NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Permanently Affiliated to JNTUK, Kakinada)
(Accredited by NAAC with "A" Grade and ISO 9001:2015 Certified Institution)
POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), VIJAYAWADA-PIN – 521212

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE FOR THIRD YEAR B.TECH PROGRAMME

III YEAR I – SEMESTER

S No	Course Code	Title of the Course	Scheme of Instruction (Periods per Week)			Total Contact Hours	Scheme of Examination (Maximum Marks)			No. of Credits
			Lecture	Tutorial	Practical		CIA	SEA	Total	
1	18A3103601 18A3103602	**Open Elective - II** 1. Introduction to Material Handling Equipment. 2. Introduction to Robotics	3	0	0	3	40	60	100	3
2	18A3103401	Design of Machine Elements–II	3	0	0	3	40	60	100	3
3	18A3103402	Dynamics of Machinery	3	0	0	3	40	60	100	3
4	18A3103403	Manufacturing Technology	3	0	0	3	40	60	100	3
5	18A3103404	Applied Thermodynamics	3	0	0	3	40	60	100	3
6	18A3103511 18A3103512 18A3103513 18A3103514	**Professional Elective - I** 1. Rapid Prototyping 2. Automation in Manufacturing 3. Hydraulic and Pneumatic Systems 4. Electric & Hybrid Vehicles	3	0	0	3	40	60	100	3
7	18A3100801	Indian Constitution	3	0	0	3	40	60	100	
8	18A3103491	Machine Tools Lab	0	0	2	2	40	60	100	1
9	18A3103492	Theory of Machines Lab	0	0	2	2	40	60	100	1
10	18A3103791	Minor Project (Design and Fabrication)	0	0	2	2	40	60	100	1
		Total	21	0	8	29	400	600	1000	
Total credits										**21**

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DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE FOR THIRD YEAR B.TECH PROGRAMME

III YEAR II – SEMESTER

S No	Course Code	Name of the Course	Scheme of Instruction (Periods per Week)			Total Contact Hours	Scheme of Examination (Maximum Marks)			No. of Credits
			Lecture	Tutorial	Practical		CIA	SEA	Total	
1	18A3203401	Heat Transfer	3	0	0	3	40	60	100	3
2	18A3203402	Operations Research	3	0	0	3	40	60	100	3
3	18A3203403	Finite Element Methods	3	0	0	3	40	60	100	3
4	18A3203301	Instrumentation & Control Systems	3	0	0	3	40	60	100	3
5	18A3203601 18A3203601	**Open Elective – III** 1. Mechatronics 2. Hydraulic and Pneumatic Systems	3	0	0	3	40	60	100	3
6	18A3203511	**Professional Elective - I**I 1. Computational Fluid Dynamics 2. Robotics 3. Non Destructive Evaluation 4. Introduction to Material Handling Equipment.	3	0	0	3	40	60	100	3
7	18A3200801	IPR and Patents	3	0	0	3	40	60	100	0
8	18A3203491	Heat Transfer Lab	0	0	2	2	40	60	100	1
9	18A3203491	Simulation Lab	0	0	2	2	40	60	100	1
		Total	21	0	6	27	400	600	1000	
Total credits										**20**

III B. Tech I Semester

Course Code:

INTRODUCTION TO MATERIAL HANDLING EQUIPMENT

(Open Elective – II)

Lecture – Tutorial:	**3 - 0 Hours**	**Internal Marks:**	**40**
Credits:	**3**	**External Marks:**	**60**

Prerequisites: NIL

Course Objectives:

1. The student will know the basic Fundamentals of Material Handling Equipment and control and safety measures incorporated on material handling equipments.
2. The student will identify and select the different handling equipments in industry.
3. The student will identify various components of material handling systems.
4. The student will know the working principles of Components of material handling systems like Flexible hoisting, hooks, elevators.
5. The student will know the working principles of Components of material handling systems like conveyors.
6. To know the operational features of various material handling system used in industries how to connect loading stations to the different discharge or unloading conditions

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic Fundamentals of Material Handling Equipment.
CO2	Identify, compare and select proper material handling equipment for specific applications.
CO3	Identify the various components of material handling systems.
CO4	Understand the working principles of Components of material handling systems like Flexible hoisting, hooks, elevators.
CO5	Understand the working principles of Components of material handling systems like conveyors.
CO6	Identify the surface transport to connect loading stations to the different discharge or unloading stations.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	1		1		1						
CO2	2	1		1		1						
CO3	2	1		1		1						
CO4	2	1		1		1						
CO5	2	1		1		1						
CO6	2	1		1		1						

UNIT I

Materials Handling Equipment: Introduction to material handling Equipment, Detail classification of MHE, Application and their selection. Criteria for selection of Material Handling Equipment's,

Factors effecting choice of material handling equipments: type of loads, hourly capacity, direction and length of travel, method of stacking at initial intermediate and final points-specific load conditions, Basic kind of material handling problems, Various methods to analyze material Handling problems, Economics of material handling systems.

UNIT II

Components of material handling systems: Flexible hoisting appliances such as welded chains, roller chains, hemp ropes, and steel wire ropes, fastening methods of wire and chains, Appliances for suspending hooks-crane grab for unit and piece loads.

Lifting Methods: Lifting tackles, lifting and rigging Load handling attachments Various types of hooks-forged, eye bolts, eye hook, electric lifting magnet, vacuum lifter, grabbing attachment for loose materials, crane attachment for handling liquids/ molten metal's.

UNIT III

Hoisting machinery and equipments: Working of different type of hoists such as lever operated hoist, portable hand chain hoist, differential hoist, worm geared and spur geared hoist, electric and pneumatic hoists.

Working of different types of cranes and Industrial Lifts: rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes and cranes traveling on guide rails. Introduction to types of Industrial Lifts.

UNIT IV

Conveying machinery: Working of traction type conveyors such as belt conveyors, chain conveyors, Working of traction less type conveyors such as gravity type conveyors, vibrating and oscillating conveyors, screw conveyors, monorail conveyors, pneumatic and hydraulic conveyors, hoppers, gates and feeders.

Surface transport equipment–functions–working of trackless equipment such as hand operated trucks, powered trucks, tractors, AGV (Automatic Guided vehicle), industrial trailers Function, working of cross handling equipment such as winches, capstans, turntables, transfer tables.

TEXT BOOKS:

1. Material Handling Equipment – N.Rundenko (Peace Publisher, Moscow)
2. Material Handling Equipment -M.P. Alexandrow (MIR Publishers, Moscow)
3. Material Handling Equipment -R.B. Chowdary & G.N.R.Tagore (Khanna Publishers, Delhi)
4. Plant layout & Material Handling-Apple J.M (John Wiley Publishers)

REFERENCE BOOKS:

1. Material Handling (Principles &Practice)-Allegri T.H (CBS Publisher, Delhi)
2. Material Handling -Immer J.R (McGraw Hill, Newyork
3. Material Handling Equipment-Parameswaran M.A (CDC in Mech. Engg., I.I.T. Chennai).

4.Conveyors and related equipments – Spivakovsy A.O. and Dyachkov V.K Volumes I and II (MIR publishers)

5.Boltzharol, A.,"Materials Handling Handbook", The Ronald press company 1958.

E-RESOURCES:

https://www.youtube.com/watch?v=3tTvVUfwchI
https://www.youtube.com/watch?v=guYD2zyUT6o
https://people.engr.ncsu.edu/kay/Material_Handling_Equipment.pdf
https://www.scribd.com/doc/222647028/Material-Handling-Full-Notes

III B. Tech I Semester

Course Code:

INTRODUCTION TO ROBOTICS

(Open Elective – II)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mathematics, Engineering Mechanics

Course Objectives:

1. Student will know the fundamental concepts of industrial robotic technology.
2. Student will be exposed to the various types of end effectors.
3. Student will apply the basic mathematics to calculate kinematic forces in robot manipulator.
4. Student will understand the robot controlling and programming methods.
5. Student will be in a position to describe various actuators, sensors.
6. Student will be aware of the various industrial applications of robots.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify various robot configurations.
CO2	Understand the basic components of robots.
CO3	Evaluate D-H notations for simple robot manipulator.
CO4	Perform trajectory planning for a manipulator by avoiding obstacles.
CO5	Select appropriate actuators and sensors for a robot.
CO6	Illustrate the industrial applications of robots.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3					1					2	
CO2	2		3								1	
CO3		3	2		1							
CO4		2	3									1
CO5	2	-	-	-	3						1	
CO6	2				3						1	

UNIT I

Introduction: Automation and robotics, Robot anatomy, robot motions, Joint notation schemes, work volume, speed of motions, load carrying capacity, Speed of response & stability, Precision of movement- Spatial resolution, accuracy, repeatability, compliance. Classification of robots by coordinate system and control system.

Components of the Industrial Robotics: Function line diagram representation of robot components, number of degrees of freedom, Types of end effectors, Mechanical grippers, gripper mechanisms, other types of grippers, Considerations in gripper selection and design.

UNIT II

Motion Analysis: Transformation matrices- Translation, Rotation, Combined translation and rotation, Homogeneous transformation matrix - Problems.

Manipulator Kinematics: Description of Link and Joint parameters, Kinematic modelling of the manipulator, D-H Notation, Kinematic relationship between adjacent links, Forward and Inverse kinematics. Differential kinematics

UNIT III

Trajectory Planning: Terminology, Steps in trajectory planning, Slew motion, joint integrated motion, straight line motion, circular motion, Joint space technique, Cartesian space technique, cubic polynomial with and without via points.

Robot Programming and Languages: Lead through programming, robot program as a path in space, WAIT, SIGNAL, DELAY commands, Branching, capabilities and limitations. Textual robot languages, generations, Language structure, Elements and functions.

