algorithm.

**Unit Outcomes:**

- Discuss various Hierarchical clustering algorithms (L5)
- Apply Partition clustering techniques in pattern recognition (L3)

**Unit 5**

Pattern Pre-Processing and Feature Selection: Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection, Applications of Pattern Recognition in bio-metric, facial recognition, Finger prints, etc.

**Unit Outcomes:**

- Describe pre-processing and feature selection algorithms in pattern recognition (L2)
- Develop various applications using pattern recognition algorithms (L6)

**Course Outcomes:**

- Formulate systems and algorithms for pattern recognition, with focus on sequences of patterns (L6)
- Interpret principles of Bayesian parameter estimation (L2)
- Analyze Non-parametric decision-making algorithms in pattern recognition (L4)
- Analyze clustering and partitioning techniques in pattern recognition (L4)
- Apply pre-processing and feature selection methods in pattern recognition (L3)
- Develop various applications using pattern recognition algorithms (L6)

**Text Books:**

1. Gose. Johnsonbaugh, Jost. "Pattern recognition and Image Analysis", PHI.
2. Tou. Rafael. Gonzalez. "Pattern Recognition Principle", Pearson Education.

**References:**

1. Richard Duda, Hart., David Stork, "Pattern Classification", John Wiley.
2. Theodoridis, S. and K. Koutroumbas, Pattern recognition. 4th ed. 2009, San Diego, CA: Academic Press.

**(19A04H04) MICRO ELECTRO MECHANICAL SYSTEMS**

**(Honors)**

**Course Objectives:**

- To provide knowledge of semiconductors and solid mechanics to fabricate mems devices.
- To educate on the rudiments of micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for mems.
- To educate on the applications of mems to disciplines beyond electrical and mechanical engineering.

**Unit 1**

**INTRODUCTION :** Intrinsic Characteristics Of MEMS – Energy Domains And Transducers- Sensors And Actuators – Introduction To Micro Fabrication – Silicon Based MEMS Processes – New Materials – Review Of Electrical And Mechanical Concepts In MEMS – Semiconductor Devices – Stress And Strain Analysis – Flexural Beam Bending- Torsional Deflection.

**Unit Outcomes:**

- Explain basic principles of MEMS (L2)
- Classify materials used for fabricating MEMS (L4)
- Analyze stress, strain, bending and deflection in semiconductor devices (L4)

**Unit 2**

**SENSORS AND ACTUATORS-I:** Electrostatic Sensors – Parallel Plate Capacitors – Applications – Interdigitated Finger Capacitor – Comb Drive Devices – Micro Grippers – Micro Motors – Thermal Sensing And Actuation – Thermal Expansion – Thermal Couples – Thermal Resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micromagnetic Components – Case Studies Of MEMS In Magnetic Actuators- Actuation Using Shape Memory Alloys.

**Unit Outcomes:**

- Summarize different types of capacitor sensors (L2)
- Understand working of different thermal sensors (L2)
- Demonstrate the application of magnetic actuators (L2)

**Unit 3**

**SENSORS AND ACTUATORS-II:** Piezoresistive Sensors – Piezoresistive Sensor Materials – Stress Analysis Of Mechanical Elements – Applications To Inertia, Pressure, Tactile And Flow Sensors – Piezoelectric Sensors And Actuators – Piezoelectric Effects – Piezoelectric Materials – Applications To Inertia , Acoustic, Tactile And Flow Sensors.

**Unit Outcomes:**

- Analyze piezoelectric effect and related mathematical concepts (L4)
- Demonstrate the applications of PZTs (L2)

**Unit 4**

**MICROMACHINING:** Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching Of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case Studies – Basic Surface Micro Machining Processes – Structural And Sacrificial Materials – Acceleration Of Sacrificial Etch – Striction And Antistriction Methods – LIGA Process – Assembly Of 3D MEMS – Foundry Process.

**Unit Outcomes:**

- Classify the types of etching processes applicable to micromachining (L4)
- Understand surface micromachining processes (L2)
- Describe various steps in LIGA process (L2)

**Unit 5**

**POLYMER AND OPTICAL MEMS:** Polymers In MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application To Acceleration, Pressure, Flow And Tactile Sensors- Optical MEMS – Lenses And Mirrors – Actuators For Active Optical MEMS.

**Unit Outcomes:**

- Discuss application of polymer materials in fabricating MEMS (L5)
- Describe operation of lenses, mirrors and actuators for optical MEMS (L2)

**Course Outcomes:**

- Explain electrical and mechanical principles of MEMS (L2)
- Describe working of electrostatic, thermal and magnetic sensors and actuators (L2)
- Demonstrate piezoelectric effect and its applications (L2)
- Categorize micromachining processes (L4)
- Describe operation of polymer and optical MEMS (L2)

**Text Books:**

1. Chang Liu, 'Foundations Of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro Systems Design And Manufacture" Tata McGraw Hill, New Delhi, 2002.

