HYDERABAD INSTITUTE OF TECHNOLOGY AND MANAGEMENT									
B.TECH. HR-21 COURSE STRUCTURE									
MECHANICAL ENGINEERING									
(Applicable for the batch admitted from 2021-22 onwards)									
V – Semester (III – Year)									
S. No.	**Course code**	**Subject**	**Hours Per Week**			**Credits**	**Scheme of Evaluation**		
							Maximum Marks		
			L	**T**	**P**		**Int.**	**Ext.**	**Tot.**
1	21PC5ME12	Dynamics of Machinery	3	-	-	3	30	70	100
2	21PC5ME13	Thermal Engineering-II	3	-	-	3	30	70	100
3	21PC5ME14	Metrology & Machine Tools	3	-	-	3	30	70	100
4	21PC5ME15	Design of Machine Members-I	3	-	-	3	30	70	100
5		**Professional Elective-1**	3	-	-	3	30	70	100
6		**Open Elective-1**	3	-	-	3	30	70	100
7	21PC5ME16	Metrology & Machine Tools Lab	-	-	2	1	30	70	100
8	21PC5ME17	Thermal Engineering Lab	-	-	2	1	30	70	100
9	21PC5ME18	Kinematics & Dynamics Lab	-	-	2	1	30	70	100
10	21PR5IN02	Internship-2	-	-	2	1	100	0	100
TOTAL						**22**	**370**	**630**	**1000**
Non Credit Courses									
11	21MC5HS03	Analytical Reasoning	2	-	-	0	100	0	**100**
VI – Semester (III – Year)									
S. No.	**Course code**	**Subject**	**Hours Per Week**			**Credits**	**Scheme of Evaluation**		
							Maximum Marks		
			L	**T**	**P**		**Int.**	**Ext.**	**Tot.**
1	21PC6ME19	Design of Machine Members-II	3	-	-	3	30	70	100
2	21PC6ME20	Heat Transfer	3	1	-	3	30	70	100
3	21PC6ME21	CAD/CAM	3	-	-	3	30	70	100
4	21PC6ME22	Machining Science	3	-	-	3	30	70	100
5		**Professional Elective-II**	3	-	-	3	30	70	100
6		**Open elective-2**	3	-	-	3	30	70	100
7	21PC6ME24	Computer-Aided Engineering and Manufacturing Lab	-	-	2	1	30	70	100
8	21PC6ME23	Heat Transfer-Lab	-	-	2	1	30	70	100
9	21HS6EG05	Advanced English Communication Skills-Lab	-	-	2	1	30	70	100
10	21PR6ME02	**Doing Engineering-2**	-	-	2	1	30	70	100
TOTAL						**22**	**300**	**700**	**1000**
Non Credit Courses									
11	21MC6HS04	Quantitative Aptitude	2	-	-	0	100	0	**100**

PE-1 Code	Professional Elective-I
21PE5ME11	Operations Research
21PE5ME12	Industrial Robotics
21PE5ME13	Mechanical Vibrations
21PE5ME14	Machine Tool Design

PE-2 Code	Professional Elective-II
21PE6ME21	Un Conventional Machining Processes
21PE6ME22	Production Planning & Control
21PE6ME23	Machining Science
21PE6ME24	Composite Materials

Sl.no	SUBJECT CODE	Open Elective-I	Offering Department
1	21OE6CS06	Computer Organization and Architecture	CSE
2	21OE5EC01	Electronics measurement & Instrumentation	ECE
3	21OE5ME01	Hybrid & Electric Vehicles	MECH
4	21OE5EE01	Fundamentals of Electric Circuit Analysis	EEE
5	21OE5HS01	Nanoscience and Technology	H&S
6	21OE5CM01	Introduction to Artificial Intelligence	CSE-AI&ML
7	21OE5CD01	Statistics for Data Science	CSE-DS
8	21OE5CO01	Introduction to IoT	CSE-IOT
9	21OE5CC01	Data Security	CSE-CS

Sl.no	SUBJECT CODE	Open Elective-II	Offering Department
1	21OE5CS09	OOPS using Java	CSE
2	21OE6EC02	Fundamentals of Digital Electronics	ECE
3	21OE6ME02	Total Quality Measurement & Six Sigma Applications	MECH
4	21OE6EE02	Fundamentals of Industrial Electronics	EEE

5	21OE6HS02	Medical Instrumentation	H&S
6	21OE6CM06	Expert Systems	CSE-AI
7	21OE6CD02	Data Mining and Data Analytics	CSE-DS
8	21OE6CO05	Sensors & Devices	CSE-IOT
9	21OE6CC02	Computer Hardware and System Essentials	CSE-CS

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PC5ME12	3	0	0	3

DYNAMICS OF MACHINERY

Pre-requisite: Kinematics of Machinery

Course Objectives:

1. The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved
2. Subjects deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced
3. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc
4. Study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations.
5. The study deals with linear, longitudinal, & torsional vibrations.

Module I

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aero planes and ships.

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

Module II

Engine Force Analysis : Engine force analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method

Turning Moment Diagram and Flywheels: Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines –crank effort and torque diagrams.

Module III

Friction: Pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches

Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake, internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

Module IV

Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors –Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting **–** stability – effort and power of the governors.

Balancing: Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing –Hammer blow – Swaying couple – variation of tractive effort.

Module V

Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads.

Applications of Vibrations: Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

Text Books:

1. Theory of Machines and Mechanisms(John J. Uicker, Gordon R. Pennock, Joseph E Shingley).
2. Theory of Machines" by Rattan S S.
3. Theory of Machines" by Thomas Bevan

Reference Books:

1. Theory of Machines: Kinematics and Dynamics by Sadhu Singh.
2. Theory Of Mechanicsms Machines" by A Ghosh.
3. Dynamics of machinery by S. Balaguru.

Web resource:

https://www.youtube.com/playlist?list=PLf-VAO7xqD8f1PdfkWG2tL56rAdBn2-_1

Course Outcomes:

CO1 –Analyze the gyroscopic couple and the static and dynamic force in mechanical systems.
CO2 – Analyze the fluctuation of energy stored in flywheel.
CO3 – Design clutches, brakes and dynamometers and analyze speed range of governors.
CO4 – Analyze the fundamental concepts of vibrating system to predict the natural frequency and estimate the frequency of damped and forced vibrating systems.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3										2	
CO2	3	2	3										2	
CO3	3	3	3										2	
CO4	3	2	3										2	

** If more PSOs are there in a particular branch, required no of columns can be added.*

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PC5ME13	3	0	0	3

THERMAL ENGINEERING-II

Note: Steam Table book Permitted.

Pre-requisite: Thermodynamics

Course Objectives:

1. To Apply the laws of Thermodynamics
2. To Analyze steam and gas turbine cycles
3. To perform analysis of the major components of steam and gas turbine plants and their applications.
4. To Explain Jet and Rocket propulsion principles.

Module I

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance– Regeneration& reheating.

Boilers : Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification. Chimney Significance.

Module-II

Steam Nozzles: Stagnation Properties- Function of nozzle – Applications and Types- Flow throughnozzles-Thermodynamicanalysis–Assumptions-Velocityofnozzleatexit-Idealandactualexpansionin nozzle- Velocity coefficient.

Condition for maximum discharge: Critical pressure ratio- Supersaturated flow, its effects, Degree of supersaturation and Degree of under cooling-Wilson line.

Module III

Steam Turbines: Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction–Power developed, Axial thrust, Blade or diagram efficiency–Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding Velocity and Pressure variation along the flow–Combined velocity diagram for a velocity compounded impulse turbine.

Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction–Velocity diagram–Parson's reaction turbine–Condition for maximum efficiency**.**

Module IV

Steam Condensers : Requirements of steam condensing plant– Classification of condensers –Working principle of different types – Vacuum efficiency and Condenser efficiency, Air pump-Cooling water requirement**.**

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles–Merits and Demerits.

Module-V

Jet Propulsion: Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency– Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation,

Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency–Specific Impulse – Solid and Liquid propellant Rocket Engines.

Textbooks:

1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/ Pearson.
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI.
3. Thermodynamics: An Engineering Approach" by Yunus A. Cengel and Michael A. Boles published by McGraw Hill Education.

Reference Books:

1. Thermal Engineering / Mahesh M Rathore/ Mc Graw Hill.
2. Gas Turbines – V. Ganesan /Mc Graw Hill.
3. Gas Turbine Theory by H.I.H. Saravanamuttoo, G.F.C. Rogers, and H. Cohen. This book, published by Pearson Education.

Course Outcomes: At the end of the course the student should be able to

CO1 – Develop state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants
CO2 – Differentiate between vapor power cycles and gas power cycles
CO3 – Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants.
CO4 – Explain the operating principles of Jet and Rockets.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	2	2									3	1
CO2	3	2	2										3	1
CO3	3	3	3	2									3	1
CO4	3	2	2										3	1

** If more PSOs are there in a particular branch, required no of columns can be added.*

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PC5ME14	3	0	0	3

METROLOGY AND MACHINE TOOLS

Pre-requisites: Engineering Prototype, Production Technology, Metallurgy and Material science,

Course Objectives:

The course content enables students to:

1. Acquire the knowledge of Engineering metrology and its practice which is having increasing importance in industry.
2. Specifically make the student to improve applications aspect in the measurements and control of process of manufacture
3. Impart the fundamental aspects of the metal cutting principles and their application in studying the behaviour of various machining processes.
4. Train in knowing the fundamental parts of various machine tools and their kinematic schemes.

Module I

Introduction to Metal cutting: Introduction, elements of cutting process, single point cutting tools and multi point cutting tools, Chip formation.

Lathe Machines: Engine lathe – Principle of working, types of lathe, specifications. Taper turning,– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

Module II

Drilling Machines: Drilling Machines – Principles of working, specifications, types, operations performed; twist drill.

Boring Machines, shaping slotting and Planning Machines: Boring Machines, Types of Boring machines and applications. Shaping, slotting and planning machines –Principles of working.

Module III

Milling and grinding machines: Principles of working – Types of milling machines – Geometry of milling cutters methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds.

Lapping and Honing: Lapping, honing and broaching machines, comparison and Constructional features.

Module IV

Limits, fits and tolerances: Limits, fits and tolerances- Types of Fits - Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.

Limit Gauges: Taylor's principle, Design of GO and NO-GO gauges, Measurement of angles using Bevel protractor and Sine bar. Measurement of flatness using straight edges, surface plates, optical flat and auto collimator.

Module V

Surface Roughness Measurement: Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf.

Screw thread, Gear Measurement and Coordinate Measuring Machines: Screw thread measurement, Gear measurement, Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines.

Text Books:

1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
2. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
3. Metrology and Measurement/ Bewoor& Kulkarni/ Tata Mc Graw Hill

Reference Books:

1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Engineering Metrology/ R.K. Jain/ Khanna Publishers
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Workshop Technology by Hazra Chowdary.

Online References:

http://www.digimat.in/nptel/courses/video/112105233/L13.html
https://nptel.ac.in/courses/112105233

Course Outcomes:

CO-1: Identify techniques to minimize the errors in measurement.

CO-2: Identify methods and devices for measurement of length, angle, gear & thread parameters, surface roughness and geometric features of parts.

CO-3: Understand working of lathe, shaper, planer, drilling, milling and grinding machines.

CO-4: Comprehend speed and feed mechanisms of machine tools.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3											3	2
CO2	3	3											2	
CO3	3	2											3	3
CO4	3	3											3	

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PC5ME15	3	0	0	3

DESIGN OF MACHINE MEMBERS-I

Pre-requisite: Mechanics of Solids, Material Science, Engg. Mathematics

Note: Design Data books are permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

Course Objectives:

1. To understand the general design procedures and principles in the design of machine elements.
2. To study different materials of construction and their properties and factors determining the selection of material for various applications.
3. To determine stresses under different loading conditions.
4. To learn the design procedure of different fasteners, joints, shafts and couplings.

Module I

Introduction: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steel.

