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

Mechanical Engineering
III B.TECH.

Semester-VI (Theory–6, Lab–1, Skill course-1, Mandatory course-1)							
S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	22A0325T	Dynamics of Machinery	PCC	2	1	0	3
2.	22A0326T	Design of Machine Elements	PCC	3	0	0	3
3.	22A0327T	Heat Transfer	PCC	2	1	0	3
4.	22A0329T	**Professional Elective Course-II**	PEC	3	0	0	3
	22A0329Ta	Renewable Energy Sources					
	22A0329Tb	Introduction to Composites					
	22A0329Tc	Measurements and Mechatronics					
5.		**Open Elective Course – II**	OEC	3	0	0	3
	22A0150T	Environmental Economics					
	22A0431T	Micro controller and applications					
	22A0213Ta	Control Systems Engineering					
	22A0528T	Introduction to Machine learning					
6.	22A0023T	Management science	HSSC	3	0	0	3
	22A0024T	Entrepreneurship & Innovation					
	22A0026T	Human Resource Management					
7.	22A0328P	Heat Transfer Lab	PCC	0	0	3	1.5
8.	22A0331P	**Skill Oriented course** 3D Printing practice	SOC	1	0	2	2
9.	22A0031T	**Mandatory Course** Intellectual Property Rights & Patents	MC	2	0	0	0
						Total	**21.5**
Industry Internship/Research Internship is mandatory during Summer vacation							

Distribution of Credits among the Category of Courses		
S.No	Category of Courses Introduced	Credits Assigned
1	Professional Core Courses (3T+1L)	10.5
2	Professional Elective Courses (1T)	3
3	Open Elective Course Courses (1T)	3
4	Humanities and Social Science Courses (1T)	3
5	Skill Oriented Course – 1 (T+P)	2
6	Mandatory Non Credit Course (1T)	0
Total Credits		21.5

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Dynamics of Machinery					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0325T	**2: 1:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PCC**

Course Objectives:

- Analysis of forces acting in mechanisms
- Effects of unbalance forces
- Modelling and analyzing the vibration behaviour of spring mass damper system
- The principles in mechanisms used for governing of machines

Syllabus		**Total Hours:45**
Module - I	**Friction and Power Screws**	**9 Hrs**

Friction: Inclined plane, friction of screws and nuts, pivot and collar, uniform pressure, uniform wear. Friction circle and friction axis, lubricated surfaces, boundary friction, film lubrication.

Power screws: Forms of threads, self locking of screws, efficiency of different screws, Square, trapezoidal, screw threads.

Module - II	**Precession, Turning Moment Diagram and Fly Wheel**	**9 Hrs**

Precession: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motorcycle, aeroplanes and ships.

Turning Moment Diagrams and Fly Wheels: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.

Module - III	**Governors**	**9 Hrs**

Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.

Module - IV	Balancing	**9 Hrs**

Balancing: Balancing of rotating masses - single and multiple – single and different planes.

Balancing Of Reciprocating Masses: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V-engine, multi cylinder inline and radial engines for primary and secondary balancing.

Module - V	**Vibration**	**9 Hrs**

Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations. Vibration Isolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems.

Course Outcomes:

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

- Determine the forces acting on various linkages when a mechanism is subjected to external forces.
- Identify and correct the unbalances of rotating body
- Analyze the vibratory motion of SDOF systems.
- Reduce the magnitude of vibration and isolate vibration of dynamic systems
- Determine dimensions of Governors for speed control.

Text Books:

1. S.S. Rattan, Theory of Machines, MGH Publishers,3/e,2013.
2. R.L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2017.

Reference Books:

1. Thomas Bevan, Theory of machines, Pearson, 3/e,2012.
2. J.E. Shigley, The theory of machines and mechanisms, McGraw hill, 2/e, 1995.
3. R.S.Khurmi, J.K.Guptha, Theory of machines S.Chandpublications, 2005.

Online Learning Resources:

1. https://nptel.ac.in/courses/112104114
2. https://nptel.ac.in/courses/112101096
3. https://archive.org/details/NPTEL-MechEngr-Dynamics_of_Machines
4. https://www.youtube.com/watch?v=OlZXxPVpmBs
5. https://www.digimat.in/nptel/courses/video/112104114/L01.html

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Design of Machine Elements					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0326T	**2: 1:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PCC**

Course Objectives:

- Provide an introduction to design of machine elements.
- Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- Explain design procedures to different types of joints.
- Teach principles of clutches and brakes and design procedures.
- Instruct different types of bearings and design procedures.

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

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.
Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.
Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Fatigue theories of failure. Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

UNIT - II		**10 Hrs**

Design of Bolted Joints: Threaded fastiness, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening, eccentrically loaded bolted joints, gasketedjoints.
Riveted Joints: Design of lap, butt and eccentrically loaded joints, failure and efficiency of riveted joints.

