GEETHANJALI INSTITUTE OF SCIENCE & TECHNOLOGY: NELLORE

(AUTONOMOUS)

NELLORE–524317 (A.P) INDIA

B.TECH IN MECHANICAL ENGINEERING

(ACCREDITATED BY NBA)

COURSE STRUCTURE AND SYLLABI UNDER RG 22 REGULATIONS

GEETHANJALI INSTITUTE OF SCIENCE AND TECHNOLOGY
(AUTONOMOUS)
NELLORE – 524137 (A.P) INDIA

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Mechanical Engineering
IV B.TECH

Semester-VII (Theory–6, Skill Course–1)							
S.No.	**Course Code**	**Course Name**	**Category**	**Hours per week**			**Credits**
				L	**T**	**P**	
1.	22A0332T	**Professional Elective Course -III**	PEC	3	0	0	3
	22A0332Ta	Design of Heat Transfer Equipment					
	22A0332Tb	Tribology					
	22A0332Tc	Unconventional Machining Processes					
2.	22A0333T	**Professional Elective Course -IV**	PEC	3	0	0	3
	22A0333Ta	Refrigeration and Air-Conditioning					
	22A0333Tb	Introduction to Robotics					
	22A0333Tc	Finite Element Methods					
3.	22A0334T	**Professional Elective Course-V**	PEC	3	0	0	3
	22A0334Ta	Power Plant Engineering					
	22A0334Tb	Non-Destructive Evaluation					
	22A0334Tc	Fundamentals of Drone Technology					
4.		**Open Elective Course -III**	OEC	3	0	0	3
	22A0151T	Disaster Management					
	22A0241Ta	Smart Electric Grid					
	22A0433T	Industrial Electronics					
	22A0529T	Cloud Computing					
5.		**Open Elective Course -IV**	OEC	3	0	0	3
	22A0152T	Construction Management					
	22A0332Ta	Electric Vehicles					
	22A0432T	Basics of VLSI Design					
	22A0534Tb	Introduction to Cyber Security					
6.	22A0335T	Operations Research	PCC	2	1	0	3
7.	22A0336P	**Skill Advanced Course** Industrial Automation	SAC	1	0	2	2
8.	22A0337	**Internship-II**(Evaluated the Industry Internship completed at the end of Third year)					3
						Total	**23**

Distribution of Credits among the Category of Courses		
S.No	**Category of Courses Introduced**	**Credits Assigned**
1	Professional Core Courses (1T)	3
2	Professional Elective Courses (3T)	9
3	Open Elective Course Courses (2T)	6
4	Skill Advanced Course – 1 (T+P)	2
5	Summer Internship of completed in Third year	3
Total Credits		23

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Mechanical Engineering
IV B.TECH

Semester-VIII						
S.No.	Course Code	Course Name	Hours per week			Credits
			L	T	P	
1	22A0338	Full Internship/Project work	0	0	24	12
					Total Credits	12

Distribution of Credits among the Category of Courses		
S.No	Category of Courses Introduced	Credits Assigned
1	Project Work	12
Total Credits		12
Overall Credits in the Program		**163**

COURSES OFFERED FOR HONOURS DEGREE IN MECHANICAL ENGINEERING

Note: 1. The Honours subjects are having a total of 20 additional credits.
2. The student should acquire four credits through MOOCs compulsory to award the Honour Degree.

S.No.	Course Code	Course Title	Contact Hours per week			Credits
			L	T	P	
1	22A03H01	Fracture Mechanics	3	1	0	4
2	22A03H02	Computational Fluid Dynamics	3	1	0	4
3	22A03H03	Analysis and Synthesis of Mechanisms	3	1	0	4
4	22A03H04	Applications of Optimization Techniques	3	1	0	4
5	22A03H05	**MOOC**				4

LIST OF MINOR COURSES OFFERED BY MECHANICAL ENGINEERING

S.No.	Course code	Minor Title	Hours per week			Credits
1.	22A03M01	Modern Manufacturing Methods	3	1	0	4
2.	22A03M02	Engineering Thermodynamics	3	1	0	4
3.	22A03M03	Material Science & Engineering	3	0	2	4
4.	22A03M04	Design of Machine Elements	3	1	0	4
5.	22A03M05	Additive Manufacturing	3	0	2	4
6.	22A03M06	Synthesis and characterization of Composites	3	1	0	4
7.	22A03M07	Mechatronics & MEMS	3	1	0	4
8.	22A03M08	Hybrid Vehicles	3	1	0	4

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Design of Heat Transfer Equipment					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0332Ta	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To introduce basic methods of design of heat exchangers.
- To familiarize with the design procedures of various heat transfer equipment

Syllabus		**Total Hours:42**
UNIT - I	**Introduction**	**12 Hrs**

Methods of design of Heat Exchangers Concept of Logarithmic Mean Temperature Difference: Expression for single pass parallel-flow and single-pass counter flow heat exchangers – Derivation from first principles, Special Cases, LMTD for a single-pass cross-flow heat exchanger , Numerical Problems, Arithmetic Mean Temperature Difference [AMTD], Relation between AMTD and LMTD, Logical Contrast between AMTD and LMTD, LMTD of a single-pass heat exchanger with linearly varying overall heat transfer coefficient [U] along the length of the heat exchanger, Numerical problems.

Concept of Effectiveness: Effectiveness-Number of Transfer Units Approach, Effectiveness of single-pass parallel-flow and counter-flow heat exchangers, Physical significance of NTU, Heat capacity ratio, Different special cases of the above approach, Chart solutions pertaining to Effectiveness-NTU approach, Numerical problems

UNIT - II	**Design of Shell and Tube Heat Exchangers**	**10 Hrs**

Single-Pass, One shell-Two tube [1S-2T] and other heat exchangers, Industrial versions of the same, Classification and Nomenclature, Baffle arrangement, Types of Baffles, Tube arrangement, Types of tube pitch lay-outs, Shell and Tube side film coefficients, Pressure drop calculations, Numerical problems on Design of Shell and Tube Heat Exchangers

UNIT - III	**Design of Hair-Pin Heat Exchangers**	**10 Hrs**

Introduction to Counter-flow Double-pipe or Hair-Pin heat exchangers, Industrial versions of the same, Film coefficients in tubes and annuli, Pressure drop, Augmentation of performance of hair-pin heat exchangers, Series and Series-Parallel arrangements of hair-pin heat exchangers, Comprehensive Design Algorithm for hair-pin heat exchangers, Industrial standards, Numerical problems on Design of Hair-Pin Heat Exchangers.

UNIT - IV	**Design of Plate Heat Exchangers**	**12 Hrs**

Introduction, Mechanical Features – Plate pack and the frame, Plate types, Advantages and performance limits, Passes and flow arrangements, Heat transfer and pressure drop calculations, Numerical problems on Design of Plate Heat Exchangers.

UNIT - V	Design of Boilers, Condensers and Cooling Towers	12 Hrs

Boiling: types of boiling, various empirical relations pertaining to boiling, Numerical problems.

Condensation –Types of condensers, Nusselt's theory on laminar film-wise condensation, Empirical Refinements, Several empirical formulae, Numerical problems.

Cooling Towers: basic principle of evaporative cooling, classification of cooling towers, empirical relations pertaining evaporative cooling. Numerical problems on Design of Boilers, Condensers and Cooling Towers

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

- Apply LMTD and NTU methods for the design of heat exchangers.
- Design shell and tube heat exchangers used in process industries.
- Design hair-pin heat exchangers used in process industries.
- Design plate heat exchangers used in milk industries.
- Design boilers, condensers and cooling towers used in steam power plants.

Textbooks:

1. Compact Heat Exchangers, Kays, W. M. and London, A. L., McGraw – Hill, New York, 2nd Edition, 1998.
2. Fundamentals of Heat Exchanger Design, Shah, R. K. and Sekulic, D. P., John Wiley and Sons, New Jersey, 2003.

