BIJUPATNAIKUNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (Mechanical Engineering) for the Batch

2018-19 and Onwards

Semester (5^{th})

B. Tech in Mechanical Engineering

(Admission Batch: 2018-2019 and Onwards)

5th Semester

Fifth Semester					
Theory					
Sl. No.	Category	Course Code	Course Title	L-T-P	Credit
1	PC 11		Basic Manufacturing Processes	3-0-0	3
2	PC 12		Mechanisms and Machines	3-0-0	3
3	PC 13		Heat Transfer	3-0-0	3
4	PE 2		Automobile Engineering	3-0-0	3
			CAD/CAM	3-0-0	
			Tribology	3-0-0	
5	PE 3		Non-Conventional Energy Sources	3-0-0	3
			Rapid Manufacturing Processes	3-0-0	
			Finite Element Methods in Engineering	3-0-0	
6	MC 5		Universal Human Values		0
Total Credit (Theory)					**15**
Practical					
1	PC 14		Basic Manufacturing Processes Lab	0-0-3	2
2	PC 15		Mechanisms and Machines Lab	0-0-3	2
3	PC 16		Heat Transfer Lab	0-0-3	2
4	PSI 2		Evaluation of Summer Internship	0-0-3	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

5th Semester

PC 11: Basic Manufacturing Processes

MODULE - I **(10 LECTURES)**

Foundry :Types of patterns, pattern materials and pattern allowances. Moulding Materials - sand moulding, metal moulding, investment moulding, shell moulding. Composition of molding sand, Silica sand, Zircon sand, binders, additives, Binders - clay, binders for CO_2, sand, binder for shell moulding, binders for core sand. Properties of moulding sand and sand testing, Melting furnaces - cupola, resistance furnace, induction and arc furnace, Solidification of castings, design of risers and runners, feeding distance, centre line freezing resistance chills and chaplets. Degasification and inoculation of metals. Casting methods like continuous casting, centrifugal casting, disc casting. Casting defects.

MODULE – II **(8 LECTURES)**

Welding and cutting: Introduction to gas welding, cutting, Arc welding and equipment's. TIG (GTAW) and MIG (GMAW) welding, resistance welding and thermit welding. Weldablity Modern Welding methods like plasma Arc, Laser Beam, Electron Beam, Ultrasonic, Explosive and friction welding, edge preparation in butt welding. Brazing and soldering, welding defects. Destructive and non-destructive testing of castings and welding.

MODULE – III **(08 LECTURES)**

Brief introduction to powder metallurgy processes. Plastic deformation of metals: Variables in metal forming and their optimization. Dependence of stress strain diagram on Strain rate and temperature. Hot and cold working of metals, classification of metal forming processes. Rolling: Pressure and Forces in rolling, types of rolling mills, Rolling defects. Forging: Smith Forging, Drop and Press forging, M/c forging, Forging defects.

MODULE – IV **(08 LECTURES)**

Extrusions: Direct, Indirect, Impact and Hydrostatic extrusion and their applications, Extrusion of tubes. Wire drawing methods and variables in wire-drawing, Optimum dies shape for extrusion and drawing. Brief introduction to sheet metal working: Bending, Forming and Deep drawing, shearing. Brief introduction to explosive forming, coating and deposition methods.

BOOKS

[1] Manufacturing technology by P.N.Rao, Tata McGraw Hill publication.
[2] Welding Technology by R.A. Little, TMH
[3] Manufacturing Science by A.Ghosh and A K Malick, EWP

[4] Fundamentals of metal casting technology by P.C. Mukherjee, Oxford PIBI.

[5] Mechanical Metallurgy by Dieter, Mc-Graw Hill
[6] Processes and Materials of Manufacture by R.A Lindberg, Prentice hall (India)
[7] A Text Book of Production Engineering by P.C.Sharma, S.Chand.