Design for Static Strength: Simple stresses, Torsional and Bending stresses – Impact stresses – Stress-strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity, preferred numbers.

Module II

Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor– Fatigue stress concentration factor- Notch Sensitivity.

Design for fluctuating stresses: Endurance limit – Estimation of Endurance strength – Gerber's curve– Goodman's line– Soderberg's line.

Module III

Riveted joints:

Methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

Welded joints: Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

Module IV:

Design of Keys and cotter joint: Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter

Knuckle Joints: Design of Knuckle joints and types of knuckle Joints.

Module V

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code.

Shaft Couplings: Rigid couplings, Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling (Modified).

Text Books:

1. Design of Machine Elements - V. B. Bhandari
2. Mechanical Engineering Design by Shigley, Budynas & Nisbett
3. Design of Machine Elements by Dr. Sadhu sign

Reference Books:

1. Fundamentals of Machine Component Design by Robert C Juvinall
2. Machine design by Zinadal
3. Machine design by Bear and Jhonson

Web Resources:

https://nptel.ac.in/courses/112106137
https://www.coursera.org/learn/machine-design

Course Outcomes:

CO1 –Explain the principles of design, material selection, component behaviour subjected to loads, and criteria of failure.
CO2 – Apply the knowledge of principal stresses, machine members' stress concentration, and fatigue loading.
CO3 – Analyse the stresses produced in welded and riveted joints.
CO4 – Design different fasteners, joints, keys, shafts and couplings.

CO-PO/PSO Mapping Chart
(3/2/1 indicates the strength of correlation)
3 – High; 2 – Medium; 1 –Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										2	
CO2	3	2	2										2	
CO3	3	2	2		1								2	
CO4	3	2	2		1								2	

** If more PSOs are there in a particular branch, the required no of columns can be added.*

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PC5ME17	0	0	2	1

METROLOGY AND MACHINE TOOLS LAB

Pre-requisite: Production Technology Lab, MMS Lab and Theoretical exposure to Metrology and machine tools.

Course Objectives:

1. To import practical exposure to the metrology equipment & Machine Tools
2. To conduct experiments and understand the working of the same.
3. Specifically make the student to improve applications aspect in the measurements and control of process of manufacture.
4. Acquire the knowledge of Engineering metrology and its practice which is having increasing importance in industry.

PART-A

Machine Tools:

Any SEVEN experiments need to be performed.

1. Step turning and Taper turning on lathe machine (2 exercises)
2. Thread cutting and knurling on lathe machine (2 exercises)
3. Measurement of cutting forces on lathe
4. Drilling and Tapping
5. Planning and Shaping
6. Slotting
7. Gear cutting on the Milling machine
8. Grinding of Tool angles using Tool and Cutter Grinder.
9. Surface Grinding
10. Cylindrical Grinding

PART-B

Metrology:

Any FIVE Experiments need to be performed.

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
2. Measurement of Diameter of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
4. Angle and taper measurements by bevel protractor and sine bars.

5. Thread measurement by 2-wire and 3-wire methods.
6. Surface roughness measurement by Tally Surf.
7. Use of mechanical comparator.

Text Books:

1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
2. Engineering Metrology/ R.K. Jain/ Khanna Publishers

Reference Books:

1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor& Kulkarni/ Tata Mc Graw Hill

Online References:

http://www.digimat.in/nptel/courses/video/112105233/L13.html

Course Outcomes: At the end of the course the student should be able to

1. Demonstrate the knowledge of lathe machines to perform turning, facing, and threading operations.
2. Understand Practical exposure on flat surface machining, milling and grinding operations.
3. Apply the procedures to measure length, width, depth, bore Diameters, internal and external tapers and surface
4. Measure angle using Sine Bar/ Bevel Protractor.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3				2							1	
CO2	3	2				2							1	1
CO3	3	3				2							1	
CO4	3	3				1							1	

B. Tech III Year–I Sem	**L**	**T**	**P**	**C**
Subject Code: 21PC5ME16	**0**	**0**	**2**	**1**

THERMAL ENGINEERING LAB

Pre-requisite: Thermodynamics & Thermal Engineering - I

Course Objectives:

1. To explain working principles of IC Engines.
2. To explain working principles of Air compressor.
3. To explain different components of SI & CI Engines.
4. To demonstrate different boilers, Heat balance on CI engine.

List of Experiments

1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance – CI/SI Engines
6. I.C. Engines Economical speed Test on a SI engine
7. I.C. Engines effect of A/F Ratio in a SI engine
8. Study of Electric Vehicles.
9. IC engine Performance Test on a 4S CI Engine at constant speed
10. Volumetric efficiency of Air – Compressor
11. Study of S.I & C.I Engine components
12. Study of Boilers

Note: Perform any 10 out of the 12 Exercises

Course Outcomes:

At the end of the course the student should be able to

CO1 – Conduct performance analysis of SI & CI engines.
CO2 – Analyze Valve/Port diagram
CO3 –Demonstrate different Morse, Retardation, Motoring on CI engine and Economical speed Test on SI engine.
CO4 – Explain operating principle of Boilers.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	1	2									3	1
CO2	3	2	1	2									3	1
CO3	3	3	1	2									3	1
CO4	3	2	1	2									3	1

** If more PSOs are there in a particular branch, required no of columns can be added.*

B. Tech III Year–I Sem	**L**	**T**	**P**	**C**
Subject Code: 21PC5ME18	**0**	**0**	**2**	**1**

KINEMATICS AND DYNAMICS LAB

Pre-requisites:
Prerequisites for the graduate-level course are Kinematics of machines, Dynamics of machines.

Course Objectives:
The objective of the lab is to

1. Understand the kinematics and dynamics of mechanical elements
2. Design mechanical elements to accomplish desired motions or tasks.

List of Experiments:
Note: (A Minimum of 10 experiments are to be conducted

1. To determine the state of balance of machines for primary and secondary forces
2. To determine the frequency of torsional vibration of a given rod
3. Determine the effect of varying mass on the centre of sleeve in porter and proell governor
4. Find the motion of the follower if the given profile of the cam
5. The balance masses statically and dynamically for single rotating mass systems
6. Determine the critical speed of a given shaft for different n-conditions
7. For a simple pendulum determine time period and its natural frequency
8. For a compound pendulum determine time period and its natural frequency
9. Determine the effect of gyroscope for different motions
10. Determine time period, amplitude and frequency of undamped free longitudinal vibration of single degree spring mass systems.
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degree spring mass systems

Course Outcomes: At the end of the course the student should be able to

1. Understand types of motion
2. Analyze forces and torques of components in linkages

3. Understand static and dynamic balance
4. Understand forward and inverse kinematics of open-loop mechanisms

CO-PO Mapping

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	

	L	T	P	C
B.Tech III Year – V Semester				
Subject Code: 21MC5HS03	**1**	**0**	**0**	**0**

Analytical Reasoning

(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/ME)

Pre-requisite: Nil

Course Objectives:

1. Improve logical thinking to solve various questions and puzzles in Reasoning.
2. To help the student understand the importance of having his language skills kept ready for effective use
3. To understand the concept of employability skills
4. To enrich their problem solving, critical and analytical skills

Course Outcomes:

1. Improve logical thinking to solve various questions and puzzles in Reasoning.
2. To help the student understand the importance of having his language skills kept ready for effective use
3. To understand the concept of employability skills
4. To enrich their problem solving, critical and analytical skills

Module I:

Coding and Decoding: Coding and Decoding, Arrow Method, Chinese coding, Series, Analogy, Odd man out

Articles and Tenses: Introduction, usage of articles, Omission of Articles, Types of tenses, Forms and Usage of tenses.

Module II:

Direction Sense: Introduction, Distance method, Facing Method and Shadow Method.

Blood Relations: Introduction, Direct, Puzzle and Coded models.

Module III:

Voices and Forms of Speech: Introduction, conversion of active and passive voice, conversions of direct and indirect speech.

Module IV:

Data Arrangements: Linear Arrangement, Circular Arrangement, Multiple Arrangements.

Syllogisms: Introduction, Tick-Cross method, Inferential Technique, Venn-Diagram method.

Module V:

Visual Reasoning: Patterns, Folded Images, Cubes and Analytical Reasoning.

Sentence Correction: Subject-Verb Agreement, Pronoun Antecedent, Parallelism, Verb-Time Sequence Error, Determiners and Modifiers.

Text Books:

1. Quick Learning Objective General English, R.S. Aggarwal, Vikas Aggarwal, 2nd edition, S.Chand, 2003.

2. A Modern Approach to Logical Reasoning, R.S. Aggarwal, Revised Edition, 2nd edition, S Chand & Co Ltd, 2018.

Reference Books:

1. Test of Reasoning for all competitive examinations, Edgar Thorpe, 6th Edition, McGraw Hill Education, 2017.

2. How to Prepare for Logical Reasoning for CAT and other Management Examinations, Arun Sharma, 4th edition, McGraw Hill Education, 2017.

3. English Grammar and Verbal Reasoning – The Toolkit for Success, SimboNuga, Trafford Publishing, 2013

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1						1					2	3		
CO2						1					2	3		
CO3						1					2	3		
CO4						1					2	3		

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PE5ME11	3	0	0	3

OPERATIONS RESEARCH (PE-I)

Pre-requisite: Engineering Mathematics, Understanding of a Manufacturing Industry. Python/C programming language knowledge.

Module I

Introduction, Development -definition, and Phases -Types of Models – Operation Research Models and their applications.

Linear Programming Problem Formulation –Graphical Solution Simplex Method. Artificial Variable techniques. Two Phase Method, Big M Method. Write a computer Program of one of the methods LPP/Simplex/

Module II

Transportation Problem -Formulation -Optimal Solution, Unbalanced Transportation Degeneracy.

Assignment Problem: Formulation – Optimal Solution – Variants of Assignment Problem – Travelling Salesman Problem. Program a problem in one of the processes Transportation/Assignment

Module III

Sequencing: Introduction -Flow -Shop sequencing -njobs through two machines – n jobs through three machines – job shop sequencing – two hobs through m machines

Replacement: Introduction – Replacement of items that deteriorate with time- when money value is not counted and counted – Replacement of items that fall completely – Group Replacement.

Module IV

Theory of Games: Introduction-Terminology -Solution of games with saddle points and without saddle points 2 X 2 games – dominance principal -m X 2 & 2 Xn games – Graphical Method

Inventory: Introduction -Single Item, Deterministic models – purchase inventory models with one price break and multiple price breaks – Stochastic Models – Demand may bediscrete variables or continuous variables – single period model and no setup cost. Write a Program for a problem on the Inventory model.

Module V

Waiting Lines: Introduction -Terminology – single Channel – Poisson arrivals and Exponential service Times with infinite population.

Dynamic Programming

Introduction – Terminology,Bellman's principle of optimality – Applications of dynamic programming – Shortest path problem – Linear Programming Problem

Text Books:

1. Operations Research/J .K. Sharma /Macmilan
2. Introduction to OR/Hillier &Libemann/TMH
3. Operations Research: An Introduction by Taha Hamdy

Reference Books:

1. Introduction to OR/Taha/PHI
2. Operations Research/ NVSRaju/ SMS Education/Latest Revision
3. Operations Research/Wagner/ PHI Publications

Course Outcomes:

1. Understand Linear Programming Problem
2. Identify variables and formation of the optimization model
3. Apply appropriate optimization techniques
4. Find the solution for the problems

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	3	3									2	
CO2	3	2	3	3									2	
CO3	3	3	3	3									2	
CO4	3	2	3	3									2	

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PE5ME12	3	0	0	3

INDUSTRIAL ROBOTICS (PE-I)

Pre-requisites: Basic principles of Kinematics and mechanics

Course Objectives:

The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

Make the students acquainted with the theoretical aspects of Robotics.

1. Enable the students to acquire practical experience in the field of Robotics through designprojects and case studies.
2. Make the students to understand the importance of robots in various fields of engineering.Expose the students to various robots and their operational details.

Module I

Introduction: Automation and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors,

Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

Module II

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics-DH notation-DH method of Assignment of frames-DH Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial RoboticManipulators.