Reference Books:

1. Fundamentals of Heat and Mass Transfer, Incropera, F. P. and Dewitt, D. P., 7th Edition, John Wiley and Sons, New York, 2013.
2. Kern, Donald Q. Process heat transfer. No. 04; QC320, K4. 1950.

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Tribology					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0332Tb	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To familiarize with the selection of lubricating system for different machine components.
- To impart knowledge on design of bearings for a given application

Syllabus		**Total Hours:42**
UNIT - I		**12 Hrs**

Basic Concepts: Oil Viscosity and temperature and pressure effect on viscosity of lubricants, viscosity index, determination of viscosity, viscosity measurements, friction and wear mechanisms- methods of fluid film formation.
Lubrication: classification of lubricant oils, characteristics of liquid, grease and solid, lubricants- additives.
Bearing Materials: Classification of bearing materials-desirable properties, advantages and applications

UNIT - II		**10 Hrs**

Hydrostatic Bearings: Introduction to hydrostatic lubrication-Viscous Flow through Rectangular Slot, Hydrostatic Bearing Analysis -Flat Circular pad, Flat square pad and Conical thrust Bearing - Energy losses and Optimum design and Temperature rise.

UNIT - III		**10 Hrs**

Hydrodynamic bearings: Principles of hydrodynamic lubrication–mechanism of pressure development in the oil-film, petroffs equation-Reynolds's equation for two-dimensional flow; hydrodynamic journal bearings-Analysis of infinitely long and infinitely short bearings- Effects of side leakage, Friction in sliding bearing heat generated and heat dissipated. Hydrodynamic thrust bearings- Analysis of plane slider bearing with fixed Pad

UNIT - IV		**12 Hrs**

Analysis of Hydrostatic Squeeze-film Lubrication: Circular plate approaching a plane - rectangular plate approaching a plane and applications of squeeze-film Lubrication
Aerostatic Bearing lubrication: Introduction, merits and demerits, applications to hydrodynamic and hydrostatic thrust bearings , externally pressurized gas bearings.
Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings –qualitative approach only.

UNIT - V		**12 Hrs**

Oil Seals &Gaskets: Different type of mechanical seals-static and dynamic, essential properties of the seals- oil flinger rings and oil grooves.
Failure of Tribological Components: Failure analysis of plain bearings, rolling bearings, gears, seals-characteristics and causes

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

- Select the appropriate lubricant and material for specific application design and analyze the hydrostatic and hydrodynamic lubrication systems used in bearings.
- Analyze and explain the hydrostatic squeeze-film lubrication, aerostatic lubrication systems used in bearings and dry rubbing bearing.
- Illustrate different types of seals and gaskets used in mechanical systems and describe the behavior of tribological components subjected to different working conditions.

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Textbooks:

1. Gwidon Stachowiak and Andrew W Batchelor, Engineering Tribology,
2. Butterworth-Heinemann, 4th Edition,2013
3. V. B. Bhandari, Design of Machine Elements,McGraw-Hill Education 4th Edition, 2013.

Reference Books:

1. H.G. Phakatkar& R.R. Ghorpade, Tribology, Nirali Prakashan.,4th Edition, 2012
2. Er. Sushil Kumar Srivastava, Tribology in Industries, S.Chand& Company Ltd, 2nd Edition, 2011
3. M.J. Neale, Tribology Handbook, Butterworth, 2nd Edition, 2001

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Unconventional Machining Processes					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0332Tc	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- Define various Modern Machining Processes.
- Acquire knowledge in the elementary mechanism and machinability of materials with different Modern Machining Processes.
- Determine basic principles of operation for each process and their applications.
- State various parameters influencing MRR in Non – Traditional Machining Process.
- Classify and understand the working of Additive Manufacturing Processes.

Syllabus		**Total Hours:42**
UNIT - I	**Non – Traditional Machining Processes**	**12 Hrs**

Introduction, Need, Classification and Brief Overview, Considerations in Process selection, Materials, Applications.

Mechanical Energy Based Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra Sonic Machining – Working Principle, Description of Equipment, Process Parameters, Metal Removal Rate, Applications, Advantages and Limitations.

UNIT - II	**Electrical Energy Based Processes**	**10 Hrs**

Electric Discharge Machining – Working Principles, Description of Equipment, Process Parameters, Surface Finish and MRR, Electrode / Tool, Power and Control Circuits, Tool Wear, Dielectric Fluid, Flushing, Advantages, Limitations and Applications. Wire cut EDM – Working Principle and Applications.

UNIT - III	**Chemical and Electro Chemical Energy Based Processes**	**10 Hrs**

Chemical Machining and Electro Chemical Machining – Working Principle, Description of Equipment, Etchants, Maskants, Techniques of Applying Maskants, Process Parameters, Surface Finish and MRR, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations

UNIT - IV	**Thermal Energy Based Processes:**	**12 Hrs**

Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Description of Equipment, Process Parameters, Applications, Advantages and Limitations.

UNIT - V	**Additive Manufacturing**	**12 Hrs**

Introduction to Additive Manufacturing, Classification of Additive Manufacturing Processes, Working Principle, Advantages, Limitations and Applications of Sterolithography (SLA), Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing

Course Outcomes (CO):

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

- Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
- Classify the mechanism of Mechanical Energy based machining processes, its applications and limitations.
- Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
- Interpret Electro Chemical machining process, economic aspects of ECM and problems on estimation of metal removal rate.

Textbooks:

1. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C and Shan H.S., Modern Machining Processes, 1/e, McGraw Hill, New Delhi, 2007.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.

Reference Books:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.
2. Benedict G.F., Nontraditional Manufacturing Processes, 1/e, CRC Press, 1987.
3. Mishra P.K., Nonconventional Manufacturing, 1/e, Narosa Publishing House, New Delhi, 2014.
4. McGeough J.A., Advanced Methods of Machining, 1/e, Springer, 1988.

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Refrigeration and Air Conditioning					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0333Ta	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To introduce the basic cycles of various refrigeration systems, their performance evaluation along with details of system components and refrigerants used.
- To impart knowledge on psychrometric properties and processes and design of air-conditioning systems

Syllabus		**Total Hours:42**
UNIT - I		**12 Hrs**

Introduction: Need and Applications of refrigeration, Unit of refrigeration and C.O.P, Methods of refrigeration.

Aircraft Refrigeration: Refrigeration needs of Aircrafts - Air craft refrigeration systems - working and their analysis.

Thermoelectric Refrigeration: Working principle and applications.

UNIT - II		**10 Hrs**

Vapor Compression Refrigeration: Working principle and essential components of the plant, actual cycle, effect of sub-cooling, super-heating, evaporator and condenser pressures on system performance – use of p-h charts.

Refrigerants: Desirable properties, classification, Nomenclature, application, Ozone Depletion, Global Warming.

UNIT - III		**10 Hrs**

VCR System Components: Classification and working of Compressors, Condensers, Evaporators and Expansion devices.

Vapor Absorption System: Description and working of NH3 – water system,Calculation of maximum COP and Description and working of Li Br –water (Two shell) System, Requirements of refrigerant and absorbent.

UNIT - IV		**12 Hrs**

Psychrometry & Psychrometric Processes: Review of Psychrometric Properties, Psychometric Processes: Sensible heating, sensible cooling, humidification and de-humidification, cooling and de-humidification, cooling with adiabatic humidification, heating and humidification, adiabatic mixing of two air streams.