Welded Joints: Strength of lap and butt welds, eccentrically loaded welded joints. Joints subjected to bending and torsion

UNIT - III		**10 Hrs**

Keys: Function, types, design of sunk, saddle, Kennedy and Woodruff keys.
Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.
Couplings: Design of flange and bushed pin couplings, universal coupling.

Springs: Design of helical compression, tension, torsion and leaf springs

UNIT - IV		**12 Hrs**

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

UNIT - V		12 Hrs

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Course Outcomes (CO):

- At the end of the course the students will be able to
- Estimate safety factors of machine members subjected to static and dynamic loads. (l5)
- Design fasteners subjected to variety of loads. (l6)
- Select of standard machine elements such as keys, shafts, couplings, springs and bearings. (l1)
- Design clutches, brakes and spur gears. (l6)

Textbooks:

1. J.E. Shigley, “Mechanical Engineering Design”, 2nd edition, Tata McGraw Hill, 1986.
2. V.B.Bhandari, “Design of Machine Elements”, 3rd edition, Tata McGraw Hill, 2010.

Reference Books:

1. R.L. Norton, “Machine Design an Integrated approach”, 2nd edition, Pearson Education, 2004.
2. R.K. Jain, “Machine Design:, Khanna Publications, 1978.
3. M.F.Spotts and T.E.Shoup, “Design of Machine Elements”, 3rd edition, Prentice Hall (Pearson Education), 2013.

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Heat Transfer					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0327T	**2: 1:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PCC**

Course Objectives:

- To impart the basic laws of conduction, convection and radiation heat transfer and their applications.
- To familiarize the convective heat transfer concepts.
- To describe the heat transfer phenomena during phase change.
- To explain basics of radiation heat transfer.
- To make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator and condenser.

Syllabus		**Total Hours:42**
UNIT - I	**Conduction Heat Transfer**	**12 Hrs**

Introduction : Modes and mechanisms of heat transfer – Basic laws of Heat Transfer – General Applications of Heat Transfer – Problems.

Conduction Heat Transfer : Fourier Rate Equation – General Heat Conduction Equation in Cartesian, Cylindrical and Spherical Coordinates, Simplification and Forms of the Field Equation – Steady, Unsteady and Periodic Heat Transfer – Boundary and Initial Conditions – Problems.

One Dimensional Steady State Heat Conduction : Solution for Plane and Composite Slabs, Hollow Cylinders and Spheres – Overall Heat Transfer Coefficient – Electrical Analogy – Critical Radius/Thickness of Insulation – Problems.

UNIT - II	**Conduction Heat Transfer**	**10 Hrs**

One Dimensional Unsteady State/Transient Heat Conduction Transient Heat Conduction – Systems with Negligible Internal Resistance – Significance of Biot and Fourier Numbers – Lumped System Analysis and Use of Heisler Charts – Problems.

First Heat Transfer in Extended Surfaces (Fins) : Heat Conduction through Fins of Uniform Cross Section – Efficiency, Effectiveness and Temperature Distribution on Long Fin, Fin with Insulated Tip and Short Fin – Problems.

UNIT - III	**Convective Heat Transfer**	**10 Hrs**

Convective Heat Transfer :

Convection : Basic Concepts of convection – heat transfer coefficients – Types of convection – Free and Forced Convection – Significance of Non-Dimensional Numbers.

Free Convection : Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate – Use of Emperical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation – Problems.

Forced Convection :

External Flows : Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for flow over Flat Plates and Cylinders – Fluid Friction-Heat Transfer Analogy – Problems.

Internal Flows : Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths – Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow – Problems.

Heat Transfer with Phase Change :

Boiling : Pool Boiling – Regimes-Nucleate, Transition and Film Boiling.

Condensation : Film wise and Drop wise Condensation.

UNIT - IV	Radiative Heat Transfer	12 Hrs

Radiative Heat Transfer : Thermal Radiation – Surface Emission Properties and Characteristics – Absorptivity, Reflectivity and Transmissivity – Different bodies-Black, Grey, Opaque and White bodies – Concept of a Black Body – Laws of Black Body Radiation – Irradiation – Total and Monochromatic Quantities – Laws of Planck, Wien, Kirchhoff, Lambert and Stefan-Boltzmann – Heat Exchange between two Black Bodies – Concepts of Shape Factor – Emissivity – Heat Exchange between Gray Bodies – Radiation Shields – Electrical Analogy for Radiation Networks.

UNIT - V	Heat Exchangers	12 Hrs

Heat Exchangers : Classification of Heat Exchangers – Overall Heat Transfer Coefficient and Fouling Factor – Concepts of LMTD and NTU Methods – Problems.

