



# **Jawaharlal Nehru Technological University Anantapur**

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

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

**II year B.Tech  
Course Structures and Syllabi  
under R19 Regulations**

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

**2<sup>nd</sup> Year to 4<sup>th</sup> Years Course Structure**

<b>Semester – 3 (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 – 4 (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>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-I Sem**

**L T P C**  
**3 0 0 3**

**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.

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**B.Tech – II-I Sem**

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**3 0 0 3**

**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.

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**B.Tech – II-I Sem**

**L T P C**  
**3 0 0 3**

**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  $I_{co}$ ,  $V_{BE}$ , , 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.

**Biasing 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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-I Sem**

**L T P C**  
**3 0 0 3**

**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,” 3rd Edition, Oxford, 1999.

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**B.Tech – II-I Sem**

**L T P C**  
**3 0 0 3**

**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.

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**B.Tech – II-I Sem**

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**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- transformer
- To understand computation and predetermination of regulation of a 1- 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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-I Sem**

**L T P C**  
**0 0 3 1.5**

**19A04302P ELECTRONIC DEVICES AND CIRCUITS LAB**

**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  **$I_P$ ,  $I_V$ ,  $V_P$ , &  $V_V$**  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).

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**B.Tech – II-I Sem**

**L T P C**  
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## **19A04303 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)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-I Sem**

**L T P C**  
**2 0 0 1**

**19A02304P ELECTRICAL TECHNOLOGY LAB**

**Course Objectives:**

- To do experiments on DC generators
- To do experiments on DC motors
- To do experiments on 1- transformer
- To do power measurements in 3- balanced and unbalanced circuits
- To do tests on 3- 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- transformer
7. Measurement of Active and reactive powers in a 3- balanced circuit
8. Measurement of 3- 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- transformer

- To know power measurement in 3- circuits
- To understand various characteristics of Induction motors, Synchronous machines

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech – II-I Sem

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## 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

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**3 0 0 3**

**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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**3 0 0 3**

**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- equivalent circuit, Hybrid- 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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**3 0 0 3**

**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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**3 0 0 3**

**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 House 2001.
4. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH, 2004.(edition)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**2 1 0 3**

**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

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**3 0 0 3**

**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





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-I Sem**

**L T P C**  
**2 0 0 2**

**19A52301 UNIVERSAL HUMAN VALUES**

(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.

**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.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

**L T P C**  
**0 0 3 1.5**

**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)



# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**B.Tech – II-II Sem**

**L T P C**  
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## **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)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech – II-II Sem**

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**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 echo 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.