UNIT IV

Robotic Actuators and Sensors: Pneumatic, Hydraulic actuators, electric & stepper motors, Internal &external sensors, Position, Velocity sensors, Tactile, Proximity and Range sensors.

Robot Applications in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection

TEXT BOOKS

1. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel,NicholasG.Odrey , Industrial Robotics – – Mc Graw Hill, 1986.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.

REFERENCE BOOKS:

1. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
2. H. Asada and J.J.E. Slotine, Robot Analysis and Control, 1st Edition Wiley- Interscience, 1986.
3. Robert J. Schillin, Fundamentals of Robotics: Analysis and control, Prentice-Hall Of India Pvt. Limited, 1996.
4. Mohsen shahinpoor, A robot Engineering text book, Harper & Row Publishers,1987.
5. John.J.Craig Addison, Introduction to Robotics: Mechanics and Control, Wesley, 1999.
6. K.S. FU, R.C. Gonzalez and C.S.G Lee, Robotics: Control, sensing, vision, and intelligence . Mc Graw Hill, 1987.
7. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

E-RESOURCES:

https://nptel.ac.in/courses/112/101/112101099/
https://nptel.ac.in/courses/112/101/112101098/
https://www.coursera.org/specializations/robotics

III B. Tech I Semester

Course Code:

DESIGN OF MACHINE ELEMENTS – II

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Mechanics of Materials, Design of Machine Elements-I

Course Objectives:

1. The student shall gain appreciation and understanding of the design and selection of bearings and chain drives.
2. Selection of proper gears based on their static, dynamic and wear load and check beam strength.
3. Learn and understanding the design procedure of different types of clutches and brakes and design flywheel.
4. Design procedure for the different machine elements such as connecting rod, crank shaft, piston and cylinder etc.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Estimate the bearing life and selection of suitable bearing.
CO2	Analyze and design of chain drive.
CO3	Analyze the forces, calculate the static and dynamic loads on gears.
CO4	Analyze and design of different types of clutches and brakes.
CO5	Analyze and design of flywheel.
CO6	Analyze and design of IC Engine components.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	2	1		1			2	2	2
CO2	3	3	3	2	1		1			2	2	2
CO3	3	3	3	2	1		1			2	2	2
CO4	3	3	3	2	1		1			2	2	2
CO5	3	3	3	2	1		1			2	2	2
CO6	3	3	3	2	1		1			2	2	2

UNIT I

Bearings: Sliding contact bearings: Classification and types of bearings- bearing materials - applications – bearing characteristic number and bearing modulus – Sommerfeld number – Coefficient of friction and heat dissipation of bearings – journal bearing design – properties of lubrication.

Rolling contact bearings: Types of ball and roller bearings – advantages and disadvantages over sliding contact bearings – static and dynamic equivalent load for roller bearings, bearing life – Reliability – Selection of ball bearings.

Chain Drive: Geometric relationships, polygonal effect, Design of chain drive.

UNIT II

Gears: Spur gears- Beam strength- Lewis equation – static, dynamic and wear tooth load– load– design analysis of spur gears – estimation of centre distance, module and face width, check for dynamic and wear considerations.
Helical gears: Virtual number of teeth, Force analysis, Beam strength – design analysis of helical gears.
Bevel gears: Force analysis, Beam strength, Wear strength, Effective load, Design of bevel gears.

UNIT III

Clutches, Brakes, Fly Wheel – **Clutches:** Torque transmitting capacity, Multi-disk clutches, cone clutch, friction materials.
Brakes: Energy equations, Block and Band brakes, Internal expanding brake.
Flywheel: Torque analysis, Design of solid disk and rimmed flywheel.

UNIT IV

Design of IC Engine Components: **Connecting Rod**: Thrust in connecting rod – stress due to whipping action on connecting rod ends – Design of crank shaft: strength and proportions of over hung and center cranks – crank pins.
Design of Piston: forces acting on piston – construction design and proportions of piston, **Design of cylinder**: cylinder liners and heads.

Note: Design data book is Permitted for examination

TEXT BOOKS

1. Design of Machine Elements/V.B. Bhandari/ McGraw Hill Publishers
2. Machine Design/ Shigley, J.E/McGraw Hill.

REFERENCE BOOKS:

1. Design of Machine Elements/V.B. Bhandari/ McGraw Hill Publishers
2. Machine design / NC Pandya & CS Shah/Charotar Publishing House Pvt. Limited
3. Machine design / Schaum Series/McGraw Hill Professional
4. Machine Design/ Shigley, J.E/McGraw Hill.
5. Design data handbook/ PSG
6. Design data handbook/Jalaludeen.
7. Design of machine elements-Spotts/Pearson Publications
8. Machine Design –Norton/ Pearson publishers

E-RESOURCES:

1. https://nptel.ac.in/courses/112105124/

2. https://www.youtube.com/watch?v=mzWMdZZaHwI&list=PL3D4EECEFAA99D9BE

III B. Tech I Semester

Course Code:
DYNAMICS OF MACHINERY

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mathematics, Engineering Mechanics, Kinematics of Machinery

Course Objectives:

1. To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
2. To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
3. To understand the principles in mechanisms used for speed control and stability control.
4. To understand the effect of Dynamics of undesirable vibrations.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze dynamic force analysis of slider crank mechanism.
CO2	Analyze and design a flywheel.
CO3	Compute balancing forces in systems with reciprocating and rotary masses.
CO4	Analyze the forces in governors.
CO5	Analyze stabilization of automobiles, airplanes and ships.
CO6	Estimate the effects of natural and forced undesirable vibrations.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1			1						1
CO2	3	2	1									1
CO3	3	2	1									1
CO4	3	2	1									1
CO5	3	2	1									1
CO6	3	2	1									1

UNIT I

Force Analysis

Static and Dynamic Force Analysis:
Static force analysis of mechanisms - D' Alembert's principle - Inertia force and inertia torque.
Dynamic Force Analysis - Dynamic Analysis of reciprocating engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque.

Flywheels - Turning moment diagrams - Flywheels of engines and punch press.

UNIT II

Balancing

Balancing of rotating masses - Static and dynamic balancing - Balancing of rotating masses single and multiple – single and different planes

Balancing of reciprocating masses: Balancing a single cylinder Engine - Primary and secondary unbalanced forces - Balancing Multi cylinder, inline and V-engines – Partial balancing in engines,

Locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

UNIT III

Mechanism For Control

Governors: Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Sensitiveness, isochronism and hunting Characteristics - Effect of friction - Controlling Force.

Gyroscope: Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Automobiles (two-wheeler and four-wheeler), Airplanes and Ships

UNIT IV

Vibrations

Single degree free vibrations,

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems. Forced vibrations

Response of one-degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

TEXT BOOKS

1. Theory of Machines / S.S Rattan/ Mc. Graw Hill
2. Mechanism and machine theory /Ashok G. Ambedkar/PHI Publications.
3. Sadhu Singh - 'Theory of Machines' - Pearson Education - 2011 - 3rd Edition
4. S. S. Rao - 'Mechanical Vibrations' - Pearson Education Inc. - 2011 - 5th Edition

REFERENCE BOOKS:

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
2. Theory of Machines / Shigley / MGH
3. Theory of Machines / Thomas Bevan / CBS Publishers
4. Theory of machines / Khurmi/S.Chand.
5. V. P. Singh, - 'Mechanical Vibrations' – Dhanpat Rai & Company Pvt. Ltd. - 2014 - 3rd Edition
6. W. T. Thomson and Marie Dillon Dahleh - 'Theory of Vibration with Applications' - Pearson Education - 2007 - 5th Edition

E-RESOURCES:

https://www.youtube.com/playlist?list=PL46AAEDA6ABAFCA78

https://nptel.ac.in/courses/112/104/112104114/

III B. Tech I Semester

Course Code:

MANUFACTURING TECHNOLOGY

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Manufacturing Process

Course Objectives:

1. To understand the concept and basic mechanics of metal cutting.
2. Study working of standard machine tools such as lathe, shaping and allied machines
3. To understand milling, drilling and allied machines, grinding and allied machines and broaching
4. To understand the basic concepts of non-traditional machining processes
5. To introduce students to the scientific principles underlying material behavior during manufacturing processes so as to enable them to undertake calculations of forces, tool stresses and material removal rates.
6. To introduce the fundamentals of digital manufacturing.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Upon completion of this course, the students will be able to understand and compare the functions and applications of different metal cutting tools.
CO2	Upon completion of this course, the students can able to apply the different metal removing ,finishing and super finishing and for component production
CO3	Learn the basic concepts of NTM.
CO4	Learn surface finishing techniques
CO5	Apply cutting mechanics to metal machining based on cutting force and power consumption
CO6	Get a basic knowledge on the importance of digital manufacturing.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2										
CO2	3		1		2							
CO3	3		2									
CO4	3		2									
CO5	3		2									
CO6	3		2		3							

UNIT I

Introduction : Manufacturing technology

Mechanics of Metal Cutting : Tool nomenclature ,Orthogonal and oblique cutting - Mechanism of metal removal,Mechanism of chip formation – Types of chips, need and types of chip breakers Analysis of cutting forces in orthogonal cutting– Work done, power required (simple problems) ,Friction forces in metal cutting – development of cutting tool materials

Thermal aspects of machining -Tool wear and wear mechanisms ,Factors affecting tool life

UNIT II

Lathe, Milling and Drilling Machine:
Lathe, types of lathes-special purpose lathes-kinematics arrangement of lathe, -work holding devices-types of milling machines-types of milling machine-schematic diagrams,-operations, milling cutters-mounting of cutters-Drilling machines-types-reaming and boring operations

UNIT III

Boring, Shaper, Slotter, Planer, Broaching:
Schematic diagram of boring machine, shaper, planer, slotting and broaching machine-operations tools. Grinding and allied finishing process. Forces, power consumption in machinery
Forces and power consumption in turning, drilling, milling and grinding, forces in up and down milling, chip thickness calculation.