Course Outcomes (CO):

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

- Apply the concepts of different modes of heat transfer.
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes.
- Analyze free and forced convection phenomena in external and internal flows.
- Design thermal shields using the concepts of black body and non – black body radiation.
- Apply the basics of heat transfer for applications in industries in heat exchangers.

Textbooks:

1. Fundamentals of Engg. Heat and Mass Transfer, R.C. Sachdeva, 5th Edition, New Age International Publications, 2017.
2. Heat Transfer, P.K. Nag, TMH Publications, 3rd Edition.
3. Heat Transfer, J.P. Holman and Bhattacharya, Special Indian Edition (10th), TMH Publications, 2017.

Reference Books :

1. A Textbook of Heat and Mass Transfer, R.K. Rajput, S.Chand Publications, Revised Edition, 2018.
2. Heat and Mass Transfer, D.S. Kumar, 8th Edition, S.K. Kataria and Sons, 2013.
3. Heat and Mass Transfer, Arora & Domkundwar, Dhanpat Rai & Co. Publications.
4. Principles of Heat Transfer, Frank Kreith, R.M. Manglik & M.S. Bohn, Cengage Learning Publishers, Special Edition.
5. Heat and Mass Transfer, R. Yadav, 6th Edition, Central Publishing House, 2011.
6. Incropera's Principles of Heat and Mass Transfer, F.P. Incropera, D.P. Dewitt, T.L. Bergman and A.S. Lavine, Wiley India Edition, 2018.
7. Heat Transfer, S.P. Sukhatme, TMH, 2009.

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Renewable Energy Sources					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0329Ta	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To be familiar with classification and characteristics of composite material and their applications.
- To gain the knowledge about manufacturing methods of composites.
- To know the testing methods related to composite materials.

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

Energy Sources and Their Availability: Conventional and non-conventional energy sources. Need of Renewable Energy Sources (RES), classification of RES, role and potential of RES in India.

Solar Radiation: Structure of the sun, solar constant, environmental impact of solar radiation, radiation at the earth surfaces, solar radiation measuring instruments, solar radiation Geometry, extraterrestrial and terrestrial solar radiation, spectral distribution of extraterrestrial radiation, solar radiation on tilted surfaces and empirical equations for estimating solar radiation.

UNIT - II		**10 Hrs**

Solar Collectors: Principles of the conversion of solar radiation into heat, classifications of solar collectors- flat plate collectors and concentrating collectors, collector materials, performance analysis of a flat plate collector.

Solar Energy Storage and applications: Different storage methods-sensible and latent heat, solar ponds, solar water heating, space heating /cooling, solar electric conversion, solar distillation, solar pumping, solar furnace, solar cooking and solar green house

UNIT - III		**10 Hrs**

Wind Energy: Principles of wind energy conversion, site selection consideration, basic components, types of wind machines – horizontal axis and vertical axis, applications, Betz coefficient.

Biomass Energy Conversion Systems: Biomass conversion technologies, photosynthesis, biogas generation, factors affecting bio-digestion, classification of biogas plants, advantages and disadvantages, bio mass gasification

Geothermal Thermal Energy: Resources, types of wells, methods of harnessing the energy.

UNIT - IV		12 Hrs

Ocean Thermal Energy: Methods of Ocean thermal electric power generation open cycle systems, closed cycle systems

Tidal Power System: Working principle, components of tidal power plant, single basin and double basin tidal energy system advantages and limitations.

Wave Energy: Wave energy conversion Devices-wave energy conversion by floats, high level reservoir wave machine and dolphin type wave power machine. Advantages and disadvantages.

UNIT - V		12 Hrs

Direct Energy Conversion: Need for DEC, limitations, principles of DEC. thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators

MHD Power Generation: Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion.

Fuel Cell: Working principle, classification – efficiency – VI characteristics

Course Outcomes (CO):

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

- Classify various types of renewable sources of energy and illustrate the principles of solar radiation.
- Evaluate solar flat plate collector efficiency and illustrate various solar energy storage methods and applications.
- Describe the techniques of exploiting wind, biomass and geothermal energies in power generation.
- Illustrate the methods of tapping ocean thermal, tidal and wave energies in power generation.
- Describe the working of various direct energy conversion systems and their applications.

Textbooks:

1. SP Sukhatme, “Solar Energy: Principles of thermal collection and storage” Tata McGraw Hill
2. Tiwari and Ghosal, “Renewable Energy Resources: Basic Principles and Applications”, narosa
3. 3. G.D. Rai, “Non-Conventional Energy Sources”, Dhanpat Rai and Sons

Reference Books:

1. B.H.Khan, “Non – conventional Energy Resources”, Tata McGraw Hill education Pvt. Ltd.
2. Twidell & Weir, “Renewable Energy Sources “. Routledge (Taylor &Francis Group)

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Introduction to Composites					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0329Tb	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To be familiar with classification and characteristics of composite material and their applications.
- To gain the knowledge about manufacturing methods of composites.
- To know the testing methods related to composite materials.