**References:**

1. NadimMaluf, "An Introduction To Micro Electro Mechanical System Design", Artech House, 2000.

2. Mohamed Gad-El-Hak, Editor, “ The MEMS Handbook”, CRC Press Baco Raton, 2001.
3. Julian W. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS And Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.

**(19A04H05) VLSI TESTING AND TESTABILITY**

**(Honors)**

**Course Objectives:**

- To impart knowledge on the basic faults that occur in digital systems
- To describe fault detection techniques in combinational circuits.
- To outline procedures to generate test patterns for detecting single stuck faults in combinational and sequential circuits.
- To explain design for testability techniques with improved fault coverage.
- To introduce BIST concepts and specific architectures.
- To give exposure to approaches for introducing BIST into logic circuits, memories and embedded cores.

**Unit 1**

Introduction to Test and Design for Testability (DFT) Fundamentals. Modeling: Modeling digital circuits at logic level, register level and structural models. Levels of modeling. Logic Simulation: Types of simulation, Delay models, Element evaluation, Hazard detection, Gate level event driven simulation.

**Unit Outcomes:**

- Model digital circuit at logic, RTL and structural levels (L3)
- Compare logic and analog simulations with respect to speed and accuracy (L2)
- List various delay models and their importance in circuit simulation (L1)

**Unit 2**

Fault Modeling – Logic fault models, Fault detection and redundancy, Fault equivalence and fault location. Single stuck and multiple stuck – Fault models. Fault simulation applications, General techniques for Combinational circuits.

**Unit Outcomes:**

- Model faults as stuck at and multiple stuck at faults (L3)
- List fault detection techniques for combinational circuits (L1)
- Apply redundancy for fault detection in a digital circuit (L3)



### **Unit 3**

Testing for single stuck faults (SSF), Automated test pattern generation (ATPG/ATG) for SSFs in combinational and sequential circuits, Functional testing with specific fault models, Vector simulation – ATPG vectors, formats, Compaction and compression, Selecting ATPG Tool.

#### **Unit Outcomes:**

- Generate test patterns for detecting single stuck faults in combinational and sequential circuits (L2)
- Test circuit function with specific fault models (L4)
- Define Vector simulation and ATPG vectors (L1)

### **Unit 4**

Design for testability – testability trade-offs, techniques. Scan architectures and testing – controllability and Observability, generic boundary scan, full integrated scan, storage cells for scan design. Board level and system level DFT approaches. Boundary scan standards. Compression techniques – different techniques, syndrome test and signature analysis.

#### **Unit Outcomes:**

- Define controllability and observability for a digital system (L1)
- Identify schemes for introducing testability into digital circuits with improved fault coverage (L3)
- Compare board level and chip level DFT approaches in testing (L2)

### **Unit 5**

Built-in self-test (BIST): BIST Concepts and test pattern generation. Specific BIST Architectures – CSBL, BEST, RTS, LOCST, STUMPS, CBIST, CEBS, RTD, SST, CATS, CSTP, BILBO. Brief ideas on some advanced BIST concepts and design for self-test at board level. Memory BIST (MBIST): Memory test architectures and techniques – Introduction to memory test, Types of memories and integration, Embedded memory testing model. Memory test requirements for MBIST. Brief ideas on embedded core testing.

#### **Unit Outcomes:**

- Compare different BIST architectures (L5)
- Perform memory test for the given memory block (L3)
- Compare different approaches for introducing BIST into logic circuits, memories and embedded cores (L5)

**Course Outcomes:**

- Model digital circuits at logic and RTL levels (L3)
- Simulate digital ICs in the presence of faults and evaluate the given test set for fault coverage (L4)
- Generate test patterns for detecting single stuck faults in combinational and sequential circuits (L3)
- Identify schemes for introducing testability into digital circuits with improved fault coverage (L3)
- Compare different approaches for introducing BIST into logic circuits, memories and embedded cores (L5)

**Text Books:**

1. MironAbramovici, Melvin A. Breur, Arthur D. Friedman, Digital Systems Testing and Testable Design, Jaico Publishing House, 2001.
2. Alfred Crouch., Design for Test for Digital ICs & Embedded Core Systems, Prentice Hall.

**References:**

1. Robert J. Feugate, Jr., Steven M. Mentyn, Introduction to VLSI Testing, Prentice Hall, Englehood Cliffs, 1998.
2. Bushnell, M., and Agrawal, Vishwani D, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Kluwer Academic Publishers,2002