Module III

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler andNewton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

Module IV

Robot actuators: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators.

Feedback components:

Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – EndEffectors and Tools.

Module V

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

Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL ,Introductions to webots ,Robot simulation.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson.
3. Industrial Robotics by Mikell Groover.

REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science
3. Robotics – Fu et al / TMH Publications.

Course Outcomes: At the end of the course, the student will be able to:

CO1 Understand the basic components of robots and its working principle.
CO2 Understand the selection of activators and sensors based on applications.
CO3 Identify types of robot configurations and its industrial applications.
CO4 Analyze forward and inverse kinematics of robot manipulators.

CO-PO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	-	-	-	-	-	-	-	-	-	2	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	2	1	1
CO3	3	2	-	-	3	-	-	-	-	-	-	2	1	1
CO4	3	2	-	-	3	-	-	-	-	-	-	2	1	1

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PE5ME13	3	0	0	3

MECHANICAL VIBRATIONS (PE-I)

Pre-requisite: Engineering Mechanics

Course Objectives:
Understand various levels of vibrations and remedies for each of them

Module I

Single degree of Freedom systems - I : Undamped and damped free vibrations; forced vibrations coulomb damping.

Single degree of Freedom systems – I: Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility.

Module II
Single degree of Freedom systems – II: Response to Non-Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations.

Single degree of Freedom systems – II: The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

Module II

Two-degree freedom systems: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers;

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time
systems.

Module IV

Continuous system: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.

Critical speeds of shafts Critical speeds without and with damping, secondary critical speed.

Numerical Methods : Rayleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer'smethods.Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

Module V

Sound level and subjective response to sound: Subjective response to sound, frequency dependent human response to sound, sound-pressure dependent human response, the decibel scale.

Relation between Sound, Intensity, Power & Pressure: Relationship among sound power, sound intensity and sound pressure level, relationship between sound power level and sound intensity, relationship between sound intensity level and sound pressure level, sound measuring instruments.

Text Books:

1. Elements of Vibration Analysis / Meirovitch/ Mc Graw Hill
2. Principles of Vibration / Benson H. Tongue/Oxford
3. "Mechanical Vibrations" by Singiresu S. Rao, Pearson Education

Reference Books:

1. Mechanical Vibrations / SS Rao / Pearson
2. Mechanical Vibration /Rao V. Dukkipati, J Srinivas/ PHI
3. Mechanical Vibrations/ G.K. Grover/ Nemchand& Brothers

Web resource:

https://youtu.be/CD_szf0S7Qg
https://youtu.be/9r630K5HmJc

Course Outcomes:

CO1 –Analyze the causes and effects of vibration in mechanical systems.
CO2 – Design schematic models for physical systems and formulate governing equations of motion.
CO3 – Analyze the role of damping, stiffness and inertia in mechanical systems Analyze rotating and reciprocating systems and compute critical speeds.
CO4 – Analyze and design machine supporting structures, vibration isolators and absorbers.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3										2	
CO2	3	2	3										2	
CO3	3	3	3										2	
CO4	3	2	3										2	

B. Tech III Year–I Sem	L	T	P	C
Subject Code: 21PE5ME14	3	0	0	3

MACHINE TOOL DESIGN (PE-I)

Pre-requisites: Production Technology

Course Objectives:

1. Implement the tool design process when designing tooling for the manufacturing of a product.
2. Apply Geometric Tolerancing principles in the designs of tooling.
3. Design, develop, and evaluate tooling for various joining processes.
4. Apply ANSI standards to tool design drawings and layouts.
5. Use CAD and conventional techniques in creating tooling drawings.

Module I

Introduction to Machine Tool Drives: Introduction to the course, Working and Auxiliary Motions in Machine Tools,

Machine Tool Drives Mechanisms: Kinematics of Machine Tools, Motion Transmission.

Module II

Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams.

Design Considerations: Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

Module III

Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures.

Machine Tool Constructional Features: Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages

Module IV

Guide-ways: Power Screws and Spindles, Functions and Types of Guide-ways.

Design of Guide ways: Design of Guide-ways, Design of Aerostatic Sideways, Design of Anti-Friction Guide-ways, Combination Guide-ways, Design of Power Screws.

Module V

Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Anti-friction Bearings.

Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Tests.

TEXT BOOKS:

1 Tool Design/ Donaldson/ Fifth Edition, Mc Graw Hill
2. Principles of Machine Tools/ G.C. Sen and A. Bhattacharyya /New Central Book Agency
3. Design of Machine Tools / D. K Pal, S. K. Basu / Oxford

REFERENCE BOOKS:

1. Machine Tool Design and Numerical Control/ N.K. Mehta / Mc Graw Hill
2. Metal Cutting and Tool Design/ Ranganath B.J./ Vikas Publishers
3. Fundamentals of Tool Design/ ASTME, PHI

Equivalent Mooc Courses if any:

https://www.digimat.in/nptel/courses/video/112105124/L01.html

https://www.youtube.com/watch?v=s-mKNbKsvyk

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

https://www.youtube.com/watch?v=aK7oXqlkZqA

Course Outcomes:

1. Understand basic motions involved in a machine tool.
2. Design machine tool structures.
3. Select subsystems for achieving high accuracy in machining.
4. Identify control strategies for machine tool operations and appropriate quality tests for quality assurance.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3												2
CO2	3	3											2	
CO3	3	2											1	2
CO4	2	3											1	

B. Tech III Year–V Sem	L	T	P	C
Subject Code: 21OE5CS06	3	0	0	3

Computer Organization and Architecture

Pre-requisite: NIL

Course Objective:

1. The purpose of the course is to introduce principles of computer organization and the basic architectural concepts
2. Understand the representation fixed-point and floating-point numbers in computer and develop hardware algorithms using them for fixed-point and floating-point arithmetic.
3. The course would display understanding of instruction set of RISC processor and develop understanding of how memory is organized and managed in a modern digital computer, including cache, virtual and physical memory.
4. It discusses input-output units and how they communicate with the processor, and howtheir performance is computed.

Course Outcomes:

1. Understand the theory and architecture of Digital computer system
2. Define different number systems, compliments, combinational circuits and Sequential circuits
3. Explain and use fixed point addition, subtraction, multiplication (Booth's) and division (Restoring and non-restoring) algorithms
4. Explain the concept of Computer I/O Organization, Memory, RISC, CISC Characteristics

Module I:

Digital Computers: Introduction to digital computers, need of Computer Organization and Computer Architecture, Basic of Computer Architecture and Organisation, Von Neumann Computers

Data Representation: Data Types, (r-1)'s Compliment, r's compliment, Fixed point Representation, conversion of Fractions, Floating point representation, Gray code, Error detection code

Module II:

Digital Logic Circuits -I: Logic gates, Boolean Algebra, Map simplification, Combinational circuits-Half Adder and Full Adder, Decoders and Multiplexers

Digital Logic Circuits -II: Flip-Flops- SR, JK, D, T and Edge triggered, Excitation Tables, Registers, Shift Registers, Binary Counters

Module III:

Computer Arithmetic -I: Addition and subtraction, multiplication Algorithms, Division Algorithms

Computer Arithmetic –II: Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

Module IV:

Basic Computer Organization: Instruction Codes, Computer Registers, Computer Instructions, Timing and control, Instruction Cycle, Memory- Reference Instructions, Input-Output and Interupt

Input-Output Organization: Priority interrupt, Peripheral devices, Input output interface, Data transfer schemes, Program control and interrupts, Direct memory access transfer, Input/output processor.

Module V:

Memory Unit: Memory Hierarchy, Main Memory, Auxiliary Memory, Associate Memory and Cache Memory

Computer Architecture: CISC Characteristics, RISC Characteristics.

Text Books:

1. Computer System Architecture by Morris Mano, Prentice hall, 3rd Edition, (2007)
2. Computer Organization by Carl Hamacher, Zvonko Vranesic, SafwatZaky, Tata McgrawHill, 5th Edition, (2011)

References:

1. Computer Architecture: A Quantitative Approach by Hennessy, J. L, David A Patterson, and Goldberg, Pearson Education, 4th Edition, (2006)
2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.

CO-PO/PSO Mapping Chart:

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*		
CO-PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO-1	2													**2**	
CO-2	2	2	3											2	
CO-3	2	2	2											2	
CO-4	2	2	2											2	

B. Tech III Year – V Sem	L	T	P	C
Subject Code: 21OE5EC01	3	0	0	3

ELECTRONIC MEASUREMENTS & INSTRUMENTATION

(OPEN ELECTIVE)

Prerequisite: Basic Electrical and Electronics

Course Objectives: This course will enable students to:

1. Learn and understand functioning of various measuring system and metrics for performance analysis.
2. Acquire knowledge of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
3. To Compare various measuring bridges and their balancing conditions.
4. Learn and understand the use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Course Outcomes: Upon completion of the course, the student should be able to

1. Explain the instrument and measurements of the parameters
2. Describe signal generators and analyzers
3. Categorize oscilloscopes for different applications
4. Apply the transducers for measurement of different parameters

MODULE I : Performance characteristics of instruments

Static characteristics: Accuracy, Resolution, Precision, Expected value, Error, Sensitivity.

Dynamic Characteristics: Speed of response, Fidelity, Lag and Dynamic error.

Types of errors in measurements and their analysis. Design of multi-range AC , DC meters (voltmeter &ammeter) and ohmmeter(series &shunt type) using D'arsonval movement. True rms meter.

MODULE II

Bridge circuits : Wheat stone bridge, measurement of very low resistance, Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance-Schearing Bridge. Wien Bridge, Errors and precautions in using bridges.

Q-meter: principle of operation, measurement methods and sources of errors.

Counters : principle of operation -modes of operation- totalizing mode, frequency mode and time period mode- sources of errors.

MODULE III

Specifications and designing aspects of Signal Generators: AF sine and square wave signal generators, Function Generators, Random noise generators, arbitrary waveform generators.

Wave Analyzers: Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

MODULE IV:

General purpose CROs: Block diagram, functions and implementation of various blocks, specifications, various controls and their functions, types of probes used in CROs. Measurement of frequency and phase difference using Lissajous patterns.

Special purpose CROs: sampling oscilloscope, analog storage oscilloscope, digital storage oscilloscope.

MODULE V:

Transducers: Transducers, Active & Passive transducers: Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers.

Measurement of physical parameters: Temperature, force, pressure, velocity, acceleration and displacement.

Textbooks :

1. Electronic instrumentation, second edition - H.S. Kalsi, Tata McGrawHill,2004.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrickand W.D. Cooper, PHI, 5th Edition, 2002.
3. Electronic Measurements And Instrumentation- A.K. Sawhney, Dhanpat Rai&CO(P) Limited, Jan2015.

Reference books:

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 3rd Edition,2013.
2. Electrical and Electronic Measurement and Instrumentation A.K. Sawhney. Dhanpat Rai & Co, 12thEdition,2002.

CO-PO &PSO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	-	-	-	-	-	-	-	-	-	1	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	-	-	-	-	-	-	-	-	-	1	2	-

B. Tech III Year–V Sem	L	T	P	C
Subject Code: 21OE5ME01	3	0	0	3

Hybrid & Electric Vehicles

Pre-requisites: IC engines, automobile engineering, basic electrical electronics engineering

Objectives: To understand the fundamental concepts, and principles, of hybrid and electric vehicles.

To know the various aspects of hybrid and electric drive trains such as their configuration,

Students should understand various automotive systems and the basics of the drive train in automobiles.

Module I

Introduction: Layout of the automobile–introduction chassis and body components. Types of Automobile engines–Power unit -working of two stroke and four stroke engine–Introduction to engine lubrication–engine servicing

Fuel System: Fuel supply systems working in IC engines,–fuel injection an its types.

Cooling System: Cooling Requirements, Air Cooling, Forced Circulation System–Radiators–Types–Cooling Fan-water pump, thermostat, evaporative cooling-antifreeze solutions.