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

Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

UNIT - II	**Manufacturing methods**	**10 Hrs**

Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength.

UNIT - III	**Mechanical Properties**	**10 Hrs**

Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

UNIT - IV	**Laminates**	**12 Hrs**

Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Crossply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses.

UNIT - V	**Joining Methods and Failure Theories**	**12 Hrs**

Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

Course Outcomes(CO):

- To provide knowledge on characteristics of composites
- To get knowledge on manufacturing and testing methods and mechanical behaviour of composites.
- To get the exposure of different materials .

Textbooks:

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York 2. B.T. Astrom, (1997),
2. Manufacturing of Polymer Composites, Chapman & Hall
3. Composite materials by J.N.Reddy

Reference Books:

1. Stuart M Lee, J. Ian Gray, Miltz, (1989), Reference Book for Composites Technology, CRC press
2. Frank L Matthews and R D Rawlings, (2006), Composite Materials: Engineering and Science, Taylor and Francis.
4. D. Hull and T.W. Clyne, (1996), Introduction to Composite Materials, Cambridge University Press
5. Analysis and Performance of Fiber Composites by Bhagwan D. Agarwal
3. Mechanics of Composite Materials by Autar K. Kaw

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Measurements and Mechatronics					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0329Tc	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**PEC**

Course Objectives:

- To instruct the principles of interchangeable manufacture.
- To introduce basic principles of mechanical measurements.
- To impart knowledge on mechatronics systems.

Syllabus		**Total Hours:42**
UNIT - I	**Limits & Fits**	**12 Hrs**

Introduction, terminology pertaining to limits and fits – unilateral and bilateral tolerance system, hole and shaft basis systems – Interchangeability, deterministic & statistical tolerance, selective assembly. International Standard system of limits and fits

Limit Gauges: Taylor's principle – Classification and design of limit gauges.

UNIT - II	**Linear and Angular Measurements**	**10 Hrs**

Line and end standards, slip gauges and length bars. bevel protractor – angle slip gauges – spirit levels and auto collimator.

Interferometry Applied to Measurement: NPL flatness interferometer and NPL gauge interferometer.

Surface Roughness Measurement: Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA, R.M.S, Rz values, Methods of measurement of surface finish – Profilograph, Talysurf

UNIT - III	**Mechanical Measurements**	**10 Hrs**

Introduction to measurement: Elements of generalized measurement system

Displacement Measurement- Linear Variable Differential Transformer (LVDT), encoders, potentiometers.

Temperature Measurement - Pyrometers, Resistance Temperature Detector (RTD)

Strain Measurement-Electrical strain gauge – gauge factor – method of usage of resistance strain gauge

UNIT - IV	**Mechatronics Systems**	**12 Hrs**

Mechatronics systems- Elements of mechatronics system, mechatronics design process, system - measurement systems, control systems, programmable logic controllers, case studies of mechatronic systems

UNIT - V	**Actuating Systems**	**12 Hrs**

Hydraulic and pneumatic actuating systems - fluid systems, hydraulic systems, and pneumatic systems, components, control valves. mechanical actuating systems and electrical actuating systems – basic principles and elements.

Course Outcomes (CO):

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

- design the limit gauges for interchangeable manufacture.
- apply the basic principles of mechanical measurements for engineering practice.
- illustrate the role of mechatronics systems in manufacturing.
- explain principles of mechanical, hydraulic, pneumatic and electrical actuating systems.

Textbooks:

1. R.K. Jain, "Engineering Metrology", Khanna Publishers.
2. BeckWith, Marangoni, Linehard, " Mechanical Measurements", 6th edition,PHI / PE.
3. W. Bolton , "Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg.", 4th Edition, Pearson, 2012.

Reference Books:

1. IC Guptha,"Engineering Metrology ",Danpath Rai Publications.
2. Doeblin Earnest. O. Adaptation by Manik and Dhanesh,"Measurement Systems: Application and Design", Tata Mc Graw Hill Publications.

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Environmental Economics					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0150T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

- To impart knowledge on sustainable development and economics of energy
- To teach regarding environmental degradation and economic analysis of degradation
- To inculcate the knowledge of economics of pollution and their management
- To demonstrate the understanding of cost benefit analysis of environmental resources
- To make the students to understand principles of economics of biodiversity

Syllabus		**Total Hours:48**
Unit-I	**Sustainable Development**	**9 Hrs**

Introduction to sustainable development - Economy-Environment interlinkages - Meaning of sustainable development - Limits to growth and the environmental Kuznets curve – The sustainability debate - Issues of energy and the economics of energy

Unit-II	**Environmental Degradation**	**9 Hrs**

Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation – Equi –marginal principle.