Digital Learning Resources:

NPTEL MOOCs:

Course Name:	Fundamentals of Manufacturing Processes
Course Link:	https://nptel.ac.in/courses/108/102/108102047/
Course Instructor:	Prof. D K Dwivedi, IIT Roorkee

5th Semester

PC 12: Mechanisms and Machines

MODULE – I **(12 HOURS)**

Mechanisms with lower pairs : Motor Vehicle Steering Gears - Davis Steering Gear &Ackermann Steering Gear, Hooke's Joint.
Cams Design: Fundamental law of Cam, Cam Terminology, Classification of Cams and followers, Analysis of follower motions (Displacement, velocity, Acceleration and jerk) – Simple Harmonic, Uniform Velocity and Constant Acceleration & Retardation Types, Generation of Cam Profiles by Graphical Method, Introduction on Cams with specified contours.
Turning Moment Diagram and Flywheel: Turning moment diagram. Turning moment diagrams for different types of engines, Fluctuation of energy and fluctuation of speed. Dynamic. Theory of Flywheel, Flywheel of an internal combustion engine and for a punch machine. Determination of flywheel size from Turning Moment Diagram.

MODULE II **(8 HOURS)**

Mechanism for Control (Governors): Governors - Watt, Porter, Proell, Hartnell, Wilson-Hartnell Governor. Performance parameters: Sensitiveness, Stability, Hunting, Isochronism. Governor Effort and Power, Controlling Force & Controlling Force Curve, Friction & insensitiveness, Comparison between governor and flywheel.
Mechanism for Control (Gyroscope): Introduction to Gyroscopes. Gyroscopic forces and Couple. Effect of Gyroscopic Couple on Aeroplanes, Gyroscopic stabilization of ship, Stability of Two Wheelers and Four Wheelers. Rigid disc at an angle fixed to rotating shaft.

MODULE III **(12 HOURS)**

Balancing of rotating components and linkages:
Static and Dynamic Balancing, Balancing of Single Rotating Mass by Balancing Masses in Same plane and in Different planes. Balancing of Several Rotating Masses rotating in same plane and in Different planes. Effect of Inertia Force due to Reciprocating Mass on Engine

Frame, Partial balance of single cylinder engines. Primary andSecondary Balance of Multi-cylinder In-line Engines. Balancing of locomotive: variation of tractiveforce, swaying couple, hammer blow. Direct and Reverse Crank method of balancing for radialengines. Balancing of V-engine. Balancing machines: Pivoted-Cradle Balancing Machine.

Vibrations: Introduction to Mechanical Vibration – Definitions, elements of vibratory system, Longitudinal, Torsional & Transverse Systems. Determination of natural frequency of vibratory systems using energy method, equilibrium method and Rayleigh's method, Free and Forced Vibration of Un-damped and Damped Single Degree Freedom Systems, Logarithmic decrement, Magnification factor, Vibration isolation and transmissibility, whirling of shafts and Evaluation of Critical Speeds of shafts.

BOOKS

[1] Theory of Machines by S.S.Rattan, Tata Mac Graw Hill
[2] Theory of Machines and Mechanisms (India Edition) by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
[3] Mechanism and Machine Theory by J.S.Rao and R.V.Dukipatti, New Age International.
[4] Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallick, East West Press.

[5] Theory of Machines by Thomas Bevan, CBS Publications.
[6] Kinematics and Dynamics of Machinery by R.L.Norton, Tata MacGraw Hill
[7] Kinematics & Dynamics of Machinery-Charles E. Wilson &J.PeterSaddler,Pearson Ed.
[8] Theory of Mechanisms and Machines by C.S.Sharma and K.Purohit, PHI
[9] Theory of Machines by Shah Jadwani, Dhanpat Rai
[10] Theory of Machines by Abdulla Shariff, Dhanpat Rai
[11] Theory of Machines by Sadhu Singh, Pearson Education.

5th Semester

PC 13:Heat Transfer

MODULE-I **(12 HOURS)**

Introduction:
Modes of heat transfer: conduction, convection, and radiation ,Mechanism & basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity, Thermal conductance &Thermal resistance, Contact resistance, convective heat transfer coefficient, radiation heat transfer coefficient , Electrical analogy, combined modes of heat transfer. Initial conditions *and* Boundary conditions of 1st, 2nd and 3rd Kind.

