B.Tech Mechanical Engineering Regulations- R21

B.TECH– III YEAR–I SEMESTER

Sl.No	Course Code	Course Title	Category	L	T	P	C
1	21ME3111	Design of Machine Members–I	PC	3	-	-	3
2	21ME3112	Thermal Engineering–II	PC	3	-	-	3
3	21ME3113	Machine Tools & Metrology	PC	3	1	-	4
4		**Open Elective–I**	OE	3	-	-	3
5		**Professional Elective–I**	PE	3	-	-	3
	21ME3171	Composite Materials					
	21ME3172	Automobile Engineering					
	21ME3173	Industrial Engineering & Management					
	21ME3174	Advanced Mechanics of Solids					
6	21ME3151	Thermal Engineering Lab	PC	-	-	3	1.5
7	21ME3152	Machine Tools & Metrology Lab	PC	-	-	3	1.5
8	21HS3153	Advanced English Communication Lab	HS	-	-	2	1
9	21ME3181	Summer Internship	PW	-	-	-	1
10	21MC0005	Indian Constitution	MC	3	-	-	-
11	21MC0006	Aptitude & Logical Reasoning	MC	3	-	-	-
Total				**18**	**1**	**8**	**21**

B.TECH– IIIYEAR–II SEMESTER

Sl.No	Course Code	Course Title	Category	L	T	P	C
1	21ME3211	Design of Machine Members-II	PC	3	-	-	3
2	21ME3212	Heat Transfer	PC	3	-	-	3
3	21ME3213	CAD/CAM	PC	3	-	-	3
4	21ME3214	Instrumentation and control system	ES	3	-	-	3
5		**Open Elective–II**	OE	3	-	-	3
6		**Professional Elective– II**	PE	3	-	-	3
	21ME3271	Applications of Machine Learning					
	21ME3272	Unconventional Machining Processes					
	21ME3273	Finite Element Methods					
	21ME3274	Lean Manufacturing					
7	21ME3251	Heat Transfer Lab	PC	-	-	3	1.5
8	21ME3252	CAD/CAM LAB	PC	-	-	3	1.5
9	21MC0007	Yoga and Indian Philosophy	MC	3	-	-	-
Total				**24**	**-**	**6**	**21**

21ME3111: DESIGN OF MACHINE MEMBERS - I

B. Tech. III Year I Semester

L	T	P	C
3	0	0	3

NOTE: Design Data handbook is not permitted into the Examinations. The design must not only satisfy strength criteria but also rigidity criteria**.**

Pre-requisites: Mechanics of solids, Kinematics of Machinery.

Course Objectives:

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

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

- Select the proper material for the machine component based on theories of failure and estimate the factor of safety.
- Analyze the stress concentration and fatigue loads induced in a machine element.
- Design and analyze of riveted and welded joints under various load conditions.
- Design keys, flywheel and analyze of stresses.
- Design shafts and shaft couplings, analyze under various load conditions and their selection.

UNIT I:

Introduction: General Considerations in the Design of Engineering Materials and their Properties – Selection –Manufacturing Consideration in Design- BIS Codes of Steels, Preferred Numbers. Design for Static Strength: Simple Stresses – Combined Stresses – Torsional and Bending Stresses – Impact Stresses – Various Theories of Failure – Factor of Safety – Design for Strength and Rigidity.

UNIT 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– Modified Goodman‟s Line– Soderberg‟s Line.

UNIT III:

Welded Joints: Design of Fillet Welds-Axial Loads-Circular Fillet Welds under Bending, Torsion. Welded Joints under Eccentric Loading.

Riveted Joints: Methods of Failure of Riveted Joints-Strength Equations-Efficiency of Riveted Joints-Eccentrically Loaded Riveted Joints.

UNIT IV:

Keys Design: Design of Keys- Introduction. Types of Keys. Sunk Keys. Saddle Keys. Tangent Keys. Round Keys, Splines, Forces Acting on a Sunk Key, Strength of a Sunk Key. Effect of Keyways. Design and Stresses in Keys.

Flywheel Design: Introduction, Coefficient of Fluctuation of Speed and Energy. Maximum Fluctuation of Energy. Coefficient of Fluctuation of Energy. Energy Stored in a Flywheel. Stresses in a Flywheel Rim, Flywheel Arms. Design of Flywheel Arms. Design of Shaft, Hub and Key. Construction of Flywheels.

UNIT V:

Design of shafts: solid and hollow shafts under torsion and bending loads. ASME code for design of shafts.

Shaft Couplings: Design of muff, unprotected and protected flange, marine type couplings.

TEXT BOOKS:

1. V. Bhandari "Design Machine Elements" Mc GrawHill 4th Edition 2016.
2. UCJindal "Machine Design" Pearson.1st Edition 2010.
3. Pandya & Shah "Machine Design" Charotar 20th Edition 2015.

REFERENCES:

1. R.S. Khurmi, J.K. Gupta "Machine Design" S Chand Publishers 25th Edition 2018
2. JEShigley "Mechanical Engineering Design" Mc GrawHill 11th Edition 2020.
3. T.Krishna Rao "Design of Machine Elements (Vol.1)" IK International Publishing House 3rdEdition Vol 1&2 2021.

21ME3112: THERMAL ENGINEERING -II

B.Tech.III Year-I Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Thermodynamics.