UNIT - V		**12 Hrs**

Design of Air-Conditioning Systems: Characterization of Sensible and latent heat loads, Need for Ventilation, Consideration of Infiltration, Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP. Comfort Air conditioning - summer air conditioning, winter air conditioning, Air conditioning Load Calculations.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

- Analyze different kinds of aircrafts refrigeration systems and illustrate the working of thermoelectric refrigerator.
- Analyze single stage vapor compression refrigeration systems and select a suitable refrigerant for a given application.
- Classify VCR system components and illustrate the working of various types of vapour absorption refrigeration systems.
- Estimate the psychrometric properties and analyze various psychrometric processes.
- Estimate the cooling/heating loads on the air-conditioning equipment for a given application

Textbooks:

1. C P Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill Education, 3rd edition.
2. S C Arora & Domkundwar, "A Course in Refrigeration and Air conditioning", Dhanpat Rai publications, 5th edition.
3. 3. Manohar Prasad, "Refrigeration and Air Conditioning", New Age publications, Revised 2nd edition.

Reference Books:

1. Dossat, "Principles of Refrigeration", Pearson Education.
2. Anantha Narayanan, "Basic Refrigeration and Air-Conditioning", Tata McGraw- Hill Education, 4th edition.

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Introduction to Robotics					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0333Tb	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- The objectives of this course are Identify robots and its peripherals for satisfactory operation and control of robots for industrial and non-industrial applications.

Syllabus		**Total Hours:42**
UNIT - I	**Robot Basics**	**12 Hrs**

Automation and Robotics: Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision, accuracy, repeatability, work and volume of robot.

UNIT - II	**Robot Elements**	**10 Hrs**

End effectors-Classification- Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation

UNIT - III	**Robot Kinematics And Control**	**10 Hrs**

Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming

UNIT - IV	**Robot Sensors**	**12 Hrs**

Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.

UNIT - V	**Robot Applications**	**12 Hrs**

Industrial applications of robots-Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.

Course Outcomes (CO):

On completion of the course the student will be able to:

- List and explain the basic elements of industrial robots
- Analyse robot kinematics and its control methods.
- Classify the various sensors used in robots for better performance.
- Summarize various industrial and non-industrial applications of robots

Textbooks:

1. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics Technology,
2. Programming and Applications”, Tata –McGraw Hill Pub. Co., 2008.
3. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.

Reference Books:

1. Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering: An Integrated Approach"', Prentice Hall of India Pvt. Ltd., 1994.
2. Fu.K.S, Gonzalez.R.C&Lee.C.S.G, "Robotics control, sensing, vision and intelligence", Tata- McGraw Hill Pub. Co., 2008
3. Yu. "Industrial Robotics", MIR Publishers Moscow, 1985

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Finite Element Method					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0333Tc	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To familiarize with the concepts of finite element method for structural , thermal and dynamic analysis

Syllabus		**Total Hours:42**
UNIT - I		**12 Hrs**

Introduction: stress and equilibrium, strain – displacement relations, stress – strain relations, variational and weighted residual methods.
Finite Element Method: Introduction to finite element methods, steps in finite element method applications, advantages and disadvantages of finite element method.

One Dimensional Bar Problems: 1-D bar element - shape functions – stiffness matrix and load vector– assembly of matrices – treatment of boundary conditions-One dimensional quadratic element.

UNIT - II		**10 Hrs**

Analysis of Trusses: Local and global coordinate systems, transformation matrix , element stiffness matrix , determination of displacements and stresses **Analysis of Beams:** Beam element - shape functions and element stiffness matrix, load vector , determination of deflections , support reactions

UNIT - III		**10 Hrs**

Two Dimensional Problems: Plane stress and plane strain problems , constant strain triangle(CST) element – shape functions , Jacobian of transformation, strain displacement matrix , element stiffness matrix , determination of deflections and stresses.

Isoparametric Formulations: Coordinate transformation, sub,iso and super parametric elements, iso parametric formulations of bar element, quadrilateral element, numerical integration – Gaussian quadrature approach.

UNIT - IV		**12 Hrs**

Steady State Heat Transfer Analysis: 1- D steady state thermal analysis of plane and composite walls, analysis of a fin.

UNIT - V		**12 Hrs**

Dynamic Analysis: Free longitudinal and transverse vibrations, eigen values and eigen vectors , natural frequencies for bars and beams.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

- Apply variational and weighted residual methods to solve differential equations.
- Determine the stresses and strains in one dimensional bar problems.
- Analyze trusses and beams to determine the stresses induced.
- Determine the displacements and stresses in 2d problems.
- Develop iso parametric formulations for finite elements and solve them using Numerical techniques.
- Analyze 1-d heat transfer problems to determine rate of heat transfer and Temperature distribution.
- Determine natural frequencies of vibrating systems using finite element method.

Textbooks:

1. Chandragupta, Ashok and Belaunde , "Introduction to Finite Elements in Engineering ", Prentice – Hall,2011
2. Daryl L Logan, "A first course in finite element method", Cengage Learning. 2011.

Reference Books:

1. Robert D Cook, "Finite element modeling for stress analysis ", John wily & Sons.
2. SS Rao , "The Finite Element Methods in Engineering", Elsevier Science,5th Edition, 2011.
3. JN Reddy, "An introduction to Finite Element Method", McGraw Hill Education, 2006.
4. S.S. Bhavikatti ," Finite Element Analysis", New Age International Pvt Ltd , 2015.

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Power Plant Engineering					
Course Code	**L: T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0334Ta	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To introduce the working of various power plants.
- To familiarize with power plant effluents and power plant economics.

Syllabus		**Total Hours:42**
UNIT - I	**Introduction to the Sources of Energy**	**12 Hrs**

Resources and Development of Power in India. **Steam Power Plant:** Plant Layout, Components, Working of different Circuits.

Coal Handling Systems: Types of fuels, Coal handling, Choice of coal handling equipment

UNIT - II	**Combustion Process**	**10 Hrs**

Methods of Coal firing, Overfeed and Underfeed stoker firing - Principles and types of stoker firing systems, Pulverized fuel firing - Principle, Types of burners and Mills, Fluidized Bed Combustion, Cyclone Burner.

Ash and Dust handling: Types of Ash handling systems, Working principles of various Dust collectors.

Cooling towers: Types of Cooling towers and their working.

UNIT - III	**Cogeneration**	**10 Hrs**

Working principles, Combined stem and gas turbine plants, Combined gas and diesel power plants, limitations.

Hydroelectric Power Plant: Water power, Hydrological cycle, Hydrographs, Flow duration curve, Mass curve. Hydroelectric Power plant layout with auxiliaries, classification of dams, spill ways and surge tanks.

UNIT - IV	**Nuclear Power Plant**	**12 Hrs**

Nuclear fusion and fission, working of nuclear plant, Components of Nuclear Reactor, Classification of reactors, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, CANDU reactor, Fast breeder reactor, Nuclear waste and its disposal.

UNIT - V	**Environmental Aspects of Power Generation**	**12 Hrs**

Effluents from power plants and their impact on environment, Pollutants and Pollution standards, Methods of Pollution control.

Load Calculations: Load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

- Illustrate working of different circuits, and coal handling systems of steam Power plant.
- Describe the methods of coal firing, ash handling systems and cooling towers in steam power plant.
- Understand the working of hydraulic and combined operations of power plants .
- Explain the working of nuclear power plant.
- Familiarize with the power plant effluents, economics and their control.

Textbooks:

1. G.D. Rai, "An Introduction to Power Plant Technology", Khanna Publishers, 2006, 5th Edition.
2. P.K.Nag, "Power Plant Engineering", Tata McGraw-Hill Education, 2008, 3rd Edition

Reference Books:

1. S.C. Arora and S. Domkundwar "A Course in Power Plant Engineering",
2. Dhanpat Rai & Co. (P) Limited, 2004, 5th edition.
3. R. K. Rajput, "A Text Book of Power Plant Engineering", Laxmi Publications(p) Ltd. 2009, 4th Edition.
4. M.M.El-Wakil, "Power Plant Technology", Tata McGraw-Hill Education, Revised 2nd edition.
5. R.K Hedge " Power plant Engineering " Pearson India Education service Limited, 2016, 2nd edition.