UNIT IV

Introduction to Digital Manufacturing: Concepts and of digital manufacturing Definition of digital manufacturing – Features and development of digital manufacturing.
Theory system of digital manufacturing science: Operation Mode and Architecture of Digital Manufacturing System

TEXT BOOKS

1. Manufacturing processes for engineering material-KalpakJain.
2. Materials & processes in Manufacturing-DE Garmo Black Khoser.
3. Manufacturing process, P C Pandey
4. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited,2012

REFERENCE BOOKS:

1. Metal cutting principles , Oxford, Clarendon PressShaw M.C.,
2. Metal Cutting Theory and Practice, Bhattacharya A.
3. R.K. Jain , Production Technology /Khanna Publishers, 17thEdition, 2012.
4. Lindberg, Process and materials of manufacturing, PE.
5. Sarma P C, Production Technology, S Chand & Company Ltd, 3rdEdition, 2012.
6. Handbook of Metal forming ", Kurt Lunge ,McGraw Hill, Pub Co.

E-RESOURCES:
https://www.youtube.com/watch?v=TkaCddeEZEY
https://nptel.ac.in/courses/112/107/112107077/

III B. Tech I Semester

Course Code:

APPLIED THERMODYNAMICS

(Steam tables and Mollier chart are permitted)

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Basic Thermodynamics

Course Objectives:

1. To make the Student learn the basic knowledge of components being used in steam power plant cycle.
2. To familiarize the student with the various vapour cycle analysis along with their function and necessity.
3. To learn about analyze the energy transfers and transformations of vapour power plant cycle components including individual performance evaluation.
4. To make the Students learn to construct velocity triangles and to calculate power and efficiency of steam turbines.
5. To make the Students learn about different types of compressors and to calculate power and efficiency of reciprocating compressors.
6. To make the Students learn mechanical details and to calculate power and efficiency of rotary compressors.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe the components and functioning of a Rankine cycle
CO2	Analyze the need of various boiler draught systems for a vapor power cycle.
CO3	Apply thermodynamic analysis to study the behavior of steam nozzles.
CO4	Evaluate the performance of impulse, reaction turbines.
CO5	To Understand different types of condensers and its performance analysis.
CO6	Evaluate the performance of reciprocating, rotary and dynamic compressors.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2	1									
CO2	3	2	1									
CO3	3	2	2									
CO4	3	3	2									
CO5	3	2	1									
CO6	3	3	2									

UNIT I

Basic Layout of Steam Power Plant: Introduction, Rankine Cycle, Actual Vapour Power Cycle, Methods to improve efficiency of Rankine cycle, Reheating and Regeneration, Fuels used in power plant.

Steam Generators: Introduction, Boiler systems-Function and Classification, Fire Tube boilers-Cornish, Lancashire, Cochran, Water Tube boilers-Babcock and Wilcox, High pressure boilers-

Loeffler, lamont and Benson boilers, Boiler Mountings and Accessories. Performance of boilers.

UNIT II

Steam Nozzles: Introduction**,** Types of nozzle, Flow through nozzles- thermodynamic analysis, velocity of nozzle at exit, condition for maximum discharge, critical pressure ratio, Ideal and actual expansion in nozzle, velocity coefficient.

Steam Condensers: Introduction, Elements of a condenser plant, Types of Condensers- Jet condensers, Surface Condensers –working principle-vacuum efficiency and condenser efficiency.
Draught: Functions, Types -Height of chimney for given draught and discharge, Condition for maximum discharge, Efficiency of chimney, artificial draught- induced and forced.

UNIT III

Steam Turbines - Introduction, Classifications of steam turbines.

Impulse Turbines: Impulse turbine- Mechanical details, Working principle, Velocity triangles – effect of friction – power developed, axial thrust, blade or diagram efficiency -condition for maximum efficiency. De-Laval Turbine - its features. Methods used to reduce rotor speed.

Reaction Turbines: Introduction, Parson‘s reaction turbine, performance analysis, degree of reaction, velocity triangles, condition for maximum efficiency.

UNIT IV

Compressors– Introduction, Classification.

Reciprocating Compressors: Principle of operation, Work required, Isothermal efficiency, volumetric efficiency and Effect of clearance volume, Free Air Delivery, Multistage Compression. Condition for Minimum work.
Rotary Compressors: Roots blower and Vane‘s sealed compressor-principle of working and applications.
Centrifugal Compressors**:** Construction, Principle of operation –Energy transfer-velocity diagram
Axial Flow Compressors**:** Construction, Principle of operation – velocity triangles and energy transfer per stage, degree of reaction.

TEXT BOOKS

1.Thermodynamics and Heat Engines/ R.Yadav,Volume -II/ Central Publishing House
2. Mahesh.M. Rathore, Thermal Engineering,TMH,1st Edition, 2012.
3. R.K.Rajput, Thermal Engineering, Laxmi publications, 5th Edition, 2005.

REFERENCE BOOKS:

1. Thermal Engineering-P.L.Bellaney/ Khanna publishers.
2. T.D Eastop and A. McConkey, Applied Thermodynamics, Pearson 5th Edition 2013.
3. R. Yadav,Thermodynamics and Heat Engines,Vol-II,Central Book Depot,5th Edtn,1999.
4. R.S.Khurmi ,Thermal Engineering , S.Chand& Company, 1st Edition , 2012.
5. P.K Nag, Power Plant Engineering, TMH, 3rd Edition 2012.

E-RESOURCES:

1.https://nptel.ac.in/courses/112/103/112103277/

2.https://lecturenotes.in/subject/152/power-plant-engineering-ppe

III B. Tech I Semester

Course Code:

RAPID PROTOTYPING

(Professional Elective – I)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Computer Aided Design, Engineering Materials

Course Objectives:

1. Student will know the concept of Rapid Prototyping, classifications, models, specifications of various Rapid Prototype Techniques.
2. Student can understand the fundamentals of various Additive Manufacturing Technologies for application to various industrial needs.
3. Students will able to understand the method of manufacturing of liquid based, powder based and solid based techniques.
4. Student will be aware of the manufacturing procedure of a prototype using FDM technique.
5. Student will know the different tools, soft-wares required and the applications of Rapid Prototyping.
6. Student will be in a position to convert part file into STL format.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the fundamentals of Additive Manufacturing Technologies for engineering and industrial applications.
CO2	Understand the methodology to manufacture the products using SLA and SGC technologies and study their applications, advantages and case studies.
CO3	Understand the methodology to manufacture the products using LOM and FDM technologies and study their applications , advantages and case studies
CO4	Understand the methodology to manufacture the products using SLS and 3D Printing technologies and study their applications, advantages and case studies.
CO5	Evaluate performance of the different types of rapid tools using in RP technologies.
CO6	Evaluate the different types of STL formats, and other Translators.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2				1					
CO2	3	2	3									
CO3		3	2									
CO4	3	3	2									
CO5	3	3	2				2					
CO6	3	3	2		2							

UNIT I

Introduction: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, differences between traditional processes and additive manufacturing production, classification of RP process. RP Applications in engineering.

Liquid-Based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering

technology, laser and laser scanning, applications, advantages and disadvantages, case studies.
Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT II

Solid-Based Rapid Prototyping Systems: Laminated object manufacturing (LOM) – models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Fused Deposition Modeling (FDM) – models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Direct metal deposition (DMD): working principle, Process, applications, advantages and disadvantages, Case study

UNIT III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Three Dimensional Printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Materials of RP Technology: Photo sensitive Resin, Wax etc.

UNIT IV

Rapid Tooling: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Kel tool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

Rapid Prototyping Data Formats: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats, Features of various RP software's.

TEXT BOOKS

1. Rapid prototyping: Principles and Applications – Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.
2. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.
3. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
4. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011

REFERENCE BOOKS:

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
2. Wholers Report 2000 – Terry Wohlers, Wohlers Associates.
3. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press.
4. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
5. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001
6. Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000
7. Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996
8. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

E-RESOURCES:

1.https://www.coursera.org/learn/3d-printing-revolution/home/welcome
2. http://asmedl.aip.org/Manufacturing/
3.file:///F:/RP/Direct%20Metal%20Deposition.pdf

III B. Tech I Semester

Course Code:

AUTOMATION IN MANUFACTURING

(Professional Elective – I)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Course Objectives:

1. To study the types and strategies and various components in Automated Systems.
2. To understand the automated flow lines, line balancing, material storage and retrieval and inspection.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand automation principles, strategies and types of automation.
CO2	Understand methods and equipment's used for inspection in an automated industry.
CO3	Understand transfer lines, automated flow lines and analyze transfer lines with and without buffer storage.
CO4	Solve the assembly line balancing problems in the various flow line systems.
CO5	Understand the different automated material handling, storage and retrieval systems and automated inspection systems.
CO6	Explain adaptive control principles and implement the same online inspection and control.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2									
CO2	3	2	3									
CO3		3	2									
CO4	3	3	2									
CO5	3	3	2									
CO6	3	3	2									

UNIT I

Introduction: Principles and Strategies of Automation, automation in machine tools, mechanical feeding and tool changing and machine tool control, levels of automations-Five levels of automation and control in manufacturing.

Automated Inspection: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision.

UNIT II

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations.
Analysis of automated flow lines – General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.
Assembly System And Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT III

Automated Material Handling And Storage Systems:
Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems.
Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.
Automatic Identification Methods-Overview of Automatic Identification Methods, Bar Code Technology, Radio Frequency Identification, Other AIDC Technologies.

UNIT IV

Adaptive Control Systems: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations.
Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

TEXT BOOKS

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover./ PE/PHI.

REFERENCE BOOKS:

1. Computer Control Of Manufacturing Systems By Yoram Coren.
2. Cad / Cam/ Cim By Radhakrishnan.
3. Automation By W. Buekinsham.