Module II

Ignition System: Function of an ignition system, battery ignition system, constructional features ofstorage, battery, auto transformer, contact breaker points, condenser, and spark plug.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, Bendixdrive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge–oil pressure gauge, engine temperature indicator etc.

Transmission System: -components and working principle. The layout of the power transmission system in a conventional and hybrid vehicle (fuel vs electrical)-introduction of components

Suspension System: Objects of suspension systems –, Dependent and Independent suspension system, air suspension system. Vehicle stability assist supplemental restraint system (SRS).

Module III

Braking System: Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic..

Steering System: Steering geometry – Ackerman Steering Mechanism, Davis Steering Mechanism ,Hydraulic and electric power steering-working principle ,construction and working.

Introduction To Hybrid Vehicles:

History of hybrid and electric vehicles, social and The environmental importance of hybrid and electric vehicles, the impact of modern drive-trains on energy supplies.

Module IV

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Module V

Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Energy Management Strategies: Energy Management Strategies: Introduction to energy

management strategies used in hybrid and electric vehicles, classification of different energy management strategies,

TEXTBOOKS:

1. Automobile Engineering/WilliamHCrouse.
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.
3. T. Denton, Electric and Hybrid Vehicles, Routledge, 2016

Reference Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016
3. K. Netwon, W. Steeds, T. K.Garrett, ―Automotive Engineering‖, Butterworth-Heinamann, 13th Edition, 2016.

Course Outcomes: At the end of the course, the students will be able to

1. Understand the working of IC engines,
2. Demonstrate the working of power transmission and brakes.
3. Understand the models to describe conventional, and hybrid vehicles and their performance.
4. Understand the different strategies related to energy storage systems.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 –Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1											2	2
CO2	3	1											2	2
CO3	3	1											2	2
CO4	3	1											2	2

	L	T	P	C
B.Tech III Year – V Sem				
Subject Code: 21OE5EE01	**3**	**0**	**0**	**3**

FUNDAMENTALS OF ELECTRICAL CIRCUIT ANALYSIS

Pre-requisite: Basic Mathematics & Physics

Course Objectives:

1) To introduce the concepts of electrical circuits and their components
2) To Analyze electrical circuits with the help of network theorems
3) To understand DC circuits and single-phase AC circuits
4) To analyse the magnetic circuits

Course Outcomes:

At the end of course student will be able to do

1. CO1 – To understand the electrical circuits with DC excitation.
2. CO2 – To analyze electrical circuits with the help of network theorems
3. CO3 – To analyze electrical circuits with AC excitation
4. CO4 – To analyse the magnetic circuits.

Module I: D.C. Circuits

Introduction to Electrical Circuits: Current, Voltage, Power, Energy, Ohm's law, types of elements, Kirchoff laws, types of sources, resistive networks, inductive networks, capacitive networks, series, parallel circuits, analysis of simple circuits with dc excitation.

Network Analysis: Mesh and Nodal analysis, Voltage and current divide rule, source transformation technique, and star-delta and delta star transformation, simple problems.

Module II:Network Theorems

Network Theorems -I: Superposition, reciprocity, Thevenin's, Norton's theorems for DC excitations, numerical problems.

Network Theorems -II: Tellegen's, Maximum power transfer, Milliman's for DC excitations, numerical problems.

Module III:A.C. Circuits

Single Phase AC Circuits: Representation of sinusoidal waveforms, Average and RMS values, peak factor, and Formfactor. Real power, Reactive power, Apparent power, power factor, Numerical problems.

RLC Analysis:Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, and RLC combinations for both series and parallel, Numerical problems.

Module IV:Magnetic Circuits

Absolute and Relative Permeability of a Medium, Laws of Magnetic Force,Flux Density (B),Faraday's laws of electromagnetic induction –concept of self and mutual inductance – dot convention

Coefficient of coupling –composite magnetic circuit - Analysis of series and parallel magnetic circuit, Simple Problems.

Module V: Network Topologies

Network Topology-I
Basic definitions of graph theory, Incidence Matrices, Branch path incidence matrices**,** and numerical problems.

Network Topology-II
Cut set matrices, Relation between branch currents I_b and loop currents I_l, Tie set matrices, the relation between branch voltages and node voltages. Duality concept and numerical problems.

TEXTBOOKS:

1. A Chakrabarty, "Electric Circuits", Dhanipat Rai & Sons, 6th Edition, 2010. L.S. Bobrow, Fundamentals of Electrical Engineering", Oxford University Press, 2011
2. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014.

REFERENCE BOOKS:

1. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010.
2. David A Bell, "Electric circuits", Oxford University Press, 7th Edition, 2009.
3. Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice-Hall India, 1989

Web Resources:

1. **https://nptel.ac.in/courses/108/104/108104139/**

2. https://nptel.ac.in/courses/117/106/117106108/

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2			3								2	2
CO2	2	3											2	
CO3	2	3											2	
CO4	2	1											2	

B.Tech III Year – V Sem	**L**	**T**	**P**	**C**
Subject Code: 21OE5CM01	**3**	**0**	**0**	**3**

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Objectives

1. To provide a strong foundation of fundamental concepts in artificial intelligence.
2. To provide a basic exposition to the goals and methods of Artificial intelligence
3. To provide the exposition to uncertainty management, decision making and learning methods.
4. To provide different knowledge representation, reasoning, and learning techniques.

Course Outcomes

1. Discuss basic concepts of Artificial Intelligence, AI principles, AI Task domains and application.
2. Apply searching techniques, constraint satisfaction problem and game playing techniques which involve perception, reasoning and learning.
3. Explain working of uncertainty management, decision making and learning methods.
4. Apply different knowledge representation, reasoning, and learning techniques to real world problems.

MODULE-I

Introduction: Artificial Intelligence, AI Problems, AI Techniques, the Level of the Model, Criteria for Success. Problem Space and Search, Defining the Problem as a State Space Search, Problem Characteristics; Tic-Tac-Toe Problem, Production Systems.

Basic Search Techniques: Solving Problems by searching; Issues in The Design of Search Programs; Uniform search strategies; Breadth first search, depth first search, depth limited search, bidirectional search, Best First search, comparing search strategies in terms of complexity.

MODULE-II

Special Search Techniques: Heuristic Search, greedy best first search, A* search Problem Reduction, AO*Algorithm; Hill climbing search, Simulated Annealing search; Genetic Algorithm; Constraint Satisfaction Problems; Adversarial search, Games, Optimal decisions and strategies in games, Minimax search, Alpha, beta pruning.

Knowledge Representation: Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms.

MODULE-III

Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction.

Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, CYC.

MODULE-IV

Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Model and Temporal Logics.

Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory.

Fuzzy Logic: Crisp Sets, Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences & Fuzzy Systems.

MODULE-IV

Experts Systems: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells, Fuzzy Expert systems.

Learning: Types of learning, general learning model, Learning by induction; generalization, specialization, example of inductive learner.

Text Book:

1. Artificial Intelligence, George F Luger, Pearson Education Publications
2. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-Hill Publications

References:

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
2. Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss. G, MIT Press.
3. Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low

CO/PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO2	PSO3
CO-1		3										2	2		
CO-2	3												2		
CO-3		3										2	2		
CO-4	3											2	2		

B.Tech III – V Sem **L T P C**
Subject Code: 21OE5CD01 **3 0 0 3**

Statistics for Data Science

Course Objective

1. The Number Theory basic concepts useful for cryptography etc
2. The theory of Probability, and probability distributions of single and multiple random variables 3. The sampling theory and testing of hypothesis and making inferences
4. Stochastic process and Markov chains.

Course Outcomes:

1. Apply the number theory concepts to cryptography domain
2. Apply the concepts of probability and distributions to some case studies
3. Correlate the material of one unit to the material in other units
4. Resolve the potential misconceptions and hazards in each topic of study.

Module I

Greatest Common Divisors and Prime Factorization: Greatest common divisors, The Euclidean algorithm, The fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers
Congruences: Introduction to congruences, Linear congruences, The Chinese remainder theorem, Systems of linear congruences

Module II

Simple Linear Regression and Correlation: Introduction to Linear Regression, The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study
Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence. Discrete probability
Distributions: Binomial Distribution, Poisson distribution.

Module III

Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial, Fundamental Sampling
Distributions: Random Sampling, Sampling Distributions, Sampling, Distribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t–Distribution, F Distribution.

Module IV

Estimation & Tests of Hypotheses: Introduction, Statistical Inference, Classical Methods of Estimation. Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Tolerance Limits, Estimating the Variance, Estimating a Proportion for single mean, Difference between Two Means, between Two Proportions for Two Samples and Maximum Likelihood Estimation.

Module V

Stochastic Processes and Markov Chains: Introduction to Stochastic processes- Markov process. Transition Probability, Transition Probability Matrix, First order and Higher order Markov process, n step transition probabilities, Markov chain, Steady state condition, Markov analysis.

TEXT BOOKS:

1. Kenneth H. Rosen, Elementary number theory & its applications, sixth edition, Addison Wesley, ISBN 978 0-321-50031-1
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
3. S. D. Sharma, Operations Research, Kedarnath and Ramnath Publishers, Meerut, Delhi

REFERENCE BOOKS:

1. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications 2. T.T. Soong, Fundamentals of Probability And Statistics For Engineers, John Wiley & Sons Ltd, 2004.
3. Sheldon M Ross, Probability and statistics for Engineers and scientists, Academic Press.

CO-PO &PSO Mapping:

Course Name - Course Outcomes / Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO 2	PSO 3
CO1	M	L			L										
CO2	M	L			L										
CO3	M	L			L										
CO4	M	L			L										

B. Tech III Year – V Sem	L	T	P	C
Subject Code: 21OE5CO01	3	0	0	3

FUNDAMENTALS OF IOT

PREREQUISITE: Basics of computers

COURSE OBJECTIVE:

1. The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time.
2. The course enables student to understand the basics of Internet of things and protocols.
3. Introduces some of the application areas where Internet of Things can be applied.
4. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things

COURSE OUTCOMES:

1. Interpret the concepts of IoT
2. Analyze the importance of Protocols in IoT
3. Understand the IoT architecture
4. Apply IoT concepts in Industry applications and IoT platforms

Module 1:

Introduction to IOT - IoT and its importance, Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications

Overview of Governance, Privacy and Security Issues.

Module II

IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – **Protocols** – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Module III

IOT ARCHITECTURE - IoT Open-source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models

IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Module IV

WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT

Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.

Module V:

IOT APPLICATIONS – Qualitative study of sensors, IoT applications for industry: Future Factory Concepts, Smart Objects, Smart Applications.

Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

TEXT & REFERENCES:

Text:

- Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
- Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet ofThings", Springer, 2011.
- David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.
- Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applicationsand Protocols", Wiley, 2012.

References:

- Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
- Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013
- CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1

Course Outcomes (CO)	**CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low**													
	Program Outcomes (POs)												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3								2	2			1	
CO2	3	1			3				2	2			2	
CO3	3	1			2				2	2			2	
CO4	3	1	3		3				2	2			1	

B. Tech III Year–V Sem	**L**	**T**	**P**	**C**
Subject Code: 21OE5CC01	**3**	**1**	**-**	**4**

DATA SECURITY

Prerequisite(s): Nil

Course Objectives:

• To introduce different classical cryptographic techniques and its theoretical security analysis.
• To provide and demonstrate different cryptanalysis attacks against the cryptographic techniques, and their attack models.
• To show the impact of these ciphers on society during the time of their use.

Course Outcomes:

At the end of the course, students are able to:

CO1: Identify the basic language & terminologies of cryptography.
CO2: Demonstrate Encryption and Decryption methods using various ciphers of classical cryptography.
CO3: Perform cryptanalysis of classical cryptography.
CO4: Understand the concept of digital signatures.

Module 1:

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks.
Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric keycryptography, steganography, key range and key size, possible types of attacks.

Module 2:

Symmetric key Ciphers: Algorithms Types, Algorithm Modes, Data Encryption Standards, International Data Encryption Algorithm (IDEA), RC4, RC5, Blowfish,
Case Study: Secure Multiparty Calculation.