Unit -III	**Economics Of Pollution**	**10 Hrs**

Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions – Managing pollution through market intervention: Taxes, subsidies and permits.

Unit -IV	**Cost – Benefit Analysis**	**10 Hrs**

Cost – Benefit Analysis: Economic value of environmental resources and environmental damage - Concept of Total Economic Value - Alternative approaches to valuation – Cost-benefit analysis and discounting.

Unit -V	**Economics of Biodiversity**	**10 Hrs**

Economics of biodiversity: Economics of biodiversity conservation - Valuing individual species and diversity of species -Policy responses at national and international levels. Economics of Climate Change – stern Report

Course Outcomes(CO):

On completion of this course, student will be able to

- The information on sustainable development and economics of energy
- The information regarding environmental degradation and economic analysis of degradation
- The identification of economics of pollution and their management
- The cost benefit analysis of environmental resources
- The principles of economics of biodiversity

Textbooks:

1. An Introduction to Environmental Economics by N. Hanley, J. Shogren and B. White Oxford University Press.(2001)
2. Blueprint for a Green Economy by D.W. Pearce, A. Markandya and E.B. Barbier Earthscan, London.(1989)

Reference Books:

1. Environmental Economics: An Elementary Introduction by R.K. Turner, D.W. Pearce and I. Bateman Harvester Wheatsheaft, London. (1994),
2. Economics of Natural Resources and the Environment by D.W. Pearce and R.K. Turner Harvester Wheat sheaf, London. (1990),

E-resources:

- **https://nptel.ac.in/courses/109107171**

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Microcontrollers & Applications					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0431T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

- To impart knowledge on sustainable development and economics of energy
- To teach regarding environmental degradation and economic analysis of degradation
- To inculcate the knowledge of economics of pollution and their management
- To demonstrate the understanding of cost benefit analysis of environmental resources
- To make the students to understand principles of economics of biodiversity

Syllabus		**Total Hours:48**
Module-I	**8051 Microcontroller**	**9 Hrs**

8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

Module-II	**Assembly language program**	**9 Hrs**

Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.

Module -III	**8051 Stack, Stack and Subroutine instructions**	**10 Hrs**

8051 Stack, Stack and Subroutine instructions: Simple Assembly language program examples to use subroutine instructions.8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin.

Module -IV	**8051 Serial Communication**	**10 Hrs**

8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch.

Module -V	**8051 C programming**	**10 Hrs**

8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Interfacing with relays and Opto isolators, Stepper Motor Interfacing, DC motor interfacing, PWM generation using 8051.

Course Outcomes(CO):

On completion of this course, student will be able to

- Understand the importance of Microcontroller

- Acquire the knowledge of Architecture of 8051 Microcontroller.
- Apply and Interface simple switches, simple LEDs, ADC 0804, LCD and Stepper Motor to using 8051 I/O ports.
- Develop the 8051 Assembly level programs using 8051 instruction set.
- Design the Interrupt system
- Understand the operation of Timers/Counters and Serial port of 8051.

Textbooks:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C", PHI, 2006 / Pearson, 2006.
2. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. Manish K Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005. Wayne Wolf, FPGA based system design, Prentice hall, 2004.

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Control Systems Engineering
(Common to all Except EEE & ECE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
22A0213TA	3: 0:0:0	3	CIE: 30 SEE:70	3Hours	OEC

Course Objectives:

The objectives of the course are to make the students learn about:

- Merits and demerits of open loop and closed loop systems; the effects of feedback
- The use of block diagram algebra and Mason's gain formula
- Transient and steady state responses , time domain specifications
- Frequency domain specifications, Bode diagrams and Nyquist plots
- The fundamental aspects of modern control

Syllabus		**Total Hours:49**
Unit-I	**INTRODUCTION**	**10 Hrs**

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, Block diagram reduction methods – Signal flow graph - Reduction using Mason's gain formula. Transfer Function of DC Servo motor - AC Servo motor - Synchro transmitter and Receiver.

Unit-II	**TIME RESPONSE ANALYSIS**	**10 Hrs**

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

Unit -III	**STABILITY**	**9 Hrs**

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 -IV	**FREQUENCY RESPONSE ANALYSIS**	**10 Hrs**

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- Phase margin and Gain margin-Stability Analysis.