Heat Conduction:
The General heat conduction in Cartesian, polar-cylindrical and polar-spherical coordinates, Simplification of the general equation for one and two dimensional steady transient conduction with constant/ variable thermal conductivity with / without heat generation. Solution of the one dimensional steady state heat conduction problem in case of plane walls, cylinders and spheres for simple and composite cases. Critical insulation thickness, Heat transfer in extended surfaces (pin fins) without heat generation, Long fin, short fin with

insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and fin effectiveness. Conduction in solids with negligible internal temperature gradient (Lumped heat analysis).

MODULE-II (12 HOURS)

Convective Heat Transfer:
Introduction to convective flow - forced and free. Dimensional analysis of forced and free connective heat transfer. Application of dimensional analysis, physical significance of Grashoff , Reynolds, Prandtl, Nusselt and Stanton numbers. Conservation equations for mass, momentum and energy for 2-dimensional convective heat transfer in case of incompressible flow, Hydrodynamic and thermal boundary layers for flow over a flat plate. Critical Reynolds number; general expressions for drag coefficient and drag force Reynolds- Colbourn analogy. Thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer Coefficient; Nusselt number. Flow inside a duct- velocity boundary layer, hydrodynamic entrance length and hydrodynamically developed flow; flow through tubes (internal flow). Use of empirical relations for solving turbulent conditions for external and internal flow. Mechanism of heat transfer during natural convection, Experimental heat transfer correlations for natural convection in the following cases(a) Vertical and horizontal plates(b) Inside and outside flows in case of tubes

Module-III (8 HOURS)

Radiative heat exchange :
Introduction, Radiation properties, definitions of various terms used in radiation heat transfer; Absorptivity, reflectivity & transmissivity. Emissive power & emissivity, Kirchoff'sidentity, Planck's relation for monochromatic emissive power of a black body, Derivation of Stefan-Boltzmann law and Wien's displacement law from Planck's relation, Radiation shape factor, Relation for shape factor and shape factor algebra. Heat exchange between blackbodies through non-absorbing medium. Gray bodies and real bodies, Heat exchange between gray bodies. Radiosity and Irradiation, Electrical analogy and radiation network for 2-body and 3-body radiations exchange in non-absorbing medium, Radiation shields.

Module-IV (8 HOURS)

Heat transfer for boiling liquids and condensing vapours :
Types of condensation, use of correlations for condensation on vertical flat surfaces, horizontal tube and; regimes of pool boiling, pool boiling correlations. Critical heat flux, concept of forced boiling. Numerical problems.
Heat Exchangers :
Introduction, Types of heat exchanger, The overall heat transfer coefficient and fouling factors, LMTD and _ - NTU analysis of heat exchangers.

Books :

[1] Heat Transfer Incropera and Dewitt, Willey publications
[2] Heat Transfer :J.P.Holman, TMH Publications
[3] Heat Transfer: P.S.Ghosdastidar, Oxford University Press
[4]Fundamentals of Engineering Heat and Mass Transfer: R.C.Sachdeva, New Age InternationalPublishers, 4th Edition

[5] Heat Transfer by P.K. Nag, TMH
[6] Heat Transfer by S.P. Sukhatme, TMH
[7] Heat Transfer: A.F.Mills and V.Ganesan, Pearson Education, 2nd Edition
[8] Heat and Mass Transfer: Domkundwar and Arora, Danpatrai and sons
[9] Heat Transfer : R. K. Rajput, Laxmi Publications
[10] Heat and Mass Transfer: A Practical Approach, Y.A.Cengel, Tata Macgraw Hills Education Private Limited

Digital Learning Resources:

NPTEL MOOCs:

Course Name:	Heat Transfer
Course Link:	https://nptel.ac.in/courses/103/105/103105140/
Course Instructor:	Prof. Sunando Dasgupta, IIT Kharagpur
Course Name:	Fundamentals of Convective Heat Transfer
Course Link:	https://swayam.gov.in/nd1_noc20_me81/preview
Course Instructor:	Prof. AmareshDalal, IIT Guwahati

5th Semester

PE 2: Automobile Engineering

MODULE I **(14 HOURS)**

Introduction
Main units of automobile chassis and body, different systems of the automobile, description of themain parts of the engine, motor vehicle act.
Power for Propulsion
Resistance to motion, rolling resistance, air resistance, gradient resistance, power required for propulsion, tractive effort and traction, road performance curves.

Breaking systems
Hydraulic breaking system, breaking of vehicles when applied to rear, front and all four wheel,theory of internal shoe brake, design of brake lining and brake drum, different arrangement ofbrake shoes, servo and power brakes.

MODULE II **(12 HOURS)**

Transmission Systems
Layout of the transmission system, main function of the different components of the transmission system, transmission system for two wheel and four-wheel drives. Hotchkiss and torque tube drives.
Gear box Sliding mesh, constant mesh and synchromesh gearbox, design of 3 speed and 4 speed gear box, over drive, torque converter, semi and fully automatic transmission.

Hookes joint, propeller shaft, differential, rear axles, types of rear axles, semi floating, there quarter floating and full floating types.

MODULE III **(14 HOURS)**

Front wheel Geometry and steering systems: Camber, castor, kingpin inclination, toe-in and toe out, centre point steering condition for true rolling, components of steering mechanism, power steering.

Electrical System of an Automobile: Starting system, charging system, ignition system, other electrical system.

Electrical vehicles:

History, electrical vehicles and the environment pollution, description of electric vehicle, operational advantages, present EV performance and applications, battery for EV, Battery types and fuel cells, Solar powered vehicles, hybrid vehicles.

BOOKS :

[1] Automobile Mechanics ,N.K.Giri, Khanna publishers
[2] Automobile Engineering, K.M. Gupta, VolI& II, Umesh Publication
[3] Automotive mechanics: William h. Crouse and Donald L. Anglin, TMH
[4] The motor vehicle, Newton and Steeds
[5] Automobile Mechanics, J. Heitner, East West Press
[6] Automobile Engineering, Jain and Asthana, Tata McGraw Hill
[7] Automobile Engineering, K.K.Ramalingam, Scitech
[8] Automobile Engineering, Vol. I & II, Kirpal Singh, Standard Publications
[9] A Text Book of Automobile Engineering, R.K.Rajput, Laxmi Publishers

5th Semester

PE 2: CAD/CAM

MODULE – I **(14 HOURS)**

Fundamentals of CAD: Design process, Applications of computer for design, Creating the Manufacturing Database, The Design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, Central Processing Unit, Memory types.

MODULE – II **(14 HOURS)**

Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, Transformations of geometry, Database structure and content, Wire frame versus solid modeling, Constraint– Based modeling, Geometric commands, Display control commands, Editing.

MODULE III **(14 HOUR)**

CAM - Numerical Control and NC Part Programming: Numerical Control, Numerical Control elements, NC Coordinate system, NC motion control system, Manual and Computer Aided programming, the APT language, Miscellaneous Functions, M, Advanced part-programming methods. Problems with conventional NC, NC technology: CNC, DNC, Combined DNC/ CNC system, Adaptive control manufacturing systems, Computer Integrated Manufacturing system, Machine Tools and related equipment, Materials Handling system: AGV, Robots, Lean manufacturing.

BOOKS :

[1] CAD/CAM Computer Aided Design and Manufacturing, M.P.Goover and E.W.Zimmers, Jr.,Pearson.
[2] CAD & CAM, J Srinivas, Oxford University Press.