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Non-Destructive Evaluation					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0334Tb	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To familiarize with the concepts of various NDT techniques to identify the defect in a mechanical component

Syllabus		**Total Hours:42**
UNIT - I	**Introduction to NDT and Radiography Test**	**12 Hrs**

Introduction: Overview of non-destructive testing, types of materials testing, Preliminary NDT methods, NDT methods

Radiography test: Sources of X rays and Gamma Rays, their properties and interaction with matter, radiographic test, film characteristics, radiographic equipment, Radiographic techniques, safety aspects, advantages, limitations, industrial applications of radiography test.

UNIT - II	**Ultrasonic Test**	**10 Hrs**

Principle of wave propagation, piezo-electric effect, ultrasonic transducers - characteristics, ultrasonic equipment, testing procedure, interpretation, evaluation, advantages, limitations, industrial applications of ultrasonic testing

UNIT - III	**Liquid Penetrant Test**	**10 Hrs**

Basic concepts, liquid penetrant system, surface preparation, test procedure, examination, interpretation, evaluation, advantages, limitations, industrial applications of liquid penetrant testing.

UNIT - IV	**Magnetic Particle Test**	**12 Hrs**

Magnetic materials, principle of magnetic particle test, magnetic particle test equipment, test procedure, interpretation and evaluation, advantages, limitations, Industrial applications of the magnetic particle test.

UNIT - V	**Eddy Current Test**	**12 Hrs**

Principle of eddy current, factors affecting eddy currents, impedance diagram, eddy current test system, test coils, advantages, limitations and industrial applications of eddy current test.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to

- Describe choose a suitable non-destructive method to find the defect in the given mechanical components using radiography test, ultrasonic test, liquid penetrant test, magnetic particle test and eddy current test

Textbooks:

1. J Prasad and GCK Nair, “Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Education, 2nd edition, 2011.
2. B Raj, T Jayakumar and M Thavasimuthu, “Practical Non Destructive Testing”,
3. Alpha Science International Limited, 3rd edition, 2017.

Reference Books:

1. V Jayakumar and K Elangovan, “Non-Destructive Testing of Materials”, Lakshmi Publications, 2nd edition, 2018.
2. George V. Crowe, “An Introduction to Nondestructive Testing”, American Society for Nondestructive Testing, 3rd edition, 2009.
3. Ravi Prakash, “Non-Destructive Testing Techniques”, New age international publishers, 1st edition, 2021.

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Fundamentals of drone technology					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0334Tc	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

The course should enable the students to:

- To make the students to understand the basic concepts of UAV drone systems.
- To introduce the stability and control of an aircraft

Syllabus		**Total Hours:42**
UNIT - I	**Introduction to Drones**	**12 Hrs**

Introduction to Unmanned Aircraft Systems, History of UAV drones, classification of drones, System Composition, applications

UNIT - II	**Design of UAV Drone Systems**	**10 Hrs**

Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects-India Specific, Design for Stealth.

UNIT - III	**Avionics Hardware of Drones**	**10 Hrs**

Autopilot, AGL-pressure sensors servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration.

UNIT - IV	**Communication, Payloads and Controls**	**12 Hrs**

Communication, Payloads and Controls: Payloads, Telemetry, Tracking, controls-PID feedback, radio control frequency range, modems, memory system, simulation, ground test-analysis-trouble shooting

UNIT - V	**Navigation and Testing**	**12 Hrs**

Navigation and Testing: Waypoints navigation, ground control software, System Ground Testing, System In-flight Testing, Future Prospects and Challenges

Course Outcomes (CO):

The student should able to:

- Ability to design UAV drone system
- To understand working of different types of engines and its area of applications.
- To understand static and dynamic stability dynamic instability and control concepts
- To know the loads taken by aircraft and type of construction and also construction materials used in Drones

Textbooks:

1. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007

Reference Books:

1. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998.
2. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics.

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Disaster Management					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0151T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- To make the students to understand the basic concepts of UAV drone systems.
- To introduce the stability and control of an aircraft

Syllabus		**Total Hours:42**
UNIT - I	**Introduction to Drones**	**12 Hrs**
Introduction to Unmanned Aircraft Systems, History of UAV drones, classification of drones, System Composition, applications		
UNIT - II	**Design of UAV Drone Systems**	**10 Hrs**
Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects-India Specific, Design for Stealth.		
UNIT - III	**Avionics Hardware of Drones**	**10 Hrs**
Autopilot, AGL-pressure sensors servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration.		
UNIT - IV	**Communication, Payloads and Controls**	**12 Hrs**
Communication, Payloads and Controls: Payloads, Telemetry, Tracking, controls-PID feedback, radio control frequency range, modems, memory system, simulation, ground test-analysis-trouble shooting		
UNIT - V	**Navigation and Testing**	**12 Hrs**
Navigation and Testing: Waypoints navigation, ground control software, System Ground Testing, System In-flight Testing, Future Prospects and Challenges		

Course Outcomes (CO):

The student should able to:

- Ability to design UAV drone system
- To understand working of different types of engines and its area of applications.
- To understand static and dynamic stability dynamic instability and control concepts
- To know the loads taken by aircraft and type of construction and also construction materials used in Drones

Textbooks:

1. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007

Reference Books:

1. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998.
2. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics.

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Smart Electric Grid (Common to all Except EEE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0241Ta	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- Overview of the technologies required for the smart grid
- Switching techniques and different means for data communication
- Standards for information exchange and smart metering
- Methods used for information security on smart grid
- Smart metering and protocols for smart metering
- Power quality management with upgraded technologies.

Syllabus		**Total Hours: 48**
Unit-I	**Introduction to Smart Grid**	**10 Hrs**
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient &Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives**.**		
Unit-II	**Smart Grid Technologies**	**8 Hrs**
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).		
Unit –III	**Smart Meters**	**10 Hrs**
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.		
Unit -IV	**Power Quality Management in Smart Grid**	**10 Hrs**
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.		
Unit –V	**High Performance Computing**	**10 Hrs**
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN),Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.		

Course Outcomes (CO):

On completion of this course, student will be able to

- Understand the concepts and design of Smart grid.
- Understand the various communication technologies in smart grid.
- Understand the various measurement technologies in smart grid.
- Understand the analysis and stability of smart grid.
- Learn the renewable energy resources and storages integrated with smart grid.
- familiarize the high performance computing for Smart Grid applications

Textbooks:

1. Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012, Reprint 2015.
2. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012, Reprint 2016.

Reference Books:

1. The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2. Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3. Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003

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Industrial Electronics					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0433T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- Describe semi-conductor devices (such as PN junction diode & Transistor) and their switching characteristics.
- Understand the characteristics of AC to DC converters.
- Understand about the practical applications Electronics in industries.
- Describe the ultrasonic and its application.

Syllabus		**Total Hours: 48**
Unit-I	**Industrial Electronics**	**10 Hrs**

Scope of industrial Electronics, Semiconductors, Merits of semiconductors, crystalline structure, Intrinsic semiconductors, Extrinsic semiconductors, current flow in semi conductor, Open circuited p-n junction, Diode resistance, Zener diode, Photo conductors and junction photo diodes, Photo voltaic effect, Light emitting diodes(LED).

Unit-II	**Transistor**	**8 Hrs**

Introduction, The junction transistor, Conventions for polarities of voltages and currents, Open circuited transistor, Transistor biased in the active region, Current components in transistors, Currents in a transistor, Emitter efficiency, Transport factor and transistor-α, Dynamic emitter resistance, Transistor as an amplifier, Transistor construction, Letter symbols for semiconductor Devices, Characteristic curves of junction transistor in common configuration, static characteristic curves of PNP junction transistor in common emitter configuration, The transistor in common collector Configuration.