Unit -V	**STATE SPACE ANALYSIS**	**10 Hrs**

Concepts of state, state variables and state model, derivation of state models from differential equations. Transfer function models. Block diagrams. Diagonalization. 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

Course Outcomes(CO):

At the end of studying the course, the student should be able to:

- Evaluate the effective transfer function of a system from
- block diagram reduction techniques (ii) Mason's gain formula
- Compute the steady state errors and transient response characteristics
- Determine the absolute stability and relative stability of a system
- Design a compensator to accomplish desired performance
- Derive state space model of a given physical system and solve the state equation

Textbooks:

1. Modern Control Engineering, Katsuhiko Ogata, PEARSON, 1st Impression 2015.
2. Control Systems Engineering, I. J. Nagrath and M. Gopal, New Age International Publishers, 5th edition, 2007, Reprint 2012.

Reference Books:

1. Automatic Control Systems, Farid Golnaraghi and Benjamin. C. Kuo, WILEY, 9th Edition, 2010.
2. Control Systems, Dhanesh N. Manik, CENGAGE Learning, 2012.
3. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design: Conventional and Modern", McGraw - Hill Book Company, 1988.

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Introduction to Machine Learning					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0528T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

The objectives of the course are to make the students learn about:

- Understand basic concepts of Machine Learning
- Study different learning algorithms
- Illustrate evaluation of learning algorithms

Syllabus		**Total Hours:48**
Module-I	**Introduction – Human Learning & Machine Learning**	**10Hrs**

Human Learning, Types of Human Learning, Machine Learning, Types of Machine Learning, Applications of Machine Learning, Issues in Machine Learning.

Basic types of Data in Machine Learning, Data Preprocessing : Data Cleaning, Data transformation and Data Reduction

Module-II	**Modeling and Evaluation**	**9Hrs**

Introduction, selecting a Model, training a Model, Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model

Module-III	**Supervised Learning :Classification**	**10Hrs**

Classification – Methods of Classification : Classification model, Classification Learning Steps, Classification by Decision tree Induction, Classification by Back propagation, K-Nearest Neighbor Classification, Random Forest Algorithm, Naïve Baye's Classification

Module-IV	**Supervised Learning : Regression**	**10Hrs**

Regression – Assumptions in Regression Analysis, Types of Regression: Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression, Curve Fitting- Method of Least Squares.

Module-V	**Unsupervised Learning : Clustering**	**9Hrs**

Clustering- Different types of clustering techniques, Partitioning Methods: K-Means Algorithm, K-Medoid's algorithm, Hierarchical Clustering Methods, Density based Clustering Methods- DBSCAN, DENCLUE, OPTICS

Course Outcomes(CO):

On completion of this course, student will be able to

- Identify machine learning techniques suitable for a given problem
- Solve the problems using various machine learning techniques
- Design application using machine learning techniques

Textbooks:

1. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

Reference Books:

1. EthernAlpaydin, “Introduction to Machine Learning”, MIT Press, 2004.
2. Stephen Marsland, “Machine Learning -An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
3. Andreas C. Müller and Sarah Guido “Introduction to Machine Learning with Python: A Guide for Data Scientists”, Oreilly.

Web Resources:

1. Andrew Ng, “Machine Learning Yearning”
2. https://www.deeplearning.ai/machine-learning-
3. https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html

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Management science					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0023T	**3: 0:0:0**	**3**	**CIE: 30 SEE:70**	**3Hours**	**OEC**

Course Objectives:

- To provide fundamental knowledge on Management, Administration,Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts.
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management.
- To make the students aware of the contemporary issues in management.

Syllabus		**Total Hours:60**
Module - I	**Introduction To Management**	**12 Hrs**

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - Organisational Designs - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

Module - II	**Operations Management**	**12 Hrs**

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control - Deming's contribution to Quality. Material Management - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - Marketing Management - Concept - Meaning - Nature- Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

Module - III	**Human Resources Management**	**12 Hrs**

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration.

Module - IV	Strategic & Project Management	12 Hrs
Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - Project Management - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).		
Module - V	**Contemporary Issues in Management**	**12 Hrs**
The concept of Management Information System(MIS) - Materials Requirement Planning (MRP)- Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.		

Course Outcomes (CO):

On completion of this course, student will be able to

- Understand the concepts & principles of management and designs of organizationin a practical world(L2)
- Apply the knowledge of Work-study principles & Quality Control techniques in industry(L3)
- Analyze the concepts of HRM in Recruitment, Selection and Training & Development.(L4)
- Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.(L3)
- Create Modern technology in management science.(L3)

Textbooks:

1. A.R Aryasri, “Management Science”, TMH, 2013
2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

Reference Books:

1. Koontz & Weihrich, “Essentials of Management”, 6th edition, TMH, 2005.
2. Thomas N.Duening & John M.Ivancevich, “Management Principles and Guidelines”,Biztantra.
3. Kanishka Bedi, “Production and Operations Management”, Oxford University Press, 2004.
4. Samuel C.Certo, “Modern Management”, 9th edition, PHI, 2005