[2] CAD/CAM Theory and Practice, Zeid and Subramanian, TMH
[3] CAD/CAM Principles, Practice and Manufacturing Management, McMahon and Browne, Pearson Education
[4] CAD/CAM Concepts and Applications, C.R.Alavala, PHI
[5] Computer Aided Design and Manufacturing, Lalit Narayan, Mallkarjuna Rao and Sarcar, PHI
[6] CAD/CAM Theory and Conepts, K.Sareen and C.Grewal, S.Chand Publication
[7] CAD/CAM/CAE, N.K.Chougule, Scitech

5th Semester

PE 2: Tribology

MODULE - I **(12 HOURS)**

Introduction : Lubricant and lubrication, Types of bearings, properties and testing of lubricants,Basic equations: Generalized Reynolds equation, Flow and Shear Stress, Energy equation, Equationof stateHydro dynamic lubrication :Mechanism of pressure development and load carrying capacity, Plane-slider bearing, Idealizedslider bearing with a pivoted shoe, Step bearing, Idealized journal bearing. – infinitely long journalbearing, Petroffs equation for a lightly loaded bearing, narrow bearing,

MODULE - II **(11 HOURS)**

Oil flow and thermal equilibrium - Heat balance of lubricantsHydrostatic Bearing **:**Principles, Component of hydrostatic lubrication , Hydrostatic circular thrust bearing , calculationof pressure, load carrying capacity, flow rate , power loss in bearing due to friction.

MODULE - III **(12 HOURS)**

Concept of gas lubricated bearingConcept of Elastohydrodynamic lubrication, Design and selection of antifiction bearingFriction and wear of metals :Theories of friction, surface

contaminants, Effect of sliding speed on friction, classification andmechanism of wear, Wear resistant materials.

BOOKS :

[1] Introduction to Tribology of Bearing , B.C .Majumdar , S. Chand & Co
[2] Fundamentals of Tribiology , Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006
[3] Basic Lubrication theory, A. Cameron, John Wiley & sons
[4] Lubrication Fundamentals, D.M.Pirro and A.A.Wessol, CRC Press
[5] Theory and Practice of Lubrication for Engineers**,** Fuller, D., New York company 1998
[6] Principles and Applications of Tribiology**,** Moore, Pergamaon press 1998
[7] Tribiology in Industries**,** Srivastava S., S Chand and Company limited, Delhi 2002
[8] Lubrication of bearings – Theoretical Principles and Design**,** Redzimovskay E I., Oxford press company 2000

5th Semester

PE3: Non-Conventional Energy Sources

MODULE I (6 CLASSES)

Energy, Ecology and environment: Introduction, Classification of Energy Resources,Common Forms of Energy, Energy Chain, Advantages and Disadvantages of ConventionalEnergy Sources, Importance and Salient Features of Non-Conventional Energy Sources,Environmental and ecological Aspects of Energy use, Environment-Economy-Energy andSustainable Development, World Energy Status, Energy Scenario in India.Energy Conservation and Energy Storage: Salient Features of "Energy Conservation Act,2001", Various Aspects of Energy Conservation, Principles of Energy Conservation, GeneralElectrical ECO's (Energy Conservation Opportunities)

MODULE II (15 CLASSES)

Solar Energy: Basics, The Sun as a Source of Energy, Sun, Earth Radiation Spectrums,Extraterrestrial and Terrestrial Radiations, Spectral Energy Distribution of Solar Radiation,Depletion of Solar Radiation, Measurements of Solar Radiation, Solar Time (Local Apparent
Time), Solar Radiation Geometry, Solar Day Length, Empirical Equations for EstimatingSolar Radiation(Hourly Global, Diffuse and Beam Radiations) on Horizontal Surface Under
loudless and Cloudy Skies, Solar Radiation on Inclined Plane Surface only (empiricalrelations for numerical). Solar Thermal Systems: Solar Collectors: Flat plate and concentric collectors, Solar WaterHeater, Solar Passive Space - Heating and Cooling Systems, Solar Refrigeration and Air-Conditioning Systems, Solar Cookers, Solar Furnaces, Solar Green House, Solar Dryer, SolarDistillation (or Desalination of Water), Solar Photovoltaic Systems: Solar CellFundamentals, Solar Cell Characteristics, Solar Cell Classification, Solar Cell, Module, Paneland Array Construction, Solar PV Systems, Solar PV Applications.