E-RESOURCES:

https://nptel.ac.in/courses/112/103/112103293/

https://nptel.ac.in/courses/112/104/112104288/

III B. Tech I Semester

Course Code:

HYDRAULIC AND PNEUMATIC SYSTEMS

(Professional Elective – I)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fluid Mechanics and Hydraulic Machinery

Course Objectives:

1. Familiarize on Fluid Power Engineering and Power Transmission System.
2. Introduce the students, the basic concepts of hydraulic and pneumatic systems.
3. Expose the students with various hydraulic and pneumatic actuators.
4. Familiarize on fluid power systems and its applications to real time.
5. Know the problem, which occur in fluid power systems and take necessary troubleshooting/ maintenance activities.
6. Get practiced in designing hydraulic and pneumatic systems.
7. Understand the design procedure available for Hydraulic and Pneumatic circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Explain the concepts of fluid power, its types, advantages, applications of fluid power systems and compare mechanical, electrical, hydraulic and pneumatic systems.
CO2	Explain the basic working principles of the hydraulic pumps and actuators, types of pumps-actuators, explain the design considerations of pumps, actuators and select the valves for hydraulic circuits.
CO3	develop the hydraulic circuits for practical applications, create circuits for various machines, select the size of the accumulators and explain the working principles of safety circuits
CO4	explain the fundamental concepts of pneumatic systems, list the properties of air for pneumatic system, demonstrate on F-R-L unit
CO5	identify various control elements in pneumatic system, develop electro pneumatic and electro hydraulic circuits for robotic applications, design a pneumatic circuit using classic, cascade and step counter methods
CO6	select pneumatic components for installation and maintenance of power packs, explain the architectures of PLC and Microprocessors, develop logical circuits in PLC for automation and determine the faults in fluid power systems

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	2	1	2							
CO2	3	2	1	1	2							
CO3	1	3	2	2	1							
CO4	3	3	2	2	1							
CO5	3	3	2	1	2							
CO6	3	3	3	2	1							

UNIT I

Fluid Power Principles And Hydraulic Pumps:

Introduction to fluid power - Types, advantages and application of fluid power systems. Properties of hydraulic fluids terminologies used in fluid power

Basic of Hydraulic and Pneumatic Systems. Comparison of Mechanical, Electrical, Hydraulic & Pneumatic systems for force and motion analysis in automation.

UNIT II

Oil Hydraulic Pumps, Actuators: Introduction-hydraulic actuators-hydraulic cylinders- Types of hydraulic pumps- construction and working principle - design considerations, selection, specifications and characteristics of pumps. Types of actuators-construction and working principle - design considerations, selection, specifications and characteristics of actuators.

Control and Regulation Elements: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for hydraulic circuits.

UNIT III

Design of Hydraulic Circuits: Speed control circuits - Regenerative circuits- Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier–Intensifier circuit. - Reservoir design - Selection of components. Hydraulic circuits - Reciprocating - Quick return - Sequencing synchronizing - Safety circuits - Industrial circuits - Press - Milling Machine - Planner - Fork Lift.

UNIT IV

Pneumatic Systems: Pneumatic fundamentals - Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Control Elements - Logic Circuits -Position - Pressure Sensing - Switching – Electro Pneumatic - Electro Hydraulic Circuits - Robotic Circuits.

Design of Pneumatic Circuits: Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors -Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation.

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R, “Oil Hydraulics”, Tata McGraw Hill, 2000.
3. Majumdar S.R, “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2001.
4. Introduction to Hydraulics and Pneumatics by S. Ilango and V. Soundararajan, PHI , New Delhi.

REFERENCE BOOKS:

1. Andrew Parr, Hydraulic & Pneumatics, 2/e, Jaico Publishing House Elsevier, 1999.
2. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987
3. Harry L. Stevart D.B, “Practical Guide to Fluid Power”, Taraoeala Sons and Port Ltd. Broadey, 1976
4. Oil Hydraulic Systems, S.R .Majumdar, McGrawHill Companies.
5. Pneumatic Systems: Principles and Maintenance, Majumdar, Mc Graw Hill.
6. Applied hydraulics and pneumatics-T. Sunder Selwyn & R. Jayendiran, Anuradha Publications.

E-RESOURCES:

https://www.youtube.com/watch?v=8xd7cWvMrvE

III B. Tech I Semester

Course Code:

ELECTRIC AND HYBRID VEHICLES

(Professional Elective – II)

Lecture – Tutorial:	3-0	Internal Marks:	40
Credits:	3	External Marks:	60

Prerequisites:

Electrical and Electronics Engineering

Course Objectives: The student will

1. Learn about the importance of electric and Hybrid vehicles.
2. Understand working of different configurations of electric vehicles and hybrid vehicles
3. Understand the properties of batteries and its types.
4. Understand the drive systems used in electric and Hybrid vehicles.
5. Recall and understand the fundamentals of power electronics.
6. Learn the concepts of electronics used in hybrid vehicles

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Acquire basic knowledge of electric and hybrid vehicles.
CO2	Describe the configurations and working principles of electric and hybrid vehicles.
CO3	Identify the various energy resources used for hybrid vehicles.
CO4	Choose the suitable drive systems for electric vehicles.
CO5	Describe the fundamentals of power electronics.
CO6	Apply the concept of power electronics for hybrid vehicles.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1									1		
CO2	1	2										
CO3	1	2										1
CO4	1	2										1
CO5	1	2										
CO6	1	2										1

UNIT I

Introduction to hybrid vehicles- History of electric vehicle, history of hybrid electric vehicle, history of fuel cell vehicle, advantages and limitations, air pollution and global warming, Electric vehicle drive train: EV transmission configurations, transmission components, ideal gearbox, types of hybrid electric vehicles.

UNIT II

Energy sources for hybrid vehicles

Battery: principle and types, Li-ion battery, ultra-capacitor, fuel cells: operating principles of PAFC, PEM, MCFC, SOFC, DMFC, PCFC, ZAFC, Alkaline and Regenerative cells.

UNIT III

Electric machines for hybrid vehicles

Permanent magnet synchronous motor, switched reluctance motor, induction motor, permanent magnet brushless DC motor, regenerative braking system.

UNIT IV

Power electronics for hybrid vehicles: Introduction to digital and Analog Inputs, Basic switches: diode, power transistor, power MOSFET, inverters, charging of hybrid electric vehicle.

TEXT BOOKS

1. Iqbal Husain, ELECTRIC and HYBRID VEHICLES, Design Fundamentals,CRCPress,2003.
2. MehrdadEhsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press,2015.

REFERENCE BOOKS:

1. SandeepDhameja, "Electric Vehicle Battery System
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles

E-resources:

https://swayam.gov.in/courses/-electric-vehicles

III B. Tech I Semester

Course Code:

THEORY OF MACHINES LAB

Lecture – Tutorial- Practical:	0-0-2	**Internal Marks:**	40
Credits:	1	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mechanics.

Course Objectives:

1. To understand and impart hands-on practical exposure on different types of assemblies and linkages used in machine parts.
2. To understand the principles of gyroscope and governors.
3. To determine the balancing of masses of rotating machine elements.
4. To determine the moment of inertia of various mechanical systems.
5. To familiarize higher pairs like cams and gears
6. To understand the vibrational behavior of systems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	To analyze the forces and motion of complex systems of linkages, gears and cams.
CO2	To apply the principles of gyroscope and governors.
CO3	To apply the principles of balancing of masses to various links, mechanisms and engines.
CO4	To demonstrate the dynamics of flywheel and their motion.
CO5	To analyze the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO6	To perform balancing, vibration and critical speeds with respect to Machine dynamics.

Contribution of Course Outcomes towards achievement of Program Outcomes

(1– Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	2	-	-	-	-	-	-	-	-
CO2	3	2	-	2	-	-	-	-	-	-	-	-
CO3	3	2	-	2	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-	-	-
CO6	3	2	-	2	-	-	-	-	-	-	-	-

List of Experiments:

1. To determine whirling speed of shaft theoretically and experimentally
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor
3. To analyze the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system

5. To determine the frequency of damped force vibration of a spring mass system
6. To analyze the static and dynamic balancing using rigid blocks
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems
9. To find coefficient of friction between belt and pulley
10. Simulation and study of four bar mechanisms.
11. Simulation and study of slider crank mechanisms.
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears.

(Any TEN of the above experiments are to be covered)

EQUIPMENT REQUIRED:

Whirling of Shaft Apparatus, Universal Governor Apparatus, Motorized Gyroscope, Universal Vibration Apparatus, Static & Dynamic Balancing Apparatus, Inertia of a Flywheel Apparatus, Cam Analysis Apparatus, and Apparatus for Determination of Co-efficient of Friction Between Belt & Pulley.

REFERENCE BOOKS:

1. Rattan, "Theory of machine", Tata McGraw-Hill Publishing Co. Ltd, New Delhi
2. P. Ballaney, "Theory of machine", Khanna Publication, New Delhi
3.Thomas Beven, "Theory of machine", C B S Publisher
4. Shigley and Vicker, "Theory of machine", McGraw-Hill Publishing Co. Ltd, New Delhi
5. J. S. Rao & R. V. Dukkipati, Mechanism & Machine Theory, New Age Publication.
6.Theory of Machines by Dr. Sadhu Singh Pearson Education.
7. Theory or Mechanisms and Machines by Amitabh Ghosh and A. Kumar Mallik.

E-RESOURCE:

http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

III B. Tech I Semester

Course Code:
MACHINE TOOLS LAB

Lecture – Tutorial- Practical:	0-0-2	**Internal Marks:**	40
Credits:	1	**External Marks:**	60

Prerequisites:
Metal cutting and Machine Tools
Course Objectives:
1. To understand the usage of different lab equipment. 2. Know the working principles of different instruments. 3. Familiarize different machine tools used in production floor. 4. Impart hands on experience on different types of lathe 5.To learn the handling of drilling, shaping, milling, slotting, 6. To operate grinding and tool and cutter grinding machines.