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Entrepreneurship & Innovation					
Course Code	**L:T:P:S**	**Credits**	**Exam marks**	**Exam Duration**	**Course Type**
22A0024T	**3:0:0:0**	**3**	**CIE:30 SEE:70**	**3 Hours**	**HSSC**

Course Objectives:

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up ofNew enterprise
- To facilitate the student in knowing various sources of finance in starting up of a business
- To impart knowledge about various government sources which provide financial assistance toentrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

Syllabus		**Total Hours: 48**
Module - I	**Introduction to Entrepreneurship**	**10 Hrs**

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

Module - II	**Starting Up New Venture**	**10 Hrs**

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

Module - III	**Sources Of Finanace**	**9 Hrs**

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

Module - IV	**Women Entrepreneurship**	**9 Hrs**

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

Module - V	Introduction to Incubation & Innovation	10 Hrs

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation – Types, Advantages and Disadvantages of incubation.
Innovation Meaning & Definition - Forms of innovation - Innovation, features and characteristics - Factors initiating innovations - Innovation process and its stages.

Course Outcomes (CO):

On completion of this course, student will be able to

- Understand the concept of Entrepreneurship and challenges in the world of competition. (L2)
- Apply the Knowledge in generating ideas for New Ventures.(L3)
- Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.(L4)
- Evaluate the role of central government and state government in promoting entrepreneurship.(L3)
- Create and design business plan structure through incubations.(L3)

Textbooks:

1. D F Kuratko and T V Rao, "Entrepreneurship**"** - A South-Asian Perspective – CengageLearning, 2012. (For PPT, Case Solutions Faculty may visit : login.cengage.com)
2. Nandan H, " Fundamentals of Entrepreneurship", PHI, 2013

Reference Books:

1. Vasant Desai, "Small Scale Industries and Entrepreneurship", Himalaya Publishing 2012.
2. Rajeev Roy "Entrepreneurship", 2nd Edition, Oxford, 2012.
3. B.JanakiramandM.Rizwana‖ "Entrepreneurship Development: Text & Cases", Excel Books,2011.
4. Stuart Read, Effectual "Entrepreneurship", Routledge, 2013.

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Human Resource Management					
Course Code	**L:T:P:S**	**Credits**	**Exam marks**	**Exam Duration**	**Course Type**
22A0026T	**3:0:0:0**	**3**	**CIE:30 SEE:70**	**3 Hours**	**HSSC**

Course Objectives:

- To make the student understand about human resource management.
- To enable the students about job analysis, job specification and job enrichment.
- To enable the students knowing about HR planning and retention.
- To impact knowledge about recruitment, selection and performance appraisal.
- To create knowledge on training and development, compensation management.

Syllabus		**Total Hours:48**
Module - I	**Human Resource Management-Introduction**	**9 Hrs**

Introduction- Objectives – Scope & Features of HRM – Importance & - Functions of HRM- Challenges of HRM. Personnel Management Vs HRM – Role of HR manager - Strategic Human Resource Management.

Module - II	**Job Analysis and Job Design**	**9 Hrs**

Job Analysis Process –Techniques of Data Collection - Contents of Job Description & Job Specification - Job design - Factors affecting Job design - Job enrichment Vs Job enlargement.

Module - III	**Human Resource Planning and Employee Retention**	**10 Hrs**

Objectives and Need of HR planning, Process of HR Planning and factors affect the HR Planning -HR Information System - Employee retention - Importance of retention - strategies of retention.

Module - IV	**HR Acquisition and Managing Employee Performance**	**10 Hrs**

Recruitment - Objectives and Sources of recruitment - Selection - Objectives - Selection Procedure - Placement - Performance Appraisal –Objectives & Importance, performance Appraisal Methods – Constraints.

Module - V	**HR Development and Compensation Management**	**9 Hrs**

Training and Development– Objectives, Need and Methods of Training –career planning and career development - Compensation Management - Job evaluation – welfare provisions and fringe benefits - Quality Circles and Total Quality Management.

Course Outcomes (CO):

On completion of this course, student will be able to

- Understand the basic concept of Human Resource Management.(L2)
- Explain the job analysis and job design methods.(L2)
- Understand the demand and supply of HR & concept of employee retention.(L2)
- Understand the sources of Recruitment, Selection process and Performanceappraisal methods.(L2)
- Examine the Training and Development methods and compensation management process.(L2)

Textbooks:

1. Gary Dessler, Biju Varkkey, Human Resource Management, 4e, Pearson 2017.
2. Robert L. Mathis, John H. Jackson, Manas Ranjan Tripathy, Human ResourceManagement, Cengage Learning 2016.