Module 3:

Asymmetric key Ciphers - I: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Comparison of symmetric and symmetric Key Cryptography.

Module 4:

Asymmetric key Ciphers - II: Digital signatures, Elgamal Digital Signature Scheme, Attacks on Digital Signature, Knapsack Algorithm, Problems with Public key Exchange.

Module 5:

Public – Key Infrastructure : Digital Certificates, private - Key management, The PKIX Model, Public Key Cryptography Standards(PKCS) , XML, PKI and security.

Text Books:

1. Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011.
2. Josef Pieprzyk, Thomas Hardjono and Jenifer Seberry, "Fundamentals of Computer Security", Springer 2010.

Resources:

1. Douglas R Stinson, "Cryptography: Theory and Practice", CRC Press 2005.
2. Alfred J Menezes, Paul C Van Oorshot and Scott A. Vanstone, "Handbook of Applied Cryptography", CRC press 1996.

CO-PO/PSO Mapping:

CO-PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO2	PSO3
CO-1			2				3								
CO-2				2			1								
CO-3				3				1							
CO-4		1						3							

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PC6ME19	3	0	0	3

DESIGN OF MACHINE MEMBERS-II

Pre-requisite: Mechanics of Solids, Material Science, Engg. Mathematics

Note: Design Data books are permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

Course Objectives:

1. To understand the design and selection procedure of bearings
2. To calculate stress and design the engine parts
3. To design commonly used important machine members such as springs, belts, gears etc.
4. To design the components using the data available in design data books.

Module I

Introduction of Bearings : Types of bearings – Lubrication – Bearing Modulus – Journal bearings Full and partial bearings, ball and roller bearing- types and bearing parameters, material selection of bearings.

Sliding contact bearings: Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

Module II

Rolling contact bearings: Ball and roller bearings – Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings.

Mechanical Springs: Stresses and deflections of helical springs – Extension and compression springs – Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity – helical torsion springs – Design of co-axial springs, Design of leaf springs.

Module III

Design of Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends.

Pistons, Forces acting on piston: Construction, Design and proportions of piston.

Module IV

Design of Belt drives: Transmission of power by Belt Transmission efficiencies, Belts –Flat and V types design.

Design of Rope drive- Types of rope drives, Transmission of power by rope drives. Design of Rope drives.

Module V

Spur gear: Brief introduction involving important concepts of Spur gear, Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

Helical Gear: Brief introduction involving important concepts of Helical gear,Types of forces acting on helical gear, Design of Helical gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

Text Books:

1. Design of Machine Elements - V. B. Bhandari.
2. Mechanical Engineering Design by Shigley, Budynas & Nisbett.
3. Design of Machine Elements by Dr. Sadhu sign

Reference Books:

1. Fundamentals of Machine Component Design by Robert C Juvinall.
2. Machine design by Zinadal.
3. Machine design by Bear and Jhonson.

Web Resources:

https: //nptel.ac.in/courses/112106137

https://www.coursera.org/learn/machine-design1

Course Outcomes: At the end of the course the student should be able to

CO1 –Design journal bearing by using different empirical relations

CO2 – Optimize the life of rolling element bearings and their selection for given service conditions.

CO3 – Design the connecting rod, piston and gears.

CO4 - Solve the design problems on spring, belt and rope.

CO-PO/PSO Mapping Chart (3/2/1 indicates the strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2										2	
CO2	3	2	2										2	
CO3	3	2	2		1								2	
CO4	3	2	2		1								2	

** If more PSOs are there in a particular branch, the required no of columns can be added.*

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PC6ME20	3	0	0	3

HEAT TRANSFER

Note: Heat Transfer and steam tables Data Books are permitted in the Examination.
Pre-requisite: Thermodynamics, fluid mechanics.

Course Objectives: To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

MODULE I

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.
Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

MODULE II

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long, Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

MODULE III

Convective Heat Transfer: Classification of systems based on causation of flow
non- dimensional correlation for convection heat transfer –Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.
Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

MODULE – IV

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 Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods, Factors effecting the design of Heat Exchangers.

MODULE – V

Heat Transfer with Phase Change:

Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation.

Radiation Heat Transfer : Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

Text Books:

1. Heat And Mass Transfer – Dixit /Mc Graw Hill .
2. Heat And Mass Transfer – Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. Dewitt, 7 Th Edition, John Wiley & Sons.
3. Heat & Mass Transfer - Dr. D.S Kumar,Publisher, S.K. Kataria & Sons. Edition, 9th, 2018

Reference Books:

1. Essential Heat Transfer - Christopher A Long / Pearson.
2. Heat & Mass Transfer: Practical Approach, Yunus A. Cengel , A. Ghajar McGraw Hill publications, 2010.
3. Fundamentals of engineering heat and mass transfer, by R.C. Sachdeva, New age Publishers.

Course Outcomes: At the end of this course, student will be able to:

1. Analyze the modes of heat transfer.
2. Derive relation for different modes of heat transfer.
3. Perform thermal circuit analysis for practical engineering problems by using heat transfer concepts.
4. Analyze and design heat exchangers.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3											3	
CO2	3	3											3	
CO3	3	3	2	1									3	1
CO4	3	3	2	1									3	2

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PC6ME21	3	0	0	3

CAD&CAM

Pre-requisites: To learn the importance and use of computer in design and manufacture

Course objectives:

1. To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture.
2. To understand the need for integration of CAD and CAM.

MODULE-I

Fundamentals of CAD/CAM: Product life Cycle, Application of computers for Design and Manufacturing, Scope and Benefits of CAD/CAM- Design workstation, CAD/CAM software-definition of system software and application software, CAD/ CAM database and structure.

Geometric Modeling: Wireframe modeling, Interpolation and approximation of curves, Concept of parametric and non parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

MODULE-II

Surface Modeling: Algebraic and geometric form, Parametric space of surface, blending functions, parameterization of surface patch, Subdividing, Cylindrical surface, ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modeling: Definition of cell composition and spatial occupancy enumeration, sweep representation, Constructive solid geometry, Boundary representations, Editing tools.

MODULE III

CNC: Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language).

CNC-Milling and Drilling,3-axis,4axis and 5 axis CNC machines, DNC.

MODULE-IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning.

MODULE V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

Rapid prototyping: Basics of Rapid prototyping

TEXTBOOKS:

1. CAD/CAM Concepts and Applications/Alavala/PHI
2. CAD/CAM Principles and Applications/P.N.Rao /McGrawHill
3. CAD CAM theory and practices by Ibrahim Zeid.

REFERENCEBOOKS:

1. CAD/CAM/Groover M.P/Pearson
2. CAD/CAM/CIM/Radhakrishnan and Subramanian/New Age.

Course Outcomes: At the end of the course the student should be able to

CO1: Develop mathematical models to represent curves and surfaces.
CO2: Develop engineering components using solid modelling techniques.
CO3: Develop programs for CNC to manufacture industrial components.
CO4: Design, Proper planning, Manufacturing cost, Layout & Material Handling system application of computers in various aspects of Manufacturing

CO-PO-PSO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3				3									1
CO2	3	3	2		3									2
CO3	3	3	2		3								2	2
CO4	3	3	3		3								3	3

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PC6ME22	3	0	0	3

MACHINING SCIENCE

Pre-requisites: Material Science & Metallurgy, Production Technology Metrology and Machine Tools.

Course Objectives:

- Introducing students to machining processes used in industries.
- Understanding on various machining parameters and their inter-relation.
- Optimization of cutting tool parameters for a smooth finish of the machined part.

Module I:

Introduction: Classification of Manufacturing Processes, History of Machining, Scope and Significance of Machining.

Geometry of Cutting Tools: Geometry of single-point turning tool: Tool-in hand system, ASA system, Significance of various angles of SPTT, Orthogonal Rake System (ORS), Normal Rake System (NRS), Conversions between ASA and ORS systems.

Module II:

Mechanics of Machining: Processes: Orthogonal and Oblique cutting, Mechanics of Chip formation: Types of chips, chip-breakers, Chip reduction coefficient, shear angle, shear strain, Built-Up-Edge and its effect in metal cutting, Merchant's analysis of metal cutting process – Various forces, power and specific energy in cutting, Effect of tool geometry on cutting forces and surface finish.
Thermal aspects in machining: Sources of heat generation, Effects of temperature, Determination of cutting temperature using analytical methods, Determination of cutting temperature using experimental methods, Methods of Controlling Cutting Temperature.

Module III:

Tool wear, Tool life, Machinability: Wear Mechanisms, Types of tool wear, Tool Life and Machinability.
Machining Economics: A brief treatment for single pass turning operations

Module IV:

Cutting Tool Materials: Desirable Properties of tool materials, Characteristics of Cutting Tool Materials, Indexable inserts, coated tools.
Cutting Fluids: Functions, characteristics and types, Selection of cutting fluids.

Module V:

Mechanics of Multipoint machining processes: Mechanics of Milling process, Mechanics of Grinding (plunge grinding and surface grinding).

Modern Machining Processes: An overview of modern machining processes – Classification, Mechanical Processes – Ultrasonic, water jet and abrasive jet machining - Working principle, application, economy and process selection, Mechanism of material removal, process parameters, Electrochemical Processes – Chemical machining, electro chemical machining - Working principle, application, economy and process selection, Mechanism of material removal, process parameters, Electric Discharge Machining (sinking EDM and Wire cut EDM) - Working principle, application, economy and process selection, Mechanism of material removal, process parameters.

Text Books:

1. Amitabha Ghosh and A.K. Mallik, "Manufacturing Science", 2nd Edition East-West Press, 2010
2. B L Juneja and G S Sekhon, "Fundamentals of metal cutting and machine Tools", New Age International publishers, 2001.
3. Rao. P.N "Manufacturing Technology – Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.

Reference Books:

1. Kalpakjian S. and Steven R. Schmid, Manufacturing, "Engineering & Technology" Pearson, 2007.
2. P. C. Pandey and H. S. Shan, "Modern Machining Processes", TMH, 2002.
3. V. K. Jain, "Advanced manufacturing Processes", Allied Publishers Pvt. Ltd, 2002.

Web References:

https://nptel.ac.in/courses/112104290.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Classify interrelations among ASA, ORS and NRS systems of tool geometry.
CO2	Discuss the stresses, cutting forces, temperature, power and specific energy in metal cutting with single point cutting tool.
CO3	Describe various aspects of tool wear and cutting fluids to improve tool life and machinability
CO4	Analyze types of modern machining process

CO-PO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	1	-	1	-	-	-	-	-	1	1

B. Tech III Year–II SEM	L	T	P	C
Subject Code: 21PC6ME24	0	0	2	1

COMPUTER-AIDED ENGINEERING AND MANUFACTURING LAB

Pre-requisites: To give the exposure to usage of software tools for design and manufacturing. To acquire the skills needed to analyze and simulate engineering systems.

Course Objectives: To be able to understand and handle design problems in a systematic manner. To be able to apply CAD in real-life applications. To understand the basic principles of different types of analysis.

Note: conduct any TEN exercises from the list given below:

1. Developing the codes for 3D Printing component
2. 3D printing of a mechanical component
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-Mises stresses in plane stress, plane strain andAxi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Mechanism simulations(any one mechanism)
8. Shape and weight optimization using generative design.
9. Study state heat transfer analysis of plane and axi-symmetric components.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAMsoftware.

Reference Books:

1. K.L. Narayana, P. Kannaiah, “Production Drawing”, New Age publishers, 3rd Edition, 2009.
2. Goutham Pohit, Goutham Ghosh, “Machine Drawing with Auto CAD”, Pearson, 1st Edition, 2004.
3. James D. Meadows, “Geometric dimensioning and tolerancing”, CRC Press, 1st Edition, 1995.