Course Outcomes:	
Upon Successful Completion of the Course, The Student will be able to:	
CO1	Apply The Procedures To Measure Length, Width, Depth, Bore Diameters, Internal And External Tapers, Tool Angles, And Surface Roughness By Using Different Instruments
CO2	Measure Effective Diameter Of Thread Profile Using Different Methods
CO3	Conduct Different Machine Alignment Tests
CO4	Demonstrate Knowledge Of Different Machine Tools Used In Machine Shop
CO5	Perform Step, Taper Turning, Knurling And Threading.
CO6	Produce Stepped Surface Using Shaper And Keyway Using Milling Machine.

Contribution of Course Outcomes towards achievement of Program Outcomes

(1– Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2	2		2				1	1		
CO2	3		2		2				1	1		
CO3	3		2		2				1	1		
CO4	3		2		2				1	2		
CO5	3		2		2				1	2		
CO6	3		2		2				1	2		

List of Experiments:

1. Introduction of General Purpose Machines
2. Step Turning and Taper Turning on Lathe
3.Thread Cutting and Knurling on Lathe Machine
4. Drilling and Tapping
5. Shaping and Planning
6. Slotting
7. Milling
8. Cylindrical Surface Grinding
9. Grinding of Tool Angle
10. Surface Grinding
11. Wood Turning Lathe
12. CNC Xl Turn
13. CNC Xl Mill

(Any TEN of the above experiments are to be covered)

EQUIPMENT REQUIRED:
Lathe machine, drilling machines, shaping, slotting, turning machines, CNC machines
REFERENCE BOOKS:
1. Manufacturing processes for engineering material-KalpakJain. 2. Materials & processes in Manufacturing-DE Garmo Black Khoser. 3. Manufacturing process, P C Pandey 4 Manufacturing Technology, Vol. 2 Metal Cutting and Machine Tools May 2013 5. Machining and Machine Tools Paperback A.B. Chattopadhyay (Author)
E-RESOURCES: http://www.machineryresources.com

III B. Tech II Semester

Course code-
HEAT TRANFER

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Thermodynamics

Course Objectives:

1. Student will be aware of various modes of heat transfer.
2. Student will be exposed to different types of fins.
3. Student will be aware of the concepts related to boundary layer theory and dimensional analysis.
4. Student will know about free and force convection.
5. Student will be in a position to classify heat exchangers.
6. Student will be exposed to the law of radiation.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Explain the basic heat transfer principles.
CO2	Analyze study and unsteady state heat transfer concepts.
CO3	Evaluate the rate of heat transfer from a finned surface.
CO4	Explain convective heat transfer in natural and forced convection for both internal and external flow.
CO5	Apply the concepts of heat transfer in Boiling and Condensation.
CO6	Evaluate the radiation heat exchange between the surfaces and know the significance of radiation shields.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2			2						2	
CO2	3	3	2	3	1							
CO3	3	2	3		2							
CO4	2	3		2							1	
CO5	3	3	3		2							
CO6	3	2	3		2						1	

UNIT I

Introduction: Modes and mechanisms of heat transfer – basic laws of heat transfer –General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier law of heat conduction – General heat conduction equation in cartesian, cylindrical and Spherical coordinates. Steady and Un-steady state heat transfer- initial and boundary conditions, Empirical relations.

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres – electrical analogy – critical radius of insulation- Variable thermal conductivity – systems with heat sources or heat generation.

UNIT II

Extended surface (fins) heat Transfer: Analysis of long fin and short fin with insulated tip- fin efficiency and effectiveness – Application to error measurement of temperature.
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – lumped heat analysis – significance of biot and fourier numbers - chart solutions of transient conduction systems.
Convective Heat Transfer: Classification of convective heat transfer – significance of non-dimensional numbers – dimensional analysis – Buckingham pi theorem applied to force and free convection.

UNIT III

Forced Convection:
External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -flat plates and cylinders.
Internal Flows: Concepts about hydrodynamic and thermal entry lengths – division of internal flow based on this –use of empirical relations for horizontal pipe flow and annulus flow.
Free Convection: Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and pipes.
Heat Transfer With Phase Change:
Boiling: Pool boiling, regimes – Critical heat flux.
Condensation: Film wise and drop wise condensation – laminar film wise condensation on a vertical plate

UNIT IV

Heat Exchangers:
Introduction – Classification of heat exchangers – overall heat transfer coefficient and fouling factor – concepts LMTD and NTU methods – problems.
Radiation Heat Transfer: Introduction – Nature of thermal radiation – absorption, reflection and transmission – concepts of black body – laws of black body radiation – radiation from non black surfaces – emissivity – kirchoff law – radiation heat exchange between two black isothermal surfaces - shape factor – heat exchange between non black infinite parallel plate – radiation shields.

Data Hand Book:
1. C.P. Kothandaraman and Subramanian Heat and Mass Transfer Data Book, New Age International Publications, 7th Edition, Reprint 2012

NOTE: Heat and Mass Transfer Data Hand Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

TEXT BOOKS

1. R.C.Sachdeva - Fundamentals of Engineering Heat and Mass Transfer —New Age Science Publishers, 3rd Edition, 2009.
2. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria& Sons**.**

REFERENCE BOOKS:

1. Yunus. A. Cengel, Heat & Mass Transfer-A Practical Approach – Tata McGraw Hill, 4th Edition, 2012.
2. M.NecatiOzisik, Heat Transfer- A basic Approach,4th Edition, McGraw-Hill book company, 1985.
3. J.P.Holman, Heat transfer - Tata McGraw-Hill, 9th Edition, 2010.
4. P.K.Nag, Heat and Mass Transfer- TMH 2nd Edition, 2007.

E-RESOURCES:
https://nptel.ac.in/courses/112/101/112101097/

https://www.coursera.org/lecture/thermodynamics-intro/02-04-heat-transfer-gyDfJ

III B. Tech II Semester

Course code-

OPERATIONS RESEARCH

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Course Objectives:

1. To impart the basic concepts of modeling models, and statements of the operations research. formulate and solve LPP
2.To solve Transportation and Assignment, sequencing problems to minimize the cost
3. Apply queuing theory to solve the problems of Traffic congestion and counters in banks in etc.. and Game theory to solve different games.
4. To acquire the knowledge on Inventory methods and solution of LPP through Dynamic programming

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Formulate and solve the problems using LPP using different methods
CO2	Find the appropriate times to replace items individually and as a group
CO3	Formulate and solve Transportation, Assignment , sequencing problems
CO4	Formulate and solve the problems having saddle and without saddle points
CO5	Solve the queuing problems using different methods
CO6	Solve different problems related to inventory maintenance, apply Dynamic programming methods

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	--	--	--	--	--	--	--	--
CO2	3	3	2	2	--	--	--	--	--	--	--	--
CO3	3	3	2	2	--	--	--	--	--	--	--	--
CO4	3	3	2	2	--	--	--	--	--	--	-	--
CO5	3	3	2	2	--	--	--	--	--	--	-	--
CO6	3	3	2	2	--	--	--	--	--	--	--	--

UNIT I

Development – Definition-characteristics – phases-applications of Operations Research.
Linear Progrmamming –formulation-Graphical Method, Simplex Method –Artificial Variable Technique- Two Phase Method –Big-M method – Duality Principle
Replacement Problems – Introduction – Replacement of Items that Deteriorate with time – When money value is not counted and counted – Replacement of items that fails completely, group replacement.

UNIT II

Transportation Problem – formulation – North west corner rule – Least cost method –Vogel's approximation –Modi method –unbalanced transportation problem – Degeneracy
Assignment Problem – formulation –Hungarian method - Travelling Salesman Problem
Sequencing Problem – Introduction-n-jobs,2-machines,n-jobs, 3-machines

UNIT III

Theory of Games – Introduction - Minimax and Maximin Criteria- Optimal Stratagies – Solution of

Games with Saddle Point- solution of Games without saddle points-Algebraic Method – Graphical Method(mx2,2xn methods) , dominance principle.

Waiting lines- Introduction – single channel- poisson arrivals - exponential service times - - with infinite population and finite population models – Multi channel - poisson arrivals – exponential service times with infinite population single channel poisson arrivals

UNIT IV

Inventory – Introduction- single item- deterministic models – Demand may be Discrete or continuous variable instantaneous production – instantaneous demand and continuous demand and set up cost – shortages are not allowed- purchase of inventory with one price break and multiple price breaks.

Dynamic Programming – Introduction – Bellman's principle of optimality – applications – linear programming problem

TEXT BOOKS:

1. OpeartionsResearch , S.D.SHARMA 15th Edition, Kedarnadh Ramnadh publications
2. Opeartions Research, TAHA H.A 9th edition Prentice Hall of India New Delhi

REFERENCE BOOKS:

1. Opeartions Research by PannerSelvam .R , 2nd edition, Prentice Hall of India New Delhi
2. Opeartions Research by P.K.Guptha and HIRA 3rd edition S.chand Company Limited

E-RESOURCES:

1. http://www2.informs.org/Resources/
2. http://www.mit.edu/~orc/
3. http://www.ieor.columbia.edu/
4. http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
5. http://www.wolfram.com/solutions/OperationsResearch/

III B. Tech II Semester

Course code-

INSTRUMENTATION AND CONTROL SYSTEMS

Lecture – Tutorial:	3 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Course Objectives:

1. The student will understand the Basic Principles of Instrumentation, Control System and measuring instruments like displacement and stress strain devices.
2. The student will understand the various temperature, pressure and humidity measuring devices.
3. The student will understand the various speed, acceleration and vibration measuring devices.
4. The student will understand the various forces, torque, power measuring devices.
5. The student will understand the various liquid level and flow measuring device.
6. The student will understand the various elements of control systems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Define basic concepts of different measuring instruments.
CO2	Choose appropriate devices for measuring of deferent physical parameters.
CO3	Classify different measuring instruments.
CO4	Compare various measuring devices.
CO5	Analyze various liquid level and flow measuring devices.
CO6	Develop various elements of control systems

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3									1		
CO2	3	2	2	3						1		
CO3	3			1						1		
CO4	3	3	3	2						1		
CO5	3	3	2							1		
CO6	3	2	2	1						1		

UNIT I

Basic Principles of Instrumentation and Control System

Definition – Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.