Reference Books:

1. Aswathappa, Human Resource Management, 4th Edition, TMH 2006.
2. Subbarao, Personnel and Human Resource Management –Text and cases,Himalaya, 2009
3. R.Wayne Mondy, Robert M.Noe, Human Resource Management, Pearson
4. Noea.Raymond, John Hollenbeck, Barry Gerhart and Patrick Wright, HumanResource Management, Tata McGraw Hill.
5. Muller, Human Resource Management a case study approach, Jaico Publishers,2008
6. VSP Rao, Human Resource Management, Text and Cases, Excel Books 2006.

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Heat Transfer Laboratory					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0328P	**0: 0:3:0**	**1.5**	**CIE: 30 SEE:70**	**3Hours**	**PCC**

Course Objectives:

Students undergoing this course would

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements

Syllabus **Total Hours:45**

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin in natural and forced convection.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Study the pool boiling phenomenon and different regimes of pool boiling.
11. Experiment on pool boiling
12. Determine the emissivity of the test plate surface.
13. Experiment on Stefan-Boltzmann apparatus
14. Determine the heat transfer rate coefficient in fluidized bed apparatus.

Course Outcomes (CO):

On completion of this course, student will be able to

- Explain different modes of heat transfer
- Identify parameters for measurement for calculating heat transfer
- Determine effectiveness of heat exchanger
- Design new equipment related to heat transfer
- Apply principles of heat transfer in wide application in industries.

Reference Books:

1. Abdul Matheen, Heat Transfer Laboratory Manual, Laxmi Publications; 2/e, 2007.

Online Learning Resources/Virtual Labs:

- https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab
- https://www.iare.ac.in/sites/default/files/lab1/IARE_HT_LAB_MANUAL.pdf
- https://mrcet.com/downloads/digital_notes/ME/III%20year/(R18A0388)Heat%20Transfer%20Lab.pdf
- https://mrcet.com/downloads/ME/Mech%20III-II.pdf

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3D Printing practice					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
22A0331P	**1: 0:2:0**	**2**	**CIE: 30 SEE:70**	**3Hours**	**SOC**

Course Objectives:

Students undergoing this course would

- Understand different methods of 3D Printing.
- Gain knowledge about simulation of FDM process
- Estimate time and material required for manufacturing a 3D component

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

Introduction to Prototyping, Working of 3D Printer, Types of 3D printing Machines:
Exp 1: Modelling of Engineering component and conversion of STL format.
Exp 2: Slicing of STL file and study of effect of process parameter like layer thickness, orientation, and infill on build time using software.
Exercise 1 : Component-1

Exercise 2 : Component-2

Module 2:		**10 Hrs**

Exp 1 : 3D Printing of modelled component by varying layer thickness.
Exp 2 : 3D Printing of modelled component by varying orientation.
Exp 3: 3D Printing of modelled component by varying infill.

Module 3:		**10 Hrs**

Study on effect of different materials like ABS, PLA, Resin etc, and dimensional accuracy.

Module 4:		**12 Hrs**

Identifying the defects in 3D Printed components.

Module 5		**12 Hrs**

Exp1: Modelling of component using 3D Scanner of real life object of unknown dimension in reverse engineering**.**
Exp 2: 3D Printing of above modelled component.

Course Outcomes (CO):

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

- Explain different types of 3d Printing techniques
- Identify parameters for powder binding and jetting process
- Determine effective use of ABS material for 3D Printing
- Apply principles of mathematics to evaluate the volume of material require.

References:

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.

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Intellectual Property Rights & Patents
(Mandatory Course)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
22A0031T	2: 0:0:0	0	CIE: 30	3Hours	MC

Course Objectives:

- This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Cyber Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations

Syllabus		**Total Hours:42**
UNIT - I		**12 Hrs**
Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory – Overuse or Misuse of Intellectual Property Rights – Compliance and Liability Issues.		
UNIT - II		**10 Hrs**
Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law- Semiconductor Chip Protection Act.		
UNIT - III		**10 Hrs**
Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.		
UNIT - IV		**12 Hrs**
Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.		
UNIT - V		**12 Hrs**
Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law. Introduction to Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.		

Course Outcomes (CO):

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

- Understand IPR law & Cyber law
- Discuss registration process, maintenance and litigations associated with trademarks
- Illustrate the copy right law
- Enumerate the trade secret law.

Textbooks:

1. Deborah E.Bouchoux: "Intellectual Property". Cengage learning, New Delhi
2. Kompal Bansal &Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press)
3. Cyber Law. Texts & Cases, South-Western's Special Topics Collections

Reference Books:

1. Prabhuddha Ganguli: ' Intellectual Property Rights" Tata Mc-Graw – Hill, New Delhi
2. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali: "Intellectual Property Right" Serials Pub.