Web Reference:

1.https://mech.iitm.ac.in/Production%20Drawing.pdf

Course Outcomes: At the end of the course, the student will be able to:

CO1 Understand the concept of 3D printing
CO2 Develop the CAD model as per standards
CO3 Analysing the mechanical component as per applications.
CO4 Generate part programming through CAM software

CO-PO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2			3							2	2	2
CO2	3	2			3							2	2	2
CO3	3	2			3							2	2	2
CO4	3	2			3							2	2	2

B. Tech III Year–II Sem	**L**	**T**	**P**	**C**
Subject Code: 21PC6ME23	**0**	**0**	**2**	**1**

HEAT TRANSFER LAB

Pre-requisite: Thermodynamics

Course Objectives: To enable the student to apply conduction, convection and radiation heattransfer concepts to practical applications

Minimum twelve experiments from the following:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

Course Outcome: At the end of the lab sessions, the student will be able to

1. Perform steady state and transient conduction experiments to estimate thermal conductivity of differentmaterials
2. Estimate heat transfer coefficients in forced convection, free convection, condensation andcorrelate with theoretical values
3. Obtain variation of temperature along the length of the pin fin under forced and freeconvection
4. Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann’s constant and compare with theoretical value

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2			3								2	2
CO2	3	2			3								2	2
CO3	3	3	2	1	3								2	2
CO4	3	2	2	1	3								2	2

B.Tech III Year -I/II Sem	**L**	**T**	**P**	**C**
Subject Code:21HS6EG05	**0**	**0**	**2**	**1**

ADVANCED ENGLISH COMMUNICATION SKILLS LAB
(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/ME)

1. INTRODUCTION:

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. Atthis stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.
The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Engaging in debates.
3. Participating in group discussions.
4. Facing interviews.
5. Writing project/research reports/technical reports.
6. Making oral presentations.
7. Writing formal letters.
8. Transferring information from non-verbal to verbal texts and vice-versa.
9. Taking part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakersand respond appropriately in different socio-cultural and professional contexts.
2. Further, they would be required to communicate their ideas relevantly and coherently in writing.
3. To prepare all the students for their placements.
4. Learn conversation skills
5. Learn reading strategies
6. Learn time management
7. Learn stress management
8. Learn career planning

Course outcomes

- Express conversational skills
- Specify reading strategies
- Perform time management

- Perform stress management
- Explore career planning

6. **SYLLABUS**:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of 7c's of effective Communication, Behaviour skills and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language - Concise - Clear - Concerts - Coherent - Complete - Correct.
   Behaviour Skills - Grooming - Formal and Informal Communication - Body language - Time Management.

   – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, wordroots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension and Business English** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling,6.listening in effective communication,Style of Communication.
   Business Conversation with dialogues reading and speaking activity
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one's writing.
4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/**Group Writing, info-graphics,**
   e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice,Career Planning, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre-interview planning, opening strategies, answering strategies, interviewthrough tele-conference & video-conference and Mock Interviews.

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PR6ME02	0	0	2	1

DOING ENGINEERING -2

Prerequisite: Kinematics of the Machinery, Engineering Mechanics, Design of Machine Elements.

Course Objectives:

1. To familiarize, how assembly needs to be analysed.
2. To familiarize the virtual prototyping through doing engineering methodology.
3. To analyse the 3D models of various machine elements.
4. Interpretation of the results where the Theory of failures practically works.

Assembly and Mechanism simulation

1. Take two sub-assemblies of the equipment from Doing Engineering -1
2. Practice user examples on Mechanism Simulation using the software tool.
3. Force analysis/mechanism Simulation using Software Tool.
4. Practice User examples on Finite Element Analysis.
5. Perform the finite element analysis on the selected assembly .
6. Practice three examples of CFD using the software tool.
7. Make a video & report preparation of the above work.

Text Books:

1. Catalogs and production drawings of equipment
2. Training Manuals of SOILD WORKS/AUTOCAD/FUSION 360.
3. Design Thinking & Critical Thinking

Course Outcomes: At the end of the course students able to

1. Demonstrate competency in the assembly of the equipment.
2. Learn about the force analysis and compare it with the traditional approach of the theoretical-practical models.
3. Learn how to force analysis is transferred to do the finite Element Analysis for assemblies
4. **S**tudent will understand that How a practical equipment will be analysed with this method.

Assessment: Three hours exam:

1. 30 marks: Continuous Internal Evaluation
2. 70 Marks: External Evaluation

CO-PO/PSO Mapping Chart (3/2/1 indicates the strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2			3				3	3				
CO2	3	2			3				3	3			2	2
CO3	3	2			3				3	3			2	2
CO4	3	2			3				3	3				

	L	T	P	C
Subject Code: 21MC6HS04	**2**	**0**	**0**	**0**

QUANITATIVE APTITUDE
(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/ME)

Course Overview

This course provides the basic skills required in solving the problems of Aptitude required by various companies for Campus Recruitment and competitive tests. The contents of course include solving problems on different concepts such as Permutations and Combinations, Averages, Percentages and Logarithms etc.

Course Pre/co-requisites

No prior knowledge is required.

Course Objectives:

1. To categorize, apply and use thought process to distinguish between concepts of Quantitative methods.
2. To prepare and explain the fundamentals related to various possibilities and probabilities related to quantitative aptitude.
3. To critically evaluate numerous possibilities related to puzzles.

Course Outcomes (COs)

After the completion of the course, the student will be able to:

1. Apply the concepts of ratios, proportions and percentages to solve problems.
2. Solve problems on Logarithms, permutations, combinations, clocks, and calendars.
3. Able to recall and use the concepts to solve problems numerical estimation with respect to company specific and competitive tests
4. Interpret data using graphs and charts.

Module I:

Arithmetic ability:-Algebraic operations- BODMAS – Fractions – Number system - Divisibility rules LCM&GCD (HCF), Simplification

Ratio and Proportion: Ratio, Proportion, Variations, Problems on Ages

Module II:

Percentages, Simple Interest (SI) and Compound Interest (CI): Fundamentals of Percentage, Percentage change, SI and CI, Relation between SI and CI.

Profit and Loss, Partnerships: Basic terminology in profit and loss, Types of partnership, Problems related to partnership

Module III:

Time and Work, Pipe and Cistern, Speed, Time and Distance, Problems on trains & boats, Calendar problems, Clock problems. Average, Mixtures and Alligation: Averages, Weighted average, Difference between mixture and alligation, Problems on Mixtures and alligation

Module IV:
Data Interpretation: Introduction, Tabulation, Bar Graph, Pie Charts, Line Graphs, Combined Graphs, Geometry: Lines and Angles, Triangle, Trigonometry, Circle, Height and Distance, Quadrilateral and Polygon

Module V:
Permutations and Combinations: Fundamentals counting principle, Definition of Permutation, Seating arrangement, Problems related to alphabets, Rank of the word, Problems related to numbers, Circular permutation, Combination.Logarithms: Fundamental formulae of logarithms and problems, finding number of terms on expanding a given number.

Text Book:
1. Quantitative Aptitude for competitive examinations, .R.S Aggarwal,S.Chand,2017.

Reference Books
1. Quantitative Aptitude for competitive examinations, AbhijitGuha, 6th Edition, McGraw Hill Education.
2. Dinesh Khattar, The Pearson guide to Quantitative Aptitude for Competitive Examinations, 3rd Edition, Pearson Education.

Webresources:
1. www.m4maths.com
2. www.Indiabix.com

CO-PO/PSO Mapping Chart **(3/2/1 indicates strength of correlation)** **3 – High; 2 – Medium; 1 - Low**														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1						2					2	3		
CO2						2					2	3		
CO3						2					2	3		
CO4						2					2	3		

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PE6ME21	3	0	0	3

UNCONVENTIONAL MACHINING PROCESSES (PE-II)

Pre-requisite: Production Technology and Machine Tools

Course Objectives:

1. To discuss the modeling technique for machining processes.
2. To discuss interpretation of data for process selection.
3. To discuss the mechanics and thermal issues associated with chip formation.
4. To discuss the effects of tool geometry on machining force components and surface finish.
5. To discuss the machining surface finish and material removal rate.

Module I

Introduction – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications

Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

Module II

Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations.

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate

Module III

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes.

Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface

Module IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes

General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

Module V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries

Chemical machining –principle - maskants - applications. Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

Text Books:

1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill
3."Advanced Machining Processes: Non traditional and Hybrid Machining Processes" by Hassan El-Hofy and Yusheng Shi, published by CRC Press

Reference Books:

1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers
2. Advanced Methods of Machining/ J.A. McGeough/ Springer International
3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

Course Outcomes:

1) Identify the selection of machining processes and its basic principle
2) Estimate the material removal rate and cutting force and Mention the real time application of unconventional machining process
3) Develop the economic aspects of the different unconventional machining process.
4) Analyze surface properties after machining without destructing the material

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2											2	

** If more PSOs are there in a particular branch, required no of columns can be added.*

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PE6ME22	3	0	0	3

PRODUCTION PLANNING AND CONTROL (PE-II)

Pre-requisite: Production Technology

Course Objectives:

Course Objectives: Understand the importance of Production planning & control. Learning way of carrying out various functions so as to produce right product, right quantity at right time with minimum cost.

Module I

Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department

Forecasting – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors

Module II

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only

Aggregate planning – Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

Module III

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

Module IV

Scheduling –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling – job shop scheduling,

line of balance (LOB) – objectives - steps involved.

Module V

Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

Follow up: definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

Text Books:

1."Operations Management" by Jay Heizer and Barry Render, published by Pearson Education
2.Production and Operations Management / Ajay K Garg / Mc Graw Hill.
3."Production Planning and Control: Text and Cases" by K. K. Chitkara, published by Tata McGraw Hill Education.

Reference Books:

1.Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications
3."Production Planning and Control for Semiconductor Wafer Fabrication Facilities: Modeling, Analysis, and Systems" by Andreas J. G. Reindl and Robert W. Grubbström, published by Springer

Course Outcomes:

1) Describe the theory of constraints for effective management of production systems
2) Evaluate MRP and JIT systems against traditional inventory control systems.
3) Analyze aggregate planning strategies
4) Apply forecasting and scheduling techniques to production systems

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2								1		2	
CO2	3	2	2								1		2	
CO3	3	2	2								1		2	
CO4	3	2	2								1		2	

** If more PSOs are there in a particular branch, required no of columns can be added.*

B. Tech III Year–II Sem	L	T	P	C
Subject Code: 21PE6ME24	3	0	0	3

COMPOSITE MATERIALS (PE-II)

Pre-requisites: Metallurgy & Material Science

Course Objectives:

1. Develop understanding on the structure of composites.
2. Develop knowledge on reinforcement and interfacing in composites.
3. Outline the key processing techniques for producing metal matrix composites and polymer matrix composites.
4. Discuss the relationship among synthesis, processing, and properties in composite materials.

SYLLABUS:

Module I

Introduction to Composite Materials : Classification of Composite Materials

Definition, Classification of Composite based on structure, based on matrix.

Constituents of Composite Materials: Reinforcements, Matrix, Coupling Agents, Coatings & Fillers.

Module II

Fabrication of Composite Materials :Reinforcements for Composite Materials

Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-oxide Reinforcements, Comparison of Fibers

Interfaces in Composite Materials: Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

Module III

Metal Matrix Composites: Fabrication of Metal Matrix Composites Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques

Interface in Metal Matrix Composites

Interface in Metal Matrix Composites: Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications

Module IV

Polymeric Matrix Composites: Fabrication of Polymeric Matrix Composites

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites

Interface in Polymeric Matrix Composites: Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

Module V

Structural and Thermal Properties of Composites: Micromechanics of Composites

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses

Thermal properties of composites: Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber

Text Books:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.

2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.
3. "Mechanics of Composite Materials" by Autar K. Kaw, published by CRC Press.

Reference Books:

1.Composites, Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.

2.Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim, Germany, 1993**.**

3.Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994

Web References:https://youtu.be/2uCzruEduDs

Course Outcomes: At the end of the course, the student will be able to:

CO1	Describe various types of composites and their applications.
CO2	Discuss how common fibers are produced and how the properties of the fibers are related to the internal structure.
CO3	Analyze various thermal and structural properties of composites.
CO4	Describe key processing methods for fabricating composites.