MODULE III **(08 CLASSES)**

Wind Energy: Origin of Winds, Nature of Winds, Wind Turbine Siting, Major Applications ofWind Power, Wind Turbine Types and Their Construction, Wind Energy ConversionSystems (WECS), Effects of Wind Speed and Grid Condition (System Integration),Biomass Energy: Photosynthesis Process, Usable Forms of Biomass, their Composition andFuel Properties, Biomass Resources , Biomass Conversion Technologies, Urban Waste toEnergy Conversion, Biomass Gasification ,Biomass Liquefaction, Biomass to EthanolProduction, Biogas Production from Waste Biomass, Energy Farming.

MODULE IV **(08 CLASSES)**

Geothermal Energy: Applications, Origin and Distribution of Geothermal Energy, Types of Geothermal Resource.Ocean Energy: Tidal Energy, Wave Energy, Ocean Thermal Energy Fuel Cell Technology: Types, Principle of operation, Advantages and disadvantages.

BOOKS:

[1] Solar Energy Technology: Sukhatme and Nayak, TMH
[2] Renewable Energy Sources and Emerging Technology: D.P.Kothari and etal., PHI
[3] Renewable Energy Sources & Conversion Technology: N.K.Bansal, Manfred Kleenman&Michael Meliss, TMH Publication.
[4] Non Conventional Energy Sources: B.M Khan, TMH Publications
[5] Renewable Energy Sources:Fundamentals & Applications:G.N.Tiwari&M.K.Ghosal, NarosaPub
[6] Non-Conventional Energy Resources: D.S. Chauhan and S.K.Srivastava, New Age International
[7] Non-Conventional Energy Sources: H.P.Garg
[8] Non-Conventional Energy Systems: G.D.Rai, Khanna publications
[9] Renewable Energy, Godfrey Boyle, Oxford University Press

Digital Learning Resources:

NPTEL MOOCs:

Course Name:	Solar Energy Engineering and Technology
Course Link:	https://swayam.gov.in/nd1_noc20_ph14/preview
Course Instructor:	Prof. P Kalita, IIT, Guwahati.

5th Semester

PE 3: Rapid Manufacturing Process

MODULE – I **(14 HOURS)**

Product Development: Classification of manufacturing processes, Different manufacturing systems, Introduction to rapid Prototyping (RP), Need of RP in context to batch production, FMS and CIMand its application. Product prototyping – solid modeling and prototype representation, reverse engineering, prototyping and manufacturing using CNC machining. Basic principles of RP steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP

MODULE – II **(14 HOURS)**

Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors,Part building errors, Error in finishing, influence of build orientation. Classification of different RPtechniques based on raw materials, layering technique (2D or 3D) and energy sources.Process technology and comparative study of stereo lithography (SL) with photopolymerisation, SLwith liquid thermal polymerization, solid foil polymerization, selective laser sintering, selective powder binding, Ballastic particle manufacturing – both 2D and 3D, Fused deposition modeling, Shape melting

MODULE – III **(16 HOURS)**

Laminated object manufacturing solid ground curing, Repetitive masking and deposition. Beam interference solidification, Holographic interference solidification special topic on RP using metallic alloys, Programming in RP modelling, Slicing, Internal Hatching, Surface skin films, support structure. Software for RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.

BOOKS :

[1] Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press
[2] Introduction to Rapid Prototyping, Amitav Ghosh, North West Publication, New Delhi.
[3] Rapid Manufacturing, Flham D.T &Dinjoy S.S Verlog London 2001. \
[4] Rapid Prototyping Materials, Gurumurthi, IISc Bangalore.
[5] Rapid Automated, Lament wood. Indus press New York
[6] Stereo Lithography and other RP & M Technologies**,** Paul F. Jacobs: SME, NY 1996

Digital Learning Resources:

Course Name:	Rapid Manufacturing
Course Link:	https://nptel.ac.in/courses/112/102/112102284/
Course Instructor:	Prof. J Ramkumar, Prof Amardeep Singh, IIT Kanpur

5th Semester

PE 3: Finite Element Methods in Engineering

MODULE – I **(12 HOURS)**

Review of 2-D and 3-D stress analyses, vibration, fluid flow and heat conduction problems. FEM fundamental concepts, Variational principles, Rayleigh Ritz and Galerkin Methods. Finite Element Modeling of one dimensional problems. Finite Element Analysis of 2-D and 3-D framed structures.