Unit –III	**AC to DC converters**	**10 Hrs**

AC to DC converters- Introduction, Classification of Rectifiers, Half wave Rectifiers, Full wave Rectifiers, Comparison of Half wave and full wave rectifiers, Bridge Rectifiers, Bridge Rectifier meter, Voltage multiplying Rectifier circuits, Capacitor filter, LC Filter, Metal Rectifiers, Regulated Power Supplies, Classification of Voltage Regulators, Short period Accuracy of Regulators, Long period .Accuracy of Voltage Regulator, Principle of automatic voltage Regulator, Simple D.C. Voltage stabilizer using Zener diode, D.C. Voltage Regulators, Series Voltage Regulators, Complete series voltage regulator circuit, Simple series voltage regulator.

Unit -IV	**Resistance welding controls**	**10 Hrs**

Resistance welding controls: Introduction, Resistance welding process, Basic Circuit for A.C. resistance welding, Types of Resistance welding, Electronic welding control used in Resistance welding, Energy storage welding. Induction heating: Principle of induction heating, Theory of Induction heating merits of induction heating, Application of induction heating, High frequency power source of induction heating. Dielectric heating: Principle of

dielectric heating, theory of dielectric heating, dielectric properties of typical materials, electrodes used in dielectric heating, method of coupling of electrodes to the R.F. generator, Thermal losses in Dielectric heating, Applications.

Unit –V	**Ultrasonics**	**10 Hrs**

Ultrasonics: Introduction, Generation of Ultrasonic waves, Application of Ultrasonic waves, Ultrasonic stroboscope, ultrasonic as means of communication, ultrasonic flaw detection, Optical image on non-homogeneities, ultrasonic study of structure of matter, Dispersive study of structure of matter, Dispersive and colloidal effect of Ultrasonic, Coagulating action of Ultrasonic, separation of mixtures by ultrasonic waves, cutting and machining of hard materials by ultrasonic vibrations, Degassing of liquids by ultrasonic waves, Physio-chemical effects of ultrasonics, chemical effects of ultrasonics, Thermal effects of ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying

Course Outcomes (CO):

On completion of this course, student will be able to

- Understand the semi-conductor devices and their switching characteristics.
- Apply the Ultrasonic waves with different applications.
- Understand the working of Transistor and its different configurations.
- Analyze the thermal effects of ultrasonic, soldering and welding by ultrasonic, ultrasonic Drying in the industry; interpret the characteristics of AC to DC converters.
- Develop the practical applications Electronics in industries.
- Apply the process of Resistance welding, Induction heating and Dielectric heating in the industry.

Textbooks:

1. Fundamentals of Industrial Electronics, Bogdan M Wilamowski, J David irwin, 2nd Edition, 2011.
2. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
3. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

Reference Books:

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edn., 2003.
2. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE

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Cloud Computing					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0529T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- To introduce the broad perceptive of cloud architecture and model
- To understand the concept of Virtualization and familiar with the lead players in cloud.
- To understand the features of cloud simulator and apply different cloud programming model
- To design of cloud Services and explore the trusted cloud Computing system

Syllabus		**Total Hours:48**
Module-I	**Basics of Cloud Computing**	**10Hrs**

Introduction to Cloud: Introduction to Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Elasticity in Cloud, On-demand Provisioning.

Virtualization: Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization, and Cloud computing.

Module-II	**Cloud Architecture, Models and Security**	**9Hrs**

Cloud Computing Architecture: Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds.

Cloud Deployment Model: Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud.

Module-III	**Cloud Technologies and Advancements**	**10Hrs**

Apache Hadoop, MapReduce, Hadoop Cluster setup, Virtual Box, Google App Engine, Programming Environment for Google App Engine – Open Stack

Module-IV	**VMware Simulator**	**9Hrs**

VMWare: Basics of VMWare, Advantages of VMware virtualization, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Module-V	**Cloud Applications**	**10Hrs**

Cloud Applications: Scientific Applications – Health Care, Geoscience.
Business And Consumer Applications - CRM and ERP, Social Networking, Media Applications, and Multiplayer Online Gaming.

Course Outcomes (CO):

On completion of this course, student will be able to

- To Understand the basic concepts about cloud computing vision and its developments and gain the Knowledge of virtualization technology.
- Analyze the concepts of cloud services and the deployment models.
- Choose among various cloud technologies for implementing applications (GAE, Open stack ,etc)
- Construct the virtual machines by using VMware simulator.
- Build scientific applications by using Cloud environment.
- Develop Business and Consumer Applications.

Textbooks:

1. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S.Thamarai Selvi from TMH 2013.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly
3. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010.

Reference Books:

1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010.
4. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O 'Reilly, SPD, rp2011.
5. Essentials of Cloud Computing by K. Chandrasekaran. CRC Press. Cloud computing A Hands-On Approach by ArshdeepBahga and Vijay Madisetti.

Web Resources:

1. https://nptel.ac.in/courses
2. https://freevideolectures.com/university/iitm

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Construction Management					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0152T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- To make the student familiar with various construction activities, preparing construction schedule and maintaining documents and records of those activities
- To teach the students about various terms and technologies involved in earthwork of construction activities
- To make the students familiar with concepts involved in project management like bar charts and milestone charts
- To teach the students the concepts of time estimates involved in CPM and PERT , float and slack, critical path calculations

Syllabus		**Total Hours:42**
UNIT - I	**Fundamentals Of Construction Technology**	**12 Hrs**

Definitions and Discussion – Construction Activities –Construction Processes -Construction Works – Construction Estimating – Construction Schedule – Productivity and Mechanized Construction – Construction Documents – Construction Records – Quality – Safety – Codes and Regulations.

UNIT - II	**Earthwork**	**10 Hrs**

Classification of Soils – Project Site – Development – Setting Out - Mechanized Excavation – Groundwater Control – Trenchless (No-dig) Technology – Grading – Dredging.Rock Excavation – Basic Mechanics of Breakage – Blasting Theory – Drillability of Rocks – Kinds of Drilling – Selection of the Drilling Method and Equipment – Explosives – Blasting Patterns and Firing Sequence – Smooth Blasting – Environmental Effect of Blasting

UNIT - III	**Project Management and Bar Charts And Milestone Charts**	**10 Hrs**

Project planning – Scheduling – Controlling – Role of decision in project management – Techniques for analyzing alternatives Operation research – Methods of planning and programming problems – Development of bar chart – Illustrative examples – Shortcomings of bar charts and remedial measures – Milestone charts

UNIT - IV	**Elements of Network and Development Of Network**	**12 Hrs**

Introduction – Event – Activity – Dummy – Network rules – Graphical guidelines for network – Common partial situations in network – Numbering the events – Cycles Problems

UNIT - V	**PERT and CPM**	**12 Hrs**

Time estimates – Frequency distribution – Mean, variance and standard deviation-Expected time Problems -Earliest expected time – Formulation for TE - Latest allowable occurrence time – Formulation for TL - Combined tabular computations for TE and TL problems. Introduction - Slack – Critical path-Illustrative examples Problems

Course Outcomes (CO):

On completion of this course, student will be able to

- Identify the various construction activities like preparing construction schedule and maintaining documents and records of those activities
- Understand the concepts and techniques involved in earthwork activities• To understand about the emerging infectious diseases and aids their management
- Understand the steps involved in developing a project scheduling and management and the application of bar charts and milestone charts.
- Understand the various elements of a network diagram like event, activity and dummy.
- Understand the concepts of calculation of time estimates of CPM and PERT

Textbooks:

1. Construction project management by Jha ,Pearsonpublications, New Delhi 2nd Edition 2015
2. Construction Technology by SubirK.Sarkar and SubhajitSaraswati – Oxford Higher EducationUniv.Press, Delhi 2008 edition
3. Project Planning and Control with PERT and CPM by Dr.B.C.Punmia, K.K.Khandelwal, Lakshmi Publications New Delhi 2022 editionDelhi

1. **Reference Books:**

1. Optimal design of water distribution networks P.R.Bhave, Narosa Publishing house 2003.
2. Total Project management, the Indian context- by : P.K.JOY- Mac Millan Publishers India Limited.