CO-PO Mapping:

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 –Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes ***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**
CO1	3	2	1											
CO2	3	2	2	1	1								1	
CO3	3	2	1		1									
CO4	3	2	1	1	-	-	1	-	-	-	-	-	1	1

B. Tech III Year–IISem	L	T	P	C
Subject Code: 21PE6ME23	3	0	0	3

FINITE ELEMENT METHODS (PE-II)

Pre-requisites: Mechanics of Solids, KOM and DOM

Course Objectives:

The course content enables students to:

- Basics of Finite Element Analysis.
- Available material models for structural materials, soils and interfaces/joints.
- Modelling of engineering systems and Soil–Structure Interaction(SSI).
- Importanceofinterfacesandjointsonthebehaviourofengineeringsystems.
- Implementationofmaterialmodelinfiniteelementmethodandapplications

Module I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain–Displacement relations. Stress–strain relations: FiniteElements:1-Dimensional,2– Dimensional,3-Dimensional&Interpolation Elements.

One Dimensional Problems: 1-D Linear and 1-D Quadratic Elements - Finite element modelling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

Module II

Analysis of Trusses: Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations.

Analysis of Beams: Element stiffness matrix for two nodded, two degrees of freedom per node beam element ,Load Vector , Deflection.

Module III

Finite element modelling of two-dimensional. Finiteelementmodelingoftwo-dimensionalstressanalysiswithconstantstraintrianglesandtreatmentofboundaryconditions, Estimation of Load Vector, Stresses

Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four nodded Isoperimetric elements and numerical integration.

Module IV

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two-dimensional analysis of thin plates.

Steady State Heat Transfer Analysis and two-dimensional analysis of thin plate

Module V

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss and beam.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of software's such as ANSYS ,ABAQUS ,NASTRAN using Hexahedral and Tetrahedral Elements

TEXT BOOKS:

1. Finite Element Methods: Basic Concept sand applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering ,Chandrupatla ,Ashok and Belegundu/Pearson
3. "Introduction to Finite Elements in Engineering" by Tirupathi R. Chandrupatla and Ashok D. Belegundu, published by Prentice Hall.

REFERENCEBOOKS:

1. An Introductionto theFinite ElementMethod /J.N.Reddy/McGrawHill
2. FiniteElementAnalysis/SS Bhavikatti/NewAge
3. FiniteElement Method/ Dixit/Cengage

Equivalent Mooc Courses if any:

https://nptel.ac.in/courses/112102015

Course Outcomes:

CO1.-Discuss the basic concepts and principles related to finite element methods.

CO2 – Apply FEM process for bars, trusses, beams, axi- symmetric and isoperimetric elements.

CO3 - Calculate heat transfer for 1D and 2D elements using FEM.

CO4 - Solve dynamic analysis problems of FEM in bars, truss and beams.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3		2			1							2	1
CO2	3		2			1							2	1
CO3	3		2			1							2	1
CO4	3		2			1							2	1

HR 21

	L	T	P	C
B.Tech III Year – VI Sem				
Subject Code: 21OE6CS09	**3**	**0**	**0**	**3**

Object Oriented Programming Using Java

Prerequisites: Programming in C

Course Objectives:
1. Understand fundamental concepts and object oriented concepts in Java
2. Implementing the concept of packages and exception handling in Java.
3. Implement the concept of multithreading and inter process communication in Java.
4. Develop GUI applications.

Course Outcomes:
1. Solve the given problem using OOPS technique.
2. Explain the concept of Package and Exception Handling.
3. Implement Multi threading and Inter process communication in java
4. Develop GUI based applications using applet, AWT , Event handling and swing.

Module - I
History and Evolution of java: Java's lineage, Java and internet, Byte code, Java buzzwords, Evolution of java.
Object oriented programming - data, types, variables, Arrays,operators, control statements, type conversion and casting, Introduction to classes, objects, methods, constructor, this and static keywords , garbage collection, overloading methods, parameter passing, access control, command line arguments,exploring String class
Inheritance: member access and inheritance, Multilevel Inheritance, super and final keywords, method overriding, dynamic method dispatch, abstract classes and methods.

Module- II
Packages and Interfaces: Defining, Creating and Accessing a Package, understanding CLASSPATH, importing packages, Differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.
Exception handling: Concepts of exception handling and its benefits, usage of try, catch, throw, throws and finally, built in exceptions, creating own exceptions.

Module -III
Multithreading: Differences between multi-threading and multi programming, thread life cycle, creating threads using thread class and Run able interface, thread priorities, synchronization , inter thread communication.
I/O Streams: Stream classes, Byte and character streams, File class, reading and writing files,reading and writing from console, serialization.

Module -IV
Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, creating applets, passing parameters to applets.

AWT: class hierarchy, user interface components- labels, buttons, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, Layout Managers- Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout.
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes.

Module- V

Swings: Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing- J Applet, J Frame and J Component, Image Icon, J Label, J Text field, J Button, J Checkbox, J List, J Radio button, J Combo Box, J Tabbed Pane, J Scroll Pane.
The Collections Framework (java.util)- Collections overview, Collection Interfaces, Generics The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array De-queue. Accessing a Collection via an iterator, Using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, Arrays, The Legacy Classes and Interfaces- Dictionary, Hash table, Properties, Stack, Vector More Utility classes, String Tokenizer, Date, Calendar, Random, Scanner

Text Books:
1. The Complete Reference JAVA 2, Author: Herbert Schield , ninth edition Publishers: TataMec-Hill
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, PearsonEducation.

Reference Books:
1. An Introduction to JAVA Programming (Chapter 6) Author: Y.Daniel Liang , Publishers:Tata Mec-Hill.
2. Programming with JAVA (2nd Edition) Author: E. Balagurusamy Publishers: Tata Mec-Hill.
3. Internet and Java Programming, R.Krishna Murthu and S.Prabhu, New Age Publishers

CO-PO/PSO Mapping:

Course Outcomes(COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***		
	PO 1	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	**2**														**1**
CO2	**2**														**1**
CO3	**2**														**1**
CO4	**3**	**1**	**1**	**1**	**3**										**3**

B. Tech III Year – VI Sem	**L**	**T**	**P**	**C**
Subject Code:21OE6EC02	3	0	0	3

Fundamentals of Digital Electronics

(Open Elective)

Prerequisite: Basic knowledge on computers

Course Objectives:

This course provides in-depth knowledge of Digital logic techniques of digital circuits, which is the basis for design of any digital circuit.

1. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
2. To impart the concepts of combinational, sequential logic circuits.
3. To learn the concepts of sequential circuits, enabling them to analyse sequential systems in terms of state machines.

Course Outcomes: Upon completion of the course, the student should be able to

1. Explain the numerical information in different forms and Boolean Algebra theorems
2. Solve Boolean expressions using Boolean Theorems-maps
3. Design and analyze combinational and sequential circuits
4. Implement logic families and realization of logic gates

Module I: Number Systems & Boolean Algebra:

Number Systems: Number base conversions: Binary, Octal, Decimal, Hexa-decimal, Complements of Numbers, Codes- Weighted and Non-weighted codes and its Properties, Parity check code and Hamming code.
Boolean algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates. The Karnaugh Map Method, don't care map entries, Prime and Essential Implicants.

Module II: Combinational Logic Circuits:
Basic Arithmetic Circuits- Half adder, Full adder, Half subtractor, Full subtractor, 4-bit parallel adder/subtractor. BCD Adder
Combinational logic circuits: 2-bit comparator, Multiplexers, Implementation of Boolean functions using Multiplexers, Decoders, Implementation of Boolean functions using Decoder, Demultiplexers, Encoder, Priority Encoder, Code converters.

Module III: Sequential Circuits Fundamentals:
Introduction to Sequential Circuits: Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops,
Flip flop Conversions: Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another.

Module IV: Sequential Logic Applications:

Sequential Logic Applications: Registers and Counters: Shift Registers – Left, Right and Bidirectional Shift Registers, Universal shift register, Applications of Shift Registers

Design of Counters: Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.

Module V: Design and Analysis of Sequential Machines: Introduction to Finite State Machines- Mealy Machine and Moore Machine, State diagram, State Assignment and minimization, Design Procedure and Realization using Flip-Flops.

Introduction to CMOS Technology: CMOS technology, Working states of CMOS, Types of CMOS, AND, OR and NOT Gates using CMOS.

Text Books:

1. Switching and Finite Automata Theory - Zvi Kohavi & Niraj K. Jha, 3rd Edition, Cambridge, 2010.
2. Modern Digital Electronics – R. P. Jain, 3rd Edition, Tata McGraw-Hill, 2007.

Reference Books:

1. Digital Design- Morris Mano, PHI, 4th Edition,2006
2. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed, John Wiley & Sons Inc.
3. Fundamentals of Logic Design- Charles H. Roth, Cengage Learning, 5th, Edition, 2004.
4. Switching Theory and Logic Design – A Anand Kumar, PHI, 2013

Web Resources:

1. http://blog.digitalelectronics.co.in/
2. www.nesoacademy.org/electronics-engineering/digital-electronics/digital
3. https://www.slideshare.net/JournalsPubwwwjourna/international-journal-of-digital-electronics-vol-2-issue-2
2. https://lecturenotes.in/subject/203/switching-theory-and-logic-design-stld
3. http://www.infocobuild.com/education/audio-video-courses/electronics/DigitalCircuitsSystems
4. https://nptel.ac.in/courses/117105080/

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-
CO4	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-

B. Tech III Year–VI Sem	**L**	**T**	**P**	**C**
Subject Code: 21OE6ME02	**3**	**0**	**0**	**3**

TOTAL QUALITY MANAGEMENT & SIX SIGMA APPLICATIONS

Pre-requisite: Management Science &Production Technology, Machine Tools

Course Objectives:

1. To understand the quality concepts and tools
2. To discuss about techniques relating to total quality management.
3. To understand the Principles and Practices of TQM
4. To understand the implementation of ISO 9000 AND Six sigma in a system

Module I

Introduction: The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.
Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

Module II

Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure.

Module III

Organizing for TQM**:** The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools

Seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, pane to diagram, Kepner& Tregoe Methodology.

Module IV

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

Use of Quality Cost information, Accounting Systems and Quality Management.

Module V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit.

Documentation ISO9000 and services, the cost of certification implementing the system.

Six sigma and applications of sixsigma.

Text Books:

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited.
2. Total Quality Management/P. N. Mukherjee/PHI
3. "Lean Six Sigma: Combining Six Sigma with Lean Speed" by Michael L. George, David Rowlands, and Bill Kastle, published by McGraw-Hill Education
4.

Reference Books:

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4.

Course Outcomes: At the end of the course, the students will be able to

1) Understand the fundamental principles of Total Quality Management.
2) Analyze the different quality approaches
3) Evaluate the different tools in Total Quality Management
4) Describe the importance and implementing of ISO9000 in the system and Six sigma

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2						1	2	2	2	2	2	
CO2	3	2	2					1	2	2	2	2	2	
CO3	3	2	2					1	2	2	2	2	2	
CO4	3	2	2					1	2	2	2	2	2	

** If more PSOs are there in a particular branch, required no of columns can be added.*

B.Tech III Year – VI Sem

Subject Code: 21OE6EE02

L	T	P	C
3	0	0	3

FUNDAMENTALS OF INDUSTRIAL ELECTRONICS
OPEN ELECTIVE II
ALL BRANCHES EXCEPT EEE

Pre-requisite: Basic Electrical and Electronics Engineering or Analog and Digital Circuits

Course Objectives:

1) To Design/develop suitable power converter for efficient control or conversion of power in drive applications.
2) To Design / develop suitable power converter for efficient transmission and utilization of power in Industrial applications.

Course Outcomes: At the end of course student will be able to do

1) CO1 – Understand the differences between signal level and power level devices.
2) CO2 – Analyze controlled rectifier circuits.
3) CO3 – Analyze the operation of DC-DC choppers.
4) CO4 – Analyze the operation of voltage source inverters.