Stress Strain Measurements : Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes

UNIT II

Measurement of Temperature: Classification – ranges – various principles of measurement –expansion,

electrical resistance – thermister – thermocouple – pyrometers – temperature indicators.
Measurement of Humidity: Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter
Measurement of Pressure: Units – classification – different principles used. manometers, piston, bourdon pressure gauges, bellows – diaphragm gauges. Low pressure measurement – thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT III

Measurement of Speed : Mechanical tachometers – electrical tachometers – stroboscope, noncontact type of tachometer
Measurement of Acceleration and Vibration: Different simple instruments – principles of seismic instruments – Vibrometer and accelerometer using this principle.
Measurement of Force, Torque and Power: Elastic force meters, load cells, torsion meters, dynamometers

UNIT IV

Measurement of Level: Direct method – indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators.
Flow Measurement: Rotameter, magnetic, ultrasonic, turbine flow meter, hot – wire anemometer, laser Doppler anemometer (LDA).
Elements of Control Systems : Introduction, importance – classification – open and closed systems, basic elements of feedback system, classification of feedback control system, error detector, servomechanisms– examples with block diagrams–temperature, speed & position control systems

Text Books:
1. Measurement Systems: Applications & design / D.S Kumar/
2. Mechanical Measurements / Beckwith, Marangoni, Linehard, Pearson
References:
1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra&K.K.Choudhary/TMH

E-RESOURCES:
Video in web: http://nptel.ac.in/courses/112104114/

Video in web: https://youtu.be/OlZXxPVpmBs

Notes in web: http://www.vssut.ac.in/lecture_notes/lecture1429901026.pdf

III B. Tech II Semester

Course code-

FINITE ELEMENT ANALYSIS

Lecture - Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mechanics

Course Objectives:

1. Introduce concepts of theory of elasticity.
2. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis.
3. To understand the basics of finite element formulation.
4. To introduce domain discretization,polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Apply the knowledge of Mathematics and Engineering to solve problems in structural engineering by approximate and numerical methods.
CO2	Identify the application and characteristics of FEA elements such as bars, trusses, beams, plane and isoparametric elements.
CO3	To use the techniques, skills, and modern engineering tools necessary for engineering practice.
CO4	Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
CO5	Design a new component or improve the existing components using FEA
CO6	Solve real life problems using finite element analysis.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	2	1	2	-	-	-	-	-	-	-	-
CO2	-	3	1	2	-	-	-	-	-	-	-	-
CO3	-	2	-	-	3	-	-	-	-	-	-	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	-
CO6	-	2	-	3	-	-	-	-	-	-	-	-

UNIT I

Theory of Elasticity & Functional Approximating Methods:

Introduction to Theory of Elasticity: Definition of stress and strain – plane stress – plane strain – stress strain relations in three dimensional elasticity.

Introduction to Variational Calculus: Variational formulation in finite elements – Ritz method – Weighted residual methods – Galerkin – sub domain – method of least squares and collocation method - numerical problems

One Dimensional Problems: Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions. Steady

state heat transfer analysis : one dimensional analysis

UNIT II

Analysis of Trusses: Finite element modelling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT III

Two Dimensional Problems: Finite element modelling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions,

Higher order and isoparametric elements: Two dimensional four noded isoparametric elements and numerical integration.

Axisymmetric Problems: Formulation of axisymmetric problems**.**

UNIT IV

Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.Steady state heat transfer analysis: one dimensional analysis of a fin.

Introduction to FE software.

TEXT BOOKS:

1. An introduction to Finite Element Method / JN Reddy / McGraw Hill
2. The Finite Element Methods in Engineering / SS Rao / Pergamon.

REFERENCE BOOKS:

1. Tirupathi R. Chandrupatla and Ashok D. Belugundu (2011) Introdution to Finite Elements in Engineering, Prentice Hall.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Zienkiewicz O.C., Taylor R.L., Zhu J.Z. (2011), The Finite Element Method: Its basis and fundamentals, Butterworth Heinmann.

E-RESOURCES:

https://nptel.ac.in/courses/112/104/112104193/

III B. Tech II Semester

Course code-

MECHATRONICS
(Open Elective – III)

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mathematics, Electronic Devices and Circuits, Digital Electronics

Course Objectives:

1. Student will be able to Introduced to integrative nature of Mechatronics.
2. Student will be exposed to the various types of sensors and transducers.
3. Student will understand the fundamentals of solid state electronic devices.
4. Student will design various Hydraulic and Pneumatic circuits.
5. Student will apply basics of digital electronics for various applications of logic gates.
6. Student will relate different logic gates and their role in Programmable logic controllers.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe mechatronics system and their elements and levels
CO2	Differentiate various sensors and transducers
CO3	Understand solid state electronic devices, analog signal conditioning
CO4	Demonstrate hydraulic and pneumatic actuating systems
CO5	Understand Digital electronics and Logic gates
CO6	Explain micro controllers and applications of PLC

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2	3											
CO3	3											
CO4	2		2		2							
CO5	3											
CO6	2				2							

UNIT I

Introduction: Definition of Mechatronics, Elements & Levels of Mechatronics system, mechatronics design process, System, Measurement System, Control system, Types of control system, Advantages and disadvantages of mechatronics systems

Sensors and Transducers : Static and Dynamic characteristics of Transducers, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and lightsensors.

UNIT II

Solid state Electronic Devices: PN junction diode, BJT, FET, DIAC, TRIAC and LEDs. Analog signal conditioning - operational amplifiers, noise reduction, types of filters.

Process Controllers: Controller principle, Two-position, Proportional, Integral, Derivative, PI, PD &PID controllers

UNIT III

Hydraulic and Pneumatic Actuating Systems: Fluid systems, Hydraulic systems, and pneumatic systems, Comparison of hydraulic and pneumatic systems, components, control valves, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits

Digital Electronics and Systems: Digital logic control, Numbering system, Boolean algebra, Logic gates, Karnaugh maps, Applications of logic gates.

UNIT IV

Microcontrollers and Programmable Logic Controllers: Architecture of Microprocessor, Microcontroller, Basic structure of a PLC, PLCs versus Computers, PLC Programming using ladder diagrams, logics, latching, sequencing, timers, relays and counters,

Dynamic models and analogies: Mechanical, Electrical, fluid and thermal systems, Pneumatic and Hydraulic systems.

TEXT BOOKS

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran, GK Vijaya Raghavan & MS Balasundaram/WILEY India Edition
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, WBolton, 3/e Pearson Education Press, 2005.

REFERENCE BOOKS:

1. Devadas Shetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010.
2. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2004.
3. Mechatronics, Robert H Bishop, CRC Press, 2005.
4. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005.
5. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010.
6. Mechatronics – Principles and Application / Godfrey C. Onwubolu/Elsevier, Indian print
7. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
8. Mechatronics /Smaili A, Mrad F/ Oxford Higher Education, Oxford University Press

E-RESOURCES:

1. https://mechatronics.colostate.edu/
2. https://nptel.ac.in/courses/112/103/112103174/
3. https://www.youtube.com/watch?v=6THmFjnmvVY&list=PLbjTnj-t5GklbeqS8OMMJBrTl3DdeNn3t
   https://www.youtube.com/watch?v=br-ezdmEq7A&list=PLHjz__UC2bJ17NfqG8wJ_lyvGZ4NMbdQ9

III B. Tech II Semester

Course Code:

HYDRAULIC AND PNEUMATIC SYSTEMS

(Open Elective – III)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fluid Mechanics and Hydraulic Machinery

Course Objectives:

1. Familiarize on Fluid Power Engineering and Power Transmission System.
2. Introduce the students, the basic concepts of hydraulic and pneumatic systems.
3. Expose the students with various hydraulic and pneumatic actuators.
4. Familiarize on fluid power systems and its applications to real time.
5. Know the problem, which occur in fluid power systems and take necessary troubleshooting/ maintenance activities.
6. Get practiced in designing hydraulic and pneumatic systems.
7. Understand the design procedure available for Hydraulic and Pneumatic circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Explain the concepts of fluid power, its types, advantages, applications of fluid power systems and compare mechanical, electrical, hydraulic and pneumatic systems.
CO2	Explain the basic working principles of the hydraulic pumps and actuators, types of pumps-actuators, explain the design considerations of pumps, actuators and select the valves for hydraulic circuits.
CO3	develop the hydraulic circuits for practical applications, create circuits for various machines, select the size of the accumulators and explain the working principles of safety circuits
CO4	explain the fundamental concepts of pneumatic systems, list the properties of air for pneumatic system, demonstrate on F-R-L unit
CO5	identify various control elements in pneumatic system, develop electro pneumatic and electro hydraulic circuits for robotic applications, design a pneumatic circuit using classic, cascade and step counter methods
CO6	select pneumatic components for installation and maintenance of power packs, explain the architectures of PLC and Microprocessors, develop logical circuits in PLC for automation and determine the faults in fluid power systems

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	2	1	2							
CO2	3	2	1	1	2							
CO3	1	3	2	2	1							
CO4	3	3	2	2	1							
CO5	3	3	2	1	2							
CO6	3	3	3	2	1							

UNIT I

Fluid Power Principles And Hydraulic Pumps:

Introduction to fluid power - Types, advantages and application of fluid power systems. Properties of hydraulic fluids terminologies used in fluid power

Basic of Hydraulic And Pneumatic Systems. Comparison of Mechanical, Electrical, Hydraulic &

Pneumatic systems for force and motion analysis in automation.