E-resources:

1. https://nptel.ac.in/courses/105104161

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Electric Vehicles (Common to all Except EEE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0232Ta	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- Understand to Provide good foundation on hybrid and electrical vehicles.
- Understand To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles
- Familiarize energy storage systems for electrical and hybrid transportation
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.

Syllabus		**Total Hours: 50**
Module-I	**Electric Vehicle Propulsion and Energy Sources**	**10Hrs**

Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge, specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

Module-II	**Electric Vehicle Power Plant And Drives**	**10 Hrs**

Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives PWM, current control method. Switch reluctance machine drives - voltage control, current control.

Unit -III	**Hybrid And Electric Drive Trains**	**9 Hrs**

Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies. Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

Unit -IV	**Electric and Hybrid Vehicles - Case Studies**	**11 Hrs**

Parallel hybrid, series hybrid -charge sustaining, charge depleting. Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles.

Unit -V	**Electric And Hybrid Vehicle Design**	**10 Hrs**

Introduction to hybrid vehicle design. Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem. Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

Course Outcomes (CO):

On completion of this course, student will be able to

- Understand the working of hybrid and electric vehicles
- Apply a suitable drive scheme for developing an hybrid and electric vehicles depending on resources
- e Develop the electric propulsion unit and its control for application of electric vehicles.
- Understand the proper energy storage systems for vehicle applications
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles

Textbooks:

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd edition, CRC Press, 2003.
2. Amir Khajepour, M. Saber Fallah, Avesta Goodarzi, "Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach", illustrated edition, John Wiley & Sons, 2014.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.

Reference Books:

1. James Larminie, John Lowry, "Electric Vehicle Technology", Explained, Wiley, 2003.
2. John G. Hayes, G. Abas Goodarzi, "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", 1st edition, WileyBlackwell, 2018.

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Basics of VLSI Design					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0432T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- To give exposure to different steps involved in fabrication Process of PMOS & NMOS transistors, CMOS & BICOM Inverters.
- To provide knowledge on electrical properties of MOS & BICMOS devices to analyze the behaviour of inverters designed with various loads.
- To provide knowledge on Basic Circuit Concepts of VLSI Design
- To apply the design Rules and draw layout of a given logic circuit and basic circuit concepts to MOS circuits.
- To Apply the design for testability methods for combinational & sequential CMOS circuits

Syllabus		**Total Hours: 50**
Module-I	**Introduction to Fabrication Process**	**10Hrs**

Introduction: Brief Introduction to IC technology, Moore's Law, Different modes MOSFET operation, Fabrication Process of PMOS, NMOS, CMOS & Bi-CMOS devices, Comparison between CMOS and Bi-polar Technologies.

Fabrication Steps: Wafer Preparation, Oxidation, Photolithography, Etching, Ion Implantations, Metallization, Testing.

Module-II	**Basic Electrical Properties of MOS/BiCMOS devices**	**10 Hrs**

Basic Electrical Properties: Ids Vs Vds relationships, MOS transistor Threshold Voltage-VT, figure of merit-ω0, Transconductance - gm, Output conductance-gds, Pass transistor logic, NMOS Inverter, Pull-up to Pull-down Ratio for NMOS inverter driven by another NMOS inverter, and through one or more pass transistors Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit -III	**Basic Circuit Concepts**	**9 Hrs**

Basic Circuit Concepts: Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out

Unit -IV	**VLSI Circuit Design Processes**	**11 Hrs**

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters Logic Gates and Various MOS Circuits. Scaling of MOS circuits, Limitations of Scaling.

Unit -V	CMOS Testing	10 Hrs

CAD Tools for Design and Simulation, Aspects of Design Tools, Design for Testability, Testing Combinational Logic, Testing Sequential Logic, Practical Design for Test (OFT) Guidelines, Scan Design Techniques, Built-In-Self-Test (BIST), Future Trends.

Course Outcomes (CO):

On completion of this course, student will be able to

- Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.
- Understand the concept of Basic Electrical Properties of MOS/Bi-CMOS Devices
- Apply the basic circuit concepts to MOS circuits.
- Understand the concept of Scaling of MOS circuits and Limitations of Scaling
- Apply the design Rules to draw the Stick diagram &layout of a given logic circuit.
- Interpret the need for testability and testing methods in VLSI.

Textbooks:

1. Kamran Eshraghian, “Essentials of VLSI Circuits and Systems”, Douglas and A. Pucknell and SholehEshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. Behzad Razavi , “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2003
3. Modern VLSI Design – Wayne Wolf, 3 Ed., 1997, Pearson Education.

Reference Books:

1. Jan M. Rabaey, “Digital Integrated Circuits”, AnanthaChandrakasan and Borivoje Nikolic, Prentice-Hall of India Pvt.Ltd, 2nd edition, 2009.
2. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, reprint 2009
3. CMOS VLSI Design-A Circuits and Systems Perspective, Neil H.E Weste, David Harris, Ayan Banerjee, 3rd Edn, Pearson, 2009.

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Introduction to Cyber Security					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0534b	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The course should enable the students to:

- The Cyber security Course will provide the students with foundational Cyber Security principles, Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies.
- Students will gain insight into the importance of Cyber Security and the integral role of Cyber Security professionals.
- Evaluate the trends and patterns that will determine the future state of cyber security.

Syllabus		**Total Hours:48**
Module-I	**Introduction to Cybercrime**	**9 Hrs**
Introduction to Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens		
Module-II	**Cyber Offenses**	**10 Hrs**
How Criminals Plan Them –Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector Backdoors-Steganography-SQL Injection.		
Module-III	**Cybercrime Mobile and Wireless Devices**	**9 Hrs**
Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile.		
Module-IV	**Tools and Methods Used in Cybercrime**	**10Hrs**
Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, DoS and DDoS Attacks, Buffer Overflow, Attacks on Wireless Networks, Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).		
Module-V	**Cyber Crimes and security**	**10Hrs**
Cyber Security –Organizational implications-cost of cybercrimes and IPR issues Web threats for organizations: the evils and Perils-Social media marketing Security and privacy Implications-Protecting people privacy in the organizations Forensic best practices for organizations. Cases.		

Course Outcomes (CO):

On completion of this course, student will be able to

- Cyber Security architecture principles
- Identifying System and application security threats and vulnerabilities
- Identifying different classes of attacks
- Cyber Security incidents to apply appropriate response
- Describing risk management processes and practices

Textbooks:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, SunitBelapure, Wiley.
2. Principles of Information Security, MichealE.Whitman and Herbert J.Mattord, Cengage Learning

Reference Books:

1. Information Security, Mark Rhodes, Ousley, MGH.

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Operations Research					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0335T	**2: 1:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PCC**

Course Objectives:

- To impart the basic concepts of modelling, models and statements of the operations research.
- Formulate and solve linear programming problem/situations.
- Model strategic behavior in different economic situations.
- To solve transportation problems to minimize cost.
- Apply Queuing theory to solve problems of traffic congestion, counters in banks, railway bookings etc.
- Explain scheduling and sequencing of production runs and develop proper replacement policies

Syllabus		**Total Hours:42**
UNIT - I	**Introduction to OR**	**12 Hrs**

Introduction to Operations Research (OR): OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

Linear Programming(LP): Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two–Phase Simplex Method, Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions; Concept of dual theorem

UNIT - II	**Transportation and Assignment Problems**	**10 Hrs**

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

UNIT - III	**Game theory & Job Sequencing**	**10 Hrs**

Game theory: Optimal solution of two person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

Job Sequencing: Introduction to Job shop Scheduling and flow shop scheduling, Solution of Job Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method

UNIT - IV	**Queuing Theory & Inventory Control**	**12 Hrs**

Queuing Theory: Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Birth & Death Process, Single Channel Models with Poisson Arrivals, Exponential Service Times with infinite and finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with infinite queue length.