MODULE – II **(12 HOURS)**

FEM formulation of 2-D and 3-D stress analysis problems. Axisymmetric solids subjected to axisymmetric loadings. Two-dimensional isoparametric elements and numerical integration.

MODULE – III **(12 HOURS)**

FE modeling of basic vibration problemsFinite element modeling of fluid flow and heat conduction problems Computer programs: preprocessing and post processing.Exposure to commercial FE codes such as ANSYS, NASTRAN and IDEAS etc.

TEXT BOOKS:

[1] Finite Elements in Engineering, T.R.Chandraputla and A.D.Belegundu, PHI
[2] The Finite Element Method – Its Basis & Fundamentals, Zienkiewicz, Taylor and Zhu, Elsevier, 6th Edn

[3] Introduction to Finite Element Method, C.Desai and J.F.Abel, CBS publishers
[4] Introduction to Finite Element Method, J.N.Reddy, Tata McGraw Hill
[5] Numerical Methods in Finite Element Analysis, K.J.Bathe and E.L.Wilson, PHI
[6] Concepts & Applications of Finite Element Analysis,Cook, D.S.Malkus&M.E.Plesha, Wiley
[7] The Finite Element Method in Engineering, S.S.Rao, Elsevier
[8] A First Course in the Finite Element Method, D.L.Logan, Cengage Learning
[9] Fundamentals of Finite Element Analysis, David V. Hutton, Tata McGraw Hill

Digital Learning Resources:

Course Name:	Basics Of Finite Element Analysis-I
Course Link:	https://nptel.ac.in/courses/112/104/112104193/
Course Instructor:	Prof. Nachikata Tiwari, IIT Kanpur

5th Semester

PC14: Basic Manufacturing Processes Lab

LIST OF EXPERIMENTS:

[1] Determination of grain size, clay content, permeability and green compressive strength of Moulding sand. (2 to 3 experiments)
[2] Foundry Practices
[3] Preparation of a wood pattern.
[4] Determination of strength of brazed and solder joints
[5] Practice and preparation of job in TIG/MIG welding
[6] Practice and preparation of job in sheet metal using processes like forming and deep drawing.
[7] Demonstration of different rolling mills
[8] Demonstration of Extrusion processes

5th Semester

PC15: Mechanisms and Machines Lab

LIST OF EXPERIMENTS:

[1] Design of any one working model related to Mechanisms and Machines, Module I &II.
[2] Design of any one working model related to Mechanisms and Machine, Module III &IV.
[3] Determination of gyroscopic couple using gyroscopic test rig.
[4] Performance characteristics of a spring loaded governor
[5] Determination of critical speed of rotating shaft
[6] Experiment on static and dynamic balancing apparatus
[7] Determination of natural frequencies of un-damped as well as damped vibratingsystems.
[8] Study of interference and undercutting for gear drives
[9] Experiment on Cam Analysis Apparatus.
[10] Experiment on evaluation of damping in a vibrating system

5th Semester

PC16: Heat Transfer Lab

LIST OF EXPERIMENTS:

[1] Determination of Thermal conductivity of composite slab
[2] Determination of heat transfer coefficient in natural/forced convention.
[3] Determination of surface emissivity
[4] Performance test on parallel flow and counter flow heat exchanger
[5] Efficiency and effectiveness of fins (Natural / Forced convection)
[6] Determination of Critical heat flux during boiling heat transfer.
[7] Verification of Stefan Boltzman's law.