UNIT II

Oil Hydraulic Pumps, Actuators: Introduction-hydraulic actuators-hydraulic cylinders- Types of hydraulic pumps - construction and working principle - design considerations, selection, specifications and characteristics of pumps. Types of actuators-construction and working principle - design considerations, selection, specifications and characteristics of actuators.

Control and Regulation Elements: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for hydraulic circuits.

UNIT III

Design of Hydraulic Circuits: Speed control circuits - Regenerative circuits- Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier–Intensifier circuit. - Reservoir design - Selection of components. Hydraulic circuits - Reciprocating - Quick return - Sequencing synchronizing - Safety circuits - Industrial circuits - Press - Milling Machine - Planner - Fork Lift.

UNIT IV

Pneumatic Systems: Pneumatic fundamentals - Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Control Elements - Logic Circuits -Position - Pressure Sensing - Switching – Electro Pneumatic - Electro Hydraulic Circuits - Robotic Circuits.

Design of Pneumatic Circuits: Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors -Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation.

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R, “Oil Hydraulics”, Tata McGraw Hill, 2000.
3. Majumdar S.R, “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2001.
4. Introduction to Hydraulics and Pneumatics by S. Ilango and V. Soundararajan, PHI , New Delhi.

REFERENCE BOOKS:

1. Andrew Parr, Hydraulic & Pneumatics, 2/e, Jaico Publishing House Elsevier, 1999.
2. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987
3. Harry L. Stevart D.B, “Practical Guide to Fluid Power”, Taraoeala Sons and Port Ltd. Broadey, 1976
4. Oil Hydraulic Systems, S.R .Majumdar, McGrawHill Companies.
5. Pneumatic Systems: Principles and Maintenance, Majumdar, Mc Graw Hill.
6. Applied hydraulics and pneumatics-T. Sunder Selwyn & R. Jayendiran, Anuradha Publications.

E-RESOURCES:

https://www.youtube.com/watch?v=8xd7cWvMrvE

III B. Tech II Semester

Course code-

COMPUTATIONAL FLUID DYNAMICS

(Professional Elective – II)

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Basic Thermodynamics, Fluid Mechanics and Hydraulic machines, Heat Transfer.

Course Objectives:

1. Student will know the concept and importance of computational fluid dynamics.
2. Student will know the governing equations of fluid flow and also problem solving techniques.
3. Student will be aware of partial differential equations and problems on partial differential equations.
4. Student will be aware of Discretization and their corresponding problems.
5. Student will be exposed to the concepts related to Analysis of stability.
6. Student will be in a position to evaluate simple CFD techniques and boundary conditions for pressure correction method.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Formulate the basic fluid dynamics problem mathematically.
CO2	Understand the philosophy of CFD and derive governing equations of fluid flow.
CO3	Analyze the mathematical behavior of partial differential equations.
CO4	Understand the principles of Discretization.
CO5	Formulate solution techniques for parabolic and hyperbolic equations.
CO6	Apply some of the popular CFD techniques in the solution of fluid flow problem.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3		1		2							
CO2	3		1		2						2	
CO3	2		1		3						2	
CO4	2		1		3						2	
CO5	2		1		3						2	
CO6	2		1		3						2	

UNIT I

Introduction: Computational Fluid Dynamics Importance, Applications of Computational Fluid Dynamics.

Governing Equations of Fluid Dynamics: Introduction, Models of flow, governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions.

UNIT II

Mathematical Behavior of Partial Differential Equations: Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM, Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT III

Basics Aspects of Discretization: Introduction, Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA). Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

UNIT IV

Simple CFD Techniques: Lax-Wendroff technique, MacCormack's technique and Iterative and Relaxation techniques. Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method.

TEXT BOOKS

1.Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition 2012.
2.Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

REFERENCE BOOKS:

1. Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub. 1st Edition, 2009.
2. Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1st Edition.
3. Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition, 2003.
4. Sengupta. T. K, Fundamentals of Computational Fluid Dynamics, University Press, 2004.

E-RESOURCES:

https://www.youtube.com/playlist?list=PL8EAF844326CBB2E3

III B. Tech II Semester

Course code-

ROBOTICS
(Professional Elective – II)

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mathematics, Engineering Mechanics

Course Objectives:

1. Student will know the fundamental concepts of industrial robotic technology.
2. Student will be exposed to the various types of end effectors.
3. Student will apply the basic mathematics to calculate kinematic forces in robot manipulator.
4. Student will understand the robot controlling and programming methods.
5. Student will be in a position to describe various actuators, sensors.
6. Student will be aware of the various industrial applications of robots.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Overview of Robotics and identify various robot configurations.
CO2	Identify various robot components and select different end effectors for specific application
CO3	Carryout Homogeneous transformations, kinematic analysis for various kinematic chains.
CO4	Perform differential transformations and calculate dynamic analysis for simple kinematic chains.
CO5	Perform trajectory planning for a manipulator by avoiding obstacles
CO6	Select appropriate actuators and sensors for a robot and to understand various robot applications in manufacturing.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3					1					2	
CO2	2		3								1	
CO3		3	2		1							
CO4		3	2		1							
CO5		2	3		-							1
CO6	2				3						1	

UNIT I

Introduction: Robot Definition, Automation and robotics, CAD/CAM and Robotics, An overview of Robotics, Present and Future applications, Classification of robots by coordinate system and control system.

Components of the Industrial Robotics: Function line diagram representation of robot components, number of degrees of freedom, joint notation scheme, Types of end effectors, Mechanical grippers, gripper mechanisms, other types of grippers, Considerations in gripper selection and design.

UNIT II

Motion Analysis & Kinematics Transformation matrices- Translation, Rotation, Combined translation and rotation, Homogeneous transformation matrix - Problems. Description of Link and Joint parameters, Kinematic modelling of the manipulator, D-H Notation, Kinematic relationship between adjacent links, Forward and Inverse kinematics.

Robot Dynamics: Differential kinematics, manipulator Jacobian, Lagrange-Euler and Newton Euler formulations.

UNIT III

Trajectory Planning: Terminology, Steps in trajectory planning, Slew motion, joint integrated motion, straight line motion, circular motion, Joint space technique, Cartesian space technique, cubic polynomial with and without via points.

Robot Programming and Languages: Lead through programming, robot program as a path in space, WAIT, SIGNAL, DELAY commands, Branching, capabilities and limitations. Textual robot languages, generations, Language structure, Elements and functions.

UNIT IV

Robotic Actuators and Sensors: Pneumatic, Hydraulic actuators, electric & stepper motors, Position sensor- potentiometers, resolvers, encoders, Velocity sensors, Tactile, Proximity and Range sensors.

Robot Applications in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection

TEXT BOOKS

1. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel,NicholasG.Odrey , Industrial Robotics — Mc Graw Hill, 1986.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.

REFERENCE BOOKS:

1. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
2. H. Asada and J.J.E. Slotine, Robot Analysis and Control, 1st Edition Wiley-Interscience, 1986.
3. Robert J. Schillin, Fundamentals of Robotics: Analysis and control, Prentice-Hall Of India Pvt. Limited, 1996.
4. Mohsen shahinpoor, A robot Engineering text book, Harper & Row Publishers,1987.
5. John.J.Craig Addison, Introduction to Robotics: Mechanics and Control, Wesley, 1999.
6. K.S. FU, R.C. Gonzalez and C.S.G Lee, Robotics: Control, sensing, vision, and intelligence . Mc Graw Hill, 1987.
7. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

E-RESOURCES:

https://www.youtube.com/playlist?list=PLED9EB384E656C007

III B. Tech II Semester

Course code-

NON DESTRUCTIVE EVALUATION

(Professional Elective – II)

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Material science, Manufacturing technology,

Course Objectives:

1. Student will know about different techniques in NDT and usage of visual inspections, liquid penetration tests.
2. Student will know about usage of magnetic particle testing and liquid penetrant tests.
3. Student will know the concept of acoustic emission and eddy current testing.
4. Student will know about infrared and thermal testing.
5. Student will know radiography testing
6. Student will know the concepts of application of ndt in various fields

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Explain about ndt and explain different tests like visual inspection and liquid penetration.
CO2	Define magnetic particle test ad liquid penetrant test .
CO3	Explain the process of acoustic emission and eddy current testing.
CO4	Analyze the process for infrared and thermal testing.
CO5	Evaluate the process of radiography testing.
CO6	Explain the applications of ndt in various fields.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1									
CO2	3	2	1									
CO3	3	2	1									1
CO4	3	1	2									
CO5	3	1	2							1		
CO6	3	2	1									1

UNIT I

Introduction:

Introduction to NDT, Comparison between destructive and NDT, Importance of NDT, Scope of NDT, difficulties of NDT, future progress in NDT, economics aspects of NDT.

Visual Inspection Technique:

Visual Inspection - tools, applications and limitations – Fundamentals of visual testing: vision, lighting, material attributes, environmental factors. Visual perception, direct and indirect methods mirrors, magnifiers, boroscopes, fibroscopes, closed circuit television, light sources. Special lighting, a systems, computer enhanced system.

Liquid Penetrant Testing:

Physical Principles, Procedure for penetrant testing, Penetrant testing methods, sensitivity, Applications and limitations.

UNIT II

Magnetic Particle Testing: Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism Applications and Limitations of the Magnetic Particle Test

Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for normal beam inspection, Techniques for angle beam inspection, Applications of ultrasonic testing, Advantages and limitations

UNIT III

Acoustic Emission:

Principle of AET, Technique, instrumentation, sensitivity, applications, Acoustic emission technique for leak detection

Eddy Current Testing:

Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing

Infrared And Thermal Testing:

Introduction and fundamentals to infrared and thermal testing–Heat transfer Active and passive techniques –Lock in and pulse thermography Contact and non-contact thermal inspection methods–Heat sensitive paints. Inspection methods Infrared radiation and infrared detectors thermo mechanical behaviour of materials, Computed Tomography

UNIT IV

Radiography Testing:

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography.