Inventory Control: Introduction, Deterministic models – EOQ model with and without shortages, Production model, Buffer stock and discount inventory models with single price breaks. Selective inventory control.

UNIT - V	Replacement and Maintenance Analysis & DP	12 Hrs

Replacement and Maintenance Analysis: Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

Dynamic Programming (DP): Introduction –Bellman's Principle of Optimality – Applications of Dynamic Programming – Shortest Path Problem – Capital Budgeting Problem Solution of Linear Programming Problem by DP

Course Outcomes (CO):

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

- Develop mathematical models for practical problems. (L3)
- Apply linear programming to transportation problems. (L3)
- Solve games using various techniques. (L3)
- Solve production scheduling and develop inventory policies. (L6)
- Apply optimality conditions for constrained and unconstrained nonlinear problems. (L3)
- Apply dynamic programming methods. (L3)

Textbooks:

1. Sharma S.D., Operations Research: Theory, Methods and Applications, 15/e, Kedar Nath Ram Nath, 2010
2. Taha H.A., Operations Research, 9/e, Prentice Hall of India, New Delhi, 2010.

Reference Books:

1. Hiller F.S., and Liberman G.J., Introduction to Operations Research, 7/e, Tata McGraw Hill, 2010.
2. Sharma J.K., Operations Research: Theory and Applications, 4/e, Laxmi Publications, 2009.
3. Prem kumar Gupta and Hira, Operations Research, 3/e, S Chand Company Ltd., New Delhi, 2003.
4. Pannerselvam R., Operations Research, 2/e, Pentice Hall of India, New Delhi, 2006.
5. Sundaresan.V, and Ganapathy Subramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications, 2015.

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Industrial Automation					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0336P	**1: 0:2:0**	**2**	**CIE: 30 SEE:70**	**3Hours**	**SAC**

Course Objectives:

- Introduce basic concepts and principles of Industrial Automation.
- Familiarize with fluid power systems circuits.
- Describe concepts of SCADA software
- Explain the principles of PLC and 8085 microprocessor.
- Expose the students on Mechatronics.

Syllabus	**Total Hours:42**
Module 1:	**12 Hrs**

Design and testing of fluid power circuits to control
Introduction to Fluid power systems, Symbolic representation of hydraulic and pneumatic components.

Tasks:-

1. Pneumatic trainer kit with FRL Unit, Single acting cylinder, push button.
2. Pneumatic training kit with FRL unit, Double acting cylinder, manually actuated DCV.
3. Pneumatic trainer kit with FRL unit, Double acting cylinder, Pilot actuated DCV.
4. Pneumatic trainer kit with FRL unit Double acting cylinder, Double solenoid actuated DCV, DCV with sensor / magnetic reed.
5. Hydraulic power pack with pumps and pressure relief valve.

Module 2:	**10 Hrs**

1. Open source SCADA software such as Free SCADA, Open SCADA,
2. Indigo SCADA Code Sys Open source for PLC programming and interfacing with real time PLC
3. Delta PLC software – free ware and corresponding PLC programming software.
4. 8085 Microprocessor Trainer with Power Supply
5. Traffic Light Control System

Module 3	**10 Hrs**

Mechatronics

1. Experiment on P, PI and PID Controller.
2. Simulation of Hydraulic Actuation System.
3. Simulation of Pneumatic Actuation System.
4. Simulation on Stepper Motor.
5. Simulation on Logic gates, decoders and flip-flops.

References:

1. B. Gavali, S. A. Patil and A. R. Koli, "Technology-Based Learning system in Programmable Logic Controller Education," 2016 IEEE Eighth International Conference on Technology for Education (T4E), Mumbai, 2016, pp. 264-265.
2. Groover, Mikell , Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 2014.
3. Lamb, Frank. Industrial Automation: Hands On (English Edition). NC, McGraw-Hill Education, 2013. ISBN 978-0071816458

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Fracture Mechanics					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A03H01	**3: 1:0:0**	**4**	**CIE: 30 SEE:70**	**3Hours**	**HCC**

Course Objectives:

- To familiarize with the basic concepts of fracture mechanics and its applications

Syllabus		**Total Hours:60**
UNIT - I		**12 Hrs**

Introduction: History and over view, fracture mechanics approach to design, effect of material properties on fracture.

Fracture Mechanisms: Ductile fracture, cleavage, ductile-brittle transition, intergranular fracture, environment assisted cracking.

Linear Elastic Fracture Mechanics: Griffith energy balance, energy release rate, crack resistance, R curve, stable and unstable crack growth.

UNIT - II		**12Hrs**

Stress Analysis of Cracks: Modes of fracture - opening , sliding and shearing mode , Airy stress function , crack tip stress field using Westergaurd approach,effect of finite size , relation between stress intensity factor and energy release rate.

UNIT - III		**12 Hrs**

Crack Tip Plastic Zone: Plastic zone shape, Irwin plastic zone correction, Dugdale approach, shape of the plastic zone, plastic constraint factor, thickness effect.

UNIT - IV		**12 Hrs**

Elastic-Plastic Fracture Mechanics: Crack-tip-opening displacement, *J* contour integral, relationships between *J* and CTOD, crack-growth resistance curves, *J*controlled fracture.

UNIT - V		**12 Hrs**

Test Methods: Introduction, KIc-test technique, test methods to determine JIc,test methods to determine GIc AND GIIc, determination of critical CTOD.

Crack Detection Through Non-Destructive Testing: Introduction, examination through human senses, liquid penetration inspection, ultrasonic testing, radiographic imaging, magnetic particle inspection.

Textbooks:

1. T. L. Anderson, Fracture Mechanics: Fundamentals and Applications, CRC Press, 3rd edition
2. Prashant Kumar, Elements Of "Fracture Mechanics, Mcgraw Hill Education, First edition.

Reference Books:

1. David Broek, Elementary engineering fracture mechanics, Kluwer Academic Publishers, 4th edition
2. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials, 2nd Edition

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Computational Fluid Dynamics					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A03H02	**3: 1:0:0**	**4**	**CIE: 30 SEE:70**	**3Hours**	**HCC**

Course Objectives:

- To solve fluid flow/ heat transfer problems by the application of finite difference and finite volume methods.

Syllabus		**Total Hours:60**
UNIT - I		**12 Hrs**

Governing equations of fluid dynamics and Heat Transfer: Models of the flow, substantial derivative, continuity equation, the momentum equation, the energy equation, initial and boundary conditions.

Classification of partial Differential Equations: Introduction, Classification of partical differential equations - Cramer's rule, Eigen value method

UNIT - II		**12Hrs**

Basic Aspects of Discretization: Introduction to Finite Differnece approach, Difference Equations. Finite difference in non-uniform grid, Types of errors, consistency, stability, convergence. Solution Techniques for System of Algebraic Equations: Direct Methods, Cramer's rule, matrix inversion, Gaussian elimination, Tri-diagonal matrix algorithm (TDMA). Iterative method: Gauss-Jacobi, Gauss -Seidel.

UNIT - III		**12 Hrs**

Finite Difference Method for Diffusion Problems: Formulation for one dimensional steady and unsteady diffusion equation - Explicit Scheme, Crank-Nicolson Sceheme, Fully Implicit Scheme.