Module I:Power Switching Devices and Protection Circuits

Power Switching Devices:

Types of power converters; Power semiconductor switches and their V-I characteristics - Power Diodes, Power BJT, Power MOSFET, Power IGBT. SCR VI Characteristics, Switching characteristics.

Thyristor voltage and current ratings and protection using Snubber Circuit.

Module II:Triggering and Commutation

Triggering Circuits: R, RC and UJT triggering circuits

Commutation Circuits: Types of Commutation circuits (Class A, B,C,D,E,F)

Module III:Rectifiers

Single Phase Rectifier: Principles of single-phase half-controlled converter with R, RL and RLE load. Principles of single-phase fully-controlled converter with RLE load. Problems on Single phase Rectifiers.

Three Phase Rectifier: Principles of three-phase fully-controlled converter operation with RLE load. Problems on Three phase Rectifiers.

Module IV:Choppers, AC Voltage Converters and Cycloconverters

DC-DC Converters (Choppers)
Introduction of Choppers, Control strategies in Choppers, Time Ratio Control, Step down and Step Up Choppers with problems.

AC Voltage Converters and Cycloconverters
Phase Controller (AC Voltage Regulator)-Introduction, principle of operation of single-phase voltage controllers for R, R-L loads.

Cyclo-converter- Principle of operation of single phase cyclo-converters: Mid Tap and Bridge type, relevant waveforms.

Module V:Inverters and Applications

DC-AC Converters (Inverters)
Introduction, principle of operation, performance parameters, single phase half and full bridge inverters with R, RL loads. Problems on single phase inverters.
Applications: UPS, SMPS, Battery Charger.

TEXT BOOKS:

1. Dr.P.S.Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.
2. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.

Reference Books:

1.N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
2. MD Singh and KB Kanchandhani, " Power Electronics", Tata Mc Graw Hill Publishing Company Limited, New Delhi.

Web Resources: www.mathworks .com

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes***	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	1											1	2
CO2	2	2	3		2								2	2
CO3	1	2	3		2								2	2
CO4	1	2	3		2								2	2

B. Tech III Year–VI Sem	L	T	P	C
Subject Code: 21OE6CM06	3	0	0	3

Expert Systems

Prerequisite:

1. Artificial Intelligence

Course Objectives:

1. Understand Expert Systems and their applications.
2. Illustrate Fuzzy Logic Concepts with an example.
3. Understand the Genetic Algorithm and its applications.
4. Explain the components of Expert System building and its tools.

Module-I

Overview of Expert Systems:

Introduction to Expert System: Characteristics of Expert System, Advantages and Disadvantages of Expert Systems, Different types of Expert Systems: Rule-based Expert Systems, Knowledge-based Expert Systems, Model-based, Case-based, and Hybrid Expert Systems, Working Architecture of Expert Systems, Components of Expert Systems, Applications of Expert Systems, Techniques for extracting the knowledge from Domain Experts.

Module – II

Knowledge Representation:

Representations and Mapping: General goal of Knowledge Representation, Approaches to Knowledge Representation: Simple Relational Knowledge, Inheritable Knowledge, Inferential Knowledge, Procedural Knowledge or Operational Knowledge, Classification of Knowledge Representation Systems: Logics (Predicate Logic, Description Logic, Nonmonotonic Logic); Procedural Schemas (Production rules), Structural Schemas (Weak slot-and-filler structures, Strong slot-and-filler structures), Knowledge-Based Systems.

Module - III

Fuzzy Logic:

Introduction to Fuzzy Logic, Fuzzy set theory, Fuzzy sets: Operation on Fuzzy sets, Scalar cardinality, fuzzy cardinality, union and intersection, complement, equilibrium points, aggregation, projection, composition, decomposition, cylindrical extension, fuzzy relation, Fuzzy membership functions, Fuzzy Expert Systems, Fuzzy Decision Making, Applications of Fuzzy System, De-fuzzification.

Module – IV

Genetic Algorithms:

Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem; Genetic algorithms operators-methods of selection, crossover and mutation, Simple GA(SGA), Different types of GA, generation gap, steady state GA, Applications of GA.

Module – V

Development of Expert System:

Nature of Expert System tools, Types of tools available for expert system building, Stages in the development of expert system tools. Building an Expert system, Stages of Expert system development, Tasks in building the Expert System.

Text Books:

1. Principles of Expert Systems by Peter, J.F. Lucas & Linda C. van der Gaag, 2014.
2. Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering by Nikola K. Kasabov, 1998.
3. Introduction to Genetic Algorithms by S. N. Sivanandam and S. N. Deepa 2008.

Reference Text Books:

1. David Goldberg. V Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, 2009.
2. Zimmermann. H.J, "Fuzzy set theory-and its Applications"- Springer international edition, 2011.

Web Resources & E-Books:

1. https://www.geeksforgeeks.org/
2. https://www.sciencedirect.com/journal/expert-systems-with-applications/

MOOC's Courses:

1. NPTEL Course on "Introduction to Fuzzy Set Theory, Arithmetic and Logic".
2. NPTEL Course on "Fundamentals Of Artificial Intelligence"

Course Outcomes:

Upon completing this course, the student will be able to

1. Describe the Expert Systems and their applications.
2. Use Knowledge Representation to solve the problem.
3. Illustrate the Fuzzy Logic and Genetic Algorithms with an example.
4. Discuss the Expert System building and its tools.

CO-PO/PSO Mapping Chart
(3/2/1 indicates strength of correlation)
3 – High; 2 – Medium; 1 - Low

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3	2													2
CO3	3	2													2
CO4	2														

B.Tech III – VI Sem	L	T	P	C
Subject Code: 21OE6CD02	3	0	0	3

Data Mining and Data Analytics

Course Objective

1. Understand the concepts of Data Mining
2. Familiarize with association rule mining
3. Familiarize various classification algorithms
4. Understand the concepts of Cluster analysis
5. Implement the Data mining concepts with various domains

Course Outcomes:

1. Discuss varies Data Mining Principles.
2. Analyze the impact of data analytics for business decisions and strategy.
3. Apply the Association, Clustering rules for mining the data.
4. Design various classification techniques.

Module I

Introduction to Data warehouse, Difference between operational database systems and data warehouses. Data warehouse Characteristics, Data warehouse Architecture.
Introduction: What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing, Data Cleaning, Missing data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of Similarity and Dissimilarity – Basics.

Module II

Data Analytics: Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables. Data Modeling Techniques, Missing Imputations etc. Need for Business Modeling.

Module III

Regression – Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc.
Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

Module IV

Association Rule Mining & Classification: Mining Frequent Patterns–Associations and correlations – Mining Methods–Mining Various kinds of Association Rules– Correlation Analysis.
Classification: Classification and Prediction – Basic concepts–Decision tree induction– Bayesian classification, Lazy learner.

Module V

Clustering and Applications: Cluster analysis–Types of Data in Cluster Analysis– Categorization of Major Clustering Methods– Partitioning Methods.
Hierarchical Methods– Density–Based Methods, Grid–Based Methods, Outlier Analysis.

TEXT BOOKS:

1. Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier.
2. Data Mining Techniques – ArunKPujari

REFERENCE BOOKS

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addision Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira

CO-PO &PSO Mapping:

Course Name - Course Outcomes / Program Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M												M		
CO2	M	H											H		
CO3	H		M											M	
CO4	M													H	

B.Tech III Year – VI Sem	L	T	P	C
Subject Code: 21OE6CO05	3	0	0	3

SENSORS AND DEVICES

Prerequisite: IoT, ADE

Course Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices

Course Outcomes:

- Understand the IoT value chain structure (device, data cloud), application areas and technologies involved.
- Analyse IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules
- Market forecast for IoT devices with a focus on sensors
- Explore Internet of Things with the help of preparing projects designed for Raspberry Pi

MODULE-I:

Introduction to Internet of Things- Definition and Characteristics of IoT, Sensors, Physical Design of IoT – IoT Protocols, IoT communication models, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems

Types: Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

MODULE-II:

IoT - Software defined networks, network function virtualization, difference between SDN and NFV for IoT

M2M Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

MODULE-III:

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi

Programming – Interfaces (serial, SPI, I2C), Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

MODULE-IV:

Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, speed control of DC Motor, unipolar and bipolar Stepper motors

Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors

MODULE-V:

IoT Physical Servers and Cloud Offerings– Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT

Course project on IoT Application

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn W allace, O'Reilly (SPD), 2014, ISBN: 9789350239759
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

REFERENCE BOOKS:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

CO-PO/PSO Mapping Chart (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Program Outcomes (POs)													**Program Specific Outcomes***	
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO-1	3												1	
CO-2	3	1											2	
CO-3	3	1											2	
CO-4	3	1											1	

B. Tech III Year–VI Sem	L	T	P	C
Subject Code: 21OE6CC02	3	0	0	3

COMPUTER HARDWARE AND SYSTEM ESSENTIALS

Prerequisites: Nil

Course Objectives:

• Computer hardware essentials is designed to introduce students to a basic understanding of the different types of computing devices, computer components (CPU, memory, power supplies, etc.), and operating systems.
• It also introduces building a fully functional Linux and Installing applications.
• Understand the basic of circuit building.

Course Outcomes:

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

CO1: Understanding the working principles of different computing devices (desktop computers, laptops, etc.).
CO2: Understand connection interfaces between peripheral devices, storage devices, displays.
CO3: Understand the procedure for Installation of OS - Linux and supporting, upgrading and new applications.
CO4: Understand the concepts of number system and circuit building.

Module 1:

Components of Computer System: Computer Memory: Secondary storage device types, Basic Principles of operation: Sequential Access device, Direct Access device -Magnetic disks,Optical disks, memory storage devices, Ports: Serial and Parallel Ports, Specialized Expansion Ports: SCSI, USB, MIDI, Expansion Slots and Boards, PC Cards, Plug and Play, HDMI ports, networking ports. System software: bootstrap module, configuration.

Module 2:

OS loading: typical Linux virtual machine. Installing a Linux virtual machine. Using package manager to install/update software. Understanding disk partitions and obtaining partition information using system tools. Obtaining essential system resource utilization and information using system tools and proc file system: disk utilization, memory utilization, process information, CPU utilization.

Module 3:

Operating System: Introduction, Objectives, classification and functions of Operating System, Basics of popular operating system (LINUX, WINDOWS). Kernel prompt, Shell commands.

The User Interface: Task Bar, Icons, Menu, Running an Application. Operating System Simple Setting: Changing System Date and Time, Changing Display Properties, To Add or

Remove a Windows Component, Changing Mouse Properties, Adding and removing Printers. File and Directory Management: Creating and renaming of files and directories, Common utilities. Interrupts statements in various OS and its uses.

Module 4:

Number systems - Signed and Unsigned numbers arithmetic, Binary, Decimal, Octal, Hex, BCD etc. Introduction to logic circuits: Variables and functions, Inversion- Truth tables – Logic Gates and Networks - Boolean algebra - Synthesis using gates - Design examples – Optimized implementation of logic functions: Karnaugh map - Strategy for minimization – Minimization of product of sums forms - Incompletely specified functions - Multiple output circuits – Tabular method for minimization.

Module 5:

Combinational circuit building blocks: Multiplexers - Decoders - Encoders, Sequential circuit building blocks: Flipflops-SR, JK, D and T- Registers - Counters
- A simple sequential circuit design example from state diagram.

Textbook:

1. Brookshear JG. Computer science: an overview. Eleventh Edition, Addison-Wesley Publishing Company; 2011.
2. Givone DD. Digital Principles and Design.Tata McGraw Hill Publishing Company Limited; 2003.
3. Mano MM, Ciletti MD. Digital Design with Introduction to the Verilog HDL.Fifth Edition, Pearson Education; 2015.

References:

1. Norton, Peter. Introduction to computers. Sixth edition, Tata McGraw-HILL; 2008.
2. Wakerly JF. Digital Design Principles and Practices. Fourth Edition, Pearson Education; 2008.
3. Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications; 2010.

CO-PO/PSO Mapping:

CO-PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO2	PSO3
CO-1			2				3								
CO-2				2											
CO-3					2	2									
CO-4		1						3							