Industrial Applications of NDE:

Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions

TEXT BOOKS

1. Practical Non-Destructive testing- Baldev Raj, T.Jaya Kumar et.al.
2. Non destructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers
3. Non destructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4. Nondestructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

REFERENCE BOOKS:

1. Hull B. and V.John, Non-Destructive Testing, Macmillan,1988.
2. Ultrasonic inspection training for NDT/ E. A. Gingel/Prometheus Press,
3. ASTM Standards, Vol 3.01, Metals and alloys
4. Non-destructive, Hand Book – R. Hamcha

E-RESOURCES:

https://www.youtube.com/watch?v=oqMXbxk4RHI

III B. Tech II Semester

Course Code:
INTRODUCTION TO MATERIAL HANDLING EQUIPMENT
(Professional Elective – II)

Lecture – Tutorial:	**2 - 1 Hours**	**Internal Marks:**	**40**
Credits:	**3**	**External Marks:**	**60**

Prerequisites: NIL

Course Objectives:

1. The student will know the basic Fundamentals of Material Handling Equipment and control and safety measures incorporated on material handling equipments.
2. The student will identify and select the different handling equipments in industry.
3. The student will identify various components of material handling systems.
4. The student will know the working principles of Components of material handling systems like Flexible hoisting, hooks, elevators.
5. The student will know the working principles of Components of material handling systems like conveyors.
6. To know the operational features of various material handling system used in industries how to connect loading stations to the different discharge or unloading conditions

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic Fundamentals of Material Handling Equipment.
CO2	Identify, compare and select proper material handling equipment for specific applications.
CO3	Identify the various components of material handling systems.
CO4	Understand the working principles of Components of material handling systems like Flexible hoisting, hooks, elevators.
CO5	Understand the working principles of Components of material handling systems like conveyors.
CO6	Identify the surface transport to connect loading stations to the different discharge or unloading stations.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	1		1		1						
CO2	2	1		1		1						
CO3	2	1		1		1						
CO4	2	1		1		1						
CO5	2	1		1		1						
CO6	2	1		1		1						

UNIT I

Materials Handling Equipment: Introduction to material handling Equipment, Detail classification of MHE, Application and their selection. Criteria for selection of Material Handling Equipment's,

Factors effecting choice of material handling equipments: type of loads, hourly capacity, direction and length of travel, method of stacking at initial intermediate and final points-specific load conditions, Basic kind of material handling problems, Various methods to analyze material Handling problems, Economics of material handling systems.

UNIT II

Components of material handling systems: Flexible hoisting appliances such as welded chains, roller chains, hemp ropes, and steel wire ropes, fastening methods of wire and chains, Appliances for suspending hooks-crane grab for unit and piece loads.

Lifting Methods: Lifting tackles, lifting and rigging Load handling attachments Various types of hooks-forged, eye bolts, eye hook, electric lifting magnet, vacuum lifter, grabbing attachment for loose materials, crane attachment for handling liquids/ molten metal's.

UNIT III

Hoisting machinery and equipments: Working of different type of hoists such as lever operated hoist, portable hand chain hoist, differential hoist, worm geared and spur geared hoist, electric and pneumatic hoists.

Working of different types of cranes and Industrial Lifts: rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes and cranes traveling on guide rails. Introduction to types of Industrial Lifts.

UNIT IV

Conveying machinery: Working of traction type conveyors such as belt conveyors, chain conveyors, Working of traction less type conveyors such as gravity type conveyors, vibrating and oscillating conveyors, screw conveyors, monorail conveyors, pneumatic and hydraulic conveyors, hoppers, gates and feeders.

Surface transport equipment–functions–working of trackless equipment such as hand operated trucks, powered trucks, tractors, AGV (Automatic Guided vehicle), industrial trailers Function, working of cross handling equipment such as winches, capstans, turntables, transfer tables.

TEXT BOOKS:

1. Material Handling Equipment – N.Rundenko (Peace Publisher, Moscow)
2. Material Handling Equipment -M.P. Alexandrow (MIR Publishers, Moscow)
3. Material Handling Equipment -R.B. Chowdary & G.N.R.Tagore (Khanna Publishers, Delhi)
4. Plant layout & Material Handling-Apple J.M (John Wiley Publishers)

REFERENCE BOOKS:

1. Material Handling (Principles &Practice)-Allegri T.H (CBS Publisher, Delhi)
2. Material Handling -Immer J.R (McGraw Hill, Newyork
3. Material Handling Equipment-Parameswaran M.A (CDC in Mech. Engg., I.I.T. Chennai).
4. Conveyors and related equipments – Spivakovsy A.O. and Dyachkov V.K Volumes I and II (MIR publishers)
5. Boltzharol, A.,"Materials Handling Handbook", The Ronald press company 1958.

E-RESOURCES:

https://www.youtube.com/watch?v=3tTvVUfwchI
https://www.youtube.com/watch?v=guYD2zyUT6o
https://people.engr.ncsu.edu/kay/Material_Handling_Equipment.pdf
https://www.scribd.com/doc/222647028/Material-Handling-Full-Notes

III B. Tech II Semester

Course code-

HEAT TRANSFER LAB

Lecture – Tutorial- Practical:	0-0-2	**Internal Marks:**	40
Credits:	1	**External Marks:**	60

Prerequisites:

Basic Thermodynamics and Advanced Thermodynamics

Course Objectives:

1. To impart practical exposure on conduction through various geometries
2. To impart practical exposure on Heat Transfer through fins
3. To impart practical exposure on Types of Convection
4. To impart practical exposure on Heat Exchangers
5. To impart practical exposure on concepts of Radiation
6. To impart practical exposure on Types of Condensation

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Find Heat Transfer rate in different geometries
CO2	Explain performance parameters of a Pin Fin
CO3	Demonstrate the concepts of Natural and Forced Convection
CO4	Determine effectiveness in parallel flow and counter flow heat exchanger
CO5	Determine emissivity of the given surface
CO6	Demonstrate the concepts of Drop-wise and Film-wise Condensation

Contribution of Course Outcomes towards achievement of Program Outcomes

(1– Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	3	3	2	2	-	-	3	-	3	2	2
CO2	3	3	3	1	2	-	-	3	-	3	2	2
CO3	3	3	2	1	1	-	-	3	-	3	2	2
CO4	3	2	3	2	2	-	-	3	-	3	2	2
CO5	3	2	2	1	-	2	3	3	-	3	2	2
CO6	3	2	2	1	-	-	-	3	-	3	2	2

List of Experiments:

1. Determination of overall heat transfer co-efficient of a composite slab
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin
6. Determination of heat transfer coefficient in Natural convection
7. Determination of heat transfer coefficient in Forced convection
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzman constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of Unsteady state of Heat Transfer
13. Determination of Thermal conductivity of liquids
14. Determination of critical heat flux.

(Any TEN of the above experiments are to be covered)

REFERENCE BOOKS:

1. Heat Transfer lab manual by Department ofMechanical Engineering. NRIIT, Pothavarappadu.
2. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria& Sons.
3. Yunus. A. Cengel, Heat & Mass Transfer-A Practical Approach – Tata McGraw Hill, 4th Edition, 2012 .
4. Data Hand Book:C.P. Kothandaraman and Subramanian Heat and Mass Transfer Data Book, New Age InternationalPublications, 7th Edition, Reprint 2012

III B. Tech II Semester

Course Code-
SIMULATION LAB

Lecture – Tutorial- Practical:	0-0-2	**Internal Marks:**
Credits:	1	**External Marks:**

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Design and assemble of the components using geometric modeling software
CO2	Construct sketches in Pro-E & CATIA software.
CO3	The student will be able to appreciate the utility of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
CO4	Apply the finite element analysis for components design.
CO5	Develop NC code for different part profiles and perform machining on CNC Machines.
CO6	Manipulate the robot by writing programs and executing them.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1		1						2		3	
CO2	1		1						2		3	
CO3	1		1						2		3	
CO4	1		1						2		3	
CO5	1		1						2		3	
CO6	-		1						2		3	

List of Experiments

1. Construction of 2D sketches.
2. Assembly Modeling (At least three examples)
3. Analysis of trusses
4. Analysis of Beams
5. Plane stress, plane strain analysis
6. Analysis of Axi-symmetric solids
7. Analysis of 3D solids
8. Estimation of natural frequencies and mode shapes for simple problems
9. Steady state heat transfer Analysis
10. Machining of simple components on NC lathe by transferring NC Code /from a CAM package
11. Machining of Simple components on NC-Mill by transferring NC Code/from a CAM Package
12. Robot programming, simulation and execution.

Note: Minimum of 10 Experiment need to be performed

REFERENCE BOOKS:

1. CAD/CAM computer aided design and manufacturing, M.Groover, E. Zimmers, Pearson education, 13th impression.
2. CAD/CAM theory and Practice, Ibrahim Zied,Tata McGraw-Hill publishers
3. CATIA V5R17 for engineers & designers By Prof. Sham Tickoo, published by Dreamtech Press, 2009; ISBN:10-81-7722-815-3, 13-978-81-7722-815-1
4. Pro/Engineer Wildfire 5.0 by Roger Toogood, Jack Zecher, SDC Publications, 28-Feb-2010.

Web Resources:

1. https://catiatutor.com/
2. www.v5train.com
3. http://www.proetutorials.com/
4. http://learningexchange.ptc.com/tutorials/by_sub_product/ptc-creo-elements-pro-pro-engineer/sub_product_id:1
5. http://www.eng-tips.com/viewthread.cfm?qid=48209