UNIT - IV		**12 Hrs**

Finite Volume Method for Diffusion Problems: Finite volume formulations for one dimensional steady state diffusion, one dimensional unsteady diffusion: Explicit scheme, Crank-Nicolson scheme, fully implicit scheme

UNIT - V		**12 Hrs**

Finite Volume Method for Convection and Diffusion Problems: Finite volume formulation for steady one-dimensional convection and diffusion, the central differencing scheme, properties of discretisation schemes, upwind differencing scheme.

Course Outcomes(CO):

Upon successful completion of the course, the students will be able to

- Develop governing equations for fluid flow and heat transfer and classify the Partial differential equations.
- Adapt basic space and time finite difference discretisation techniques and
- Solve algebraic equations using direct and iterative techniques.
- Apply finite difference approach to solve one dimensional steady and unsteady Diffusion problems.

- Apply finite volume method for solving one dimensional steady and unsteady Diffusion problems.
- Solve one dimensional convection and diffusion problems using finite volume Method.

Textbooks:

1. John D. Anderson, J R "Computational fluid dynamics The basic with applications", Mc Graw Hill international, 2012.
2. H. Versteeg, W Malalasekra , "An Introduction to Computational Fluid
3. Dynamics The finite volume method", Pearson Publishers, 2nd Edition, 2018.

Reference Books

1. T. J. Chung - "Computational fluid dynamics", Cambridge university press, 2003
2. Suhas V. Patankar, "Numerical heat transfer and fluid flow" Butter-worth Publishers
3. T. K Sengupta, "Fundamentals of Computational Fluid Dynamics", University Press, 2013.

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Analysis and Synthesis of Mechanisms					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A03H03	**3: 1:0:0**	**4**	**CIE: 30 SEE:70**	**3Hours**	**HCC**

Course Objectives:

- To impart the concepts of force analysis of mechanisms.
- To familiarize with the concepts of synthesis of mechanisms.
- To impart hands on training on analysis and synthesis of mechanisms using software packages

Syllabus		**Total Hours:60**
UNIT - I	**Analysis of Complex mechanisms**	**12 Hrs**

Goodman indirect method and Hall Ault auxiliary point method

Dynamic Force Analysis: D Alembert principle , dynamic analysis of four bar mechanism and single slider crank mechanism – dynamically equivalent system – inertia of Connecting Rod – inertia force and torque in reciprocating Engine.

UNIT - II	**Path Curvature Theory**	**12Hrs**

Introduction, fixed and moving centrodes, inflection points and inflection circle, Euler Savary Equation, Bobilliers Construction, Collineation axis, Bobillier theorem, Hartmann construction

UNIT - III	**Kinematic Synthesis**	**12 Hrs**

Introduction, type, dimensional and number Synthesis ,synthesis for function generation, path and motion generation, Chebyschev Spacing of accuracy points

Motion Generation: Motion generation for two prescribed positions and three prescribed positions – path generation for three prescribed positions without and with prescribed timing – function generation for three prescribed positions, Poles and relative poles, relative poles of 4-bar mechanism, relative poles of slider crank mechanism.

UNIT - IV	**Coupler Curves**	**12 Hrs**

Equation of coupler curves, synthesis for path generation, graphical synthesis for path generation, Robert-Chebyshev theorem (cognate linkages), coupler curves from 5-bar mechanisms.

Analytical Synthesis Techniques: Four bar and slider crank function generator with three accuracy points , Freudenstein equation.

UNIT - V	**Manipulator Kinematics**	**12 Hrs**

Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller, robot joint control design.

Course Outcomes(CO):

Upon successful completion of the course, the students will be able to

- Determine the displacement , velocity and accelerations of links of mechanism.
- Evaluate the forces and torque acting by performing force analysis.
- Apply path curvature characteristics in analysis of mechanisms.
- Apply synthesis techniques in design of mechanisms.
  Analyze and synthesize mechanisms using software packages

Textbooks:

1. Erdman and Sandor , "Advanced Mechanism Design ",Prentice Hall International, 2nd Edition
2. S.S. Rattan, "Theory of Machines",Tata Mc Graw Hill, 3rd Edition
3. JJ Craig, "Introduction to Robotic Mechanisms and Control" , Pearson, 3rd Edition.
4. Eric Constans and Karl B. Dyer, "Introduction to Mechanism Design With Computer Applications", CRC Press,1st Edition , 2019

Reference Books

5. Uicker, Pennock and Shigley, "Theory of machines and Mechanisms", Oxford Univ Press.
6. Amitabha Ghosh and Ashok Kumar Mallik, "Theory of Mechanism and machines", East West Press pvt Ltd, 2nd edition.
7. Robert L.Norton," Design of Machinery", Tata McGraw Hill, 3rd edition.

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Applications of Optimization Techniques					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A03H04	**3: 1:0:0**	**4**	**CIE: 30 SEE:70**	**3Hours**	**HCC**

Course Objectives:

- Explain principles of optimization and its need.
- Familiarization with theory of optimization methods and algorithms developed for solving various types of optimization problems.
- Understand the mathematical foundations for Genetic Algorithm, Operators.
- Know fundamental theory and concepts of neural networks, neuro – modelling, several neural network paradigms and its applications.
- Identify the application of optimization to design of machine elements.

Syllabus		**Total Hours:60**
UNIT - I	**Introduction**	**12 Hrs**

Classical Optimization Techniques: Single variable optimization with and without Constraints, Multi – Variable Optimization without constraints, Multi – Variable Optimization with Constraints – Method of Lagrange Multipliers, Kuhn-Tucker Conditions.
Numerical Methods for Optimization: Interval Halving Method, Fibonacci Method, Quadratic Interpolation Method, Newton Method, Quasi Newton Method, Secant Method.

UNIT - II	**Genetic Algorithm (GA)**	**12Hrs**

Differences and Similarities between Conventional and Evolutionary Algorithms, Working Principle, Reproduction, Crossover, Mutation, Termination Criteria, Different Reproduction and Crossover Operators, GA for Constrained Optimization, Draw Backs of GA.

UNIT - III	**Genetic Programming (GP)**	**12 Hrs**

Principles of Genetic Programming, Terminal Sets, Functional Sets, Differences between GA & GP, Random Population Generation, Solving Differential Equations using GP.

UNIT - IV	**Neural networks**	**12 Hrs**

Introduction to Neural networks: Knowledge base information processing, General View of Knowledge Based Algorithm, Neural Information Processing, Hybrid Intelligence and Artificial Neurons.
Characteristics of Artificial Neural Networks: Single Neural Networks, Multi – Layer Neural Networks, Training of ANN – Objective, Supervise Training, Unsupervised Training, Overview of training.

UNIT - V	**Applications of Optimization in Design and Manufacturing Systems**	**12 Hrs**

Some typical applications like Optimization of Path Synthesis of a Four – bar Mechanism, Minimization of Weight of a Cantilever Beam, Optimization of Springs and Gears, General Optimization model of a Machining Process, Optimization of Arc Welding Parameters and General Procedure in Optimizing Machining Operations Sequence.

Textbooks:

1. Singiresu S. Rao, Engineering Optimization, 3/e, New Age Publishers, 2010.
2. Bart Kosko, Neural Networks and Fuzzy System, 2/e, Prentice Hall of India, 2001.
3. Goldberg D.E., Genetic algorithms in Search, Optimization, and Machine learning, 4/e, Pearson, 2009.
4. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, 2/e, PHI Learning Pvt. Ltd., 2012

Reference Books:

1. Kalyanmoy Deb, Multi Objective Optimization using Evolutionary Algorithms, 1/e, John Wiley and Sons, 2001.
2. Jasbir S. Arora, Introduction to Optimum Design, 4/e, Academic Press, 2016.
3. Ravindran A., Engineering Optimization Methods and Applications, 2/e, John Wiley and Sons, 2006.
4. Fox R.L., Optimization Methods for Engineering Design, 1/e, Addison Wesley PublicationCo., 1971