Course Objectives:

- To understand the combustion phenomenon of IC engines.
- To evaluate the performance of IC engines for different applications.
- To understand the working of different types of compressors and its applications.
- To understand the working of Gas turbine and methods for improving the efficiency
- Understand the working of different types of Jet engines and Propellants for Rockets.

Course Outcomes: At the end of the course Student would be able to

- Differentiate Combustion phenomenon in SI and CI engines.
- Estimate engine Performance parameters and different methods of their measurement.
- Understand different compressors for various applications.
- Understand different types of Gas turbines for various applications.
- Identify the working of various propulsive engines and its applications.

UNIT I

IC Engines Combustion: Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines–Fuel requirements and fuel rating, anti-knock additives–combustion chamber–requirements, types of SI engines. Four stages of combustion in CI engines – Delay period and its importance–Effect of engine variables – Diesel Knock–Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating.

UNITII

Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power– Determination of frictional losses and indicated power, Morse test – Performance test– Heat balance sheet and chart.

Engine Emission and Controls: Engine emissions and its harmful effect. Methods of measuring pollutants and control of engine emission.

UNIT III

Compressors: Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types– reciprocating and rotary types.
Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work ,minimum work condition for staged compression.

Rotary Compressor (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor– mechanical details and principle of working –efficiency considerations.

Dynamic Compressors: Centrifugal compressors : Mechanical details and principle of operation– velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient– velocity diagrams.

Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations– Polytrophic efficiency.

UNIT IV

Gas Turbines: Simple Gas Turbine Plant – Ideal Cycle – Closed Cycle and Open Cycle for Gas Turbines, Constant Pressure Cycle, Constant Volume Cycle, Efficiency – Work Ratio and Optimum

Pressure Ratio for Simple Gas Turbine Cycle. Parameters of Performance, Actual Cycle, Regeneration, inter cooling and Reheating– Closed cycle gas turbine and applications.

UNITV

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 jetengines–Needs and Demands met by Turbojet–Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation–Methods.

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

TEXTBOOKS:

1. V.Ganesan"I C Engines "McGrawHill, 2ndEdition, 2017.
2. MaheshMRathore"ThermalEngineering"McGrawHill,2ndEdition,2010.

REFERENCES:

1. Saravanamuttoo,Cohen,Rogers"GasTurbineTheory"Pearson,5thEdition,2001.
2. Rathakrishnan"Fundamentals of Engineering Thermodynamics"PHI, 2ndEdition, 2006.
3. R.K.Rajput"ThermalEngineering"McGrawHillEd.6thEdition,2006.
4. Thermal Engineering,R. Rudra murthy, TataMcGraw-HillEducation.

21ME3113: MACHINE TOOLS AND METROLOGY

B.Tech. III Year -I Sem

L	T	P	C
3	1	0	4

Pre-requisites: Manufacturing process – I.

Course Objectives: To learn

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

Course Outcome: At the end of the course, the student would be able to

- Understand the basics of machining and lathe operations
- Analyze the machining operations like drilling, boring, shaping, slotting and planing. operations.
- Analyze milling, grinding and few surface finishing processes by estimating the machining time.
- Identify techniques to minimize the errors in measurement.
- Identify methods and devices for measurement of length, angle, and gear& thread parameters, surface roughness and geometric features of parts.

UNIT – I

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips. 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.

UNIT – II

Drilling and Boring Machines – Principles of working, specifications, types, and operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines – Principles of working – machining time calculations.

UNIT – III

Milling 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. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations.

UNIT – IV

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.

UNIT – V

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Types and Applications of CMM.

TEXT BOOKS:

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

REFERENCES :

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/ RegaRajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor& Kulkarni/ Tata Mc Graw Hill.

21ME3171: COMPOSITE MATERIALS
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year -I Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Metallurgy and Material Science, Strength of Materials.

Course Objectives: To learn

- To study the importance of composites.
- To identify the components of composites for fabrication.
- To learn the manufacturing methods of composites.
- To study the various mechanical joints for composite joining.
- To predict the machining behavior of composite materials.

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

- Understand the importance of composites and their applications.
- Understand the use of reinforcements in composite production.
- Comprehend various composite manufacturing methods.
- Examine the various mechanical joints for composite part assembly.
- Apply the machining operations to composites to know the material behavior.

UNIT I

Introduction: Conventional Engineering Materials, Functions of Fibbers and Matrix, Special Features of Composites, drawbacks of Composites, Composites Processing, Composites Product Fabrication, Composites Markets, Barriers in Composite Markets.

UNIT II

Raw Materials for Part Fabrication: Reinforcements - Glass Fiber Manufacturing, Carbon Fiber Manufacturing, Aramid Fiber Manufacturing; Matrix Materials - Thermoset Resins, Thermoplastic Resins; Fabrics, Prepregs, Performs, Honeycomb and Other Core Materials.

UNIT III

Manufacturing Techniques: Manufacturing Process Selection Criteria, Product Fabrication Needs, Basic Steps in a Composites Manufacturing Process, Manufacturing Processes for Thermo set Composites - Prepreg Lay-Up Process, Wet Lay-Up Process, Spray-Up Process, Filament Winding Process, Pultrusion Process, Resin Transfer Molding Process; Manufacturing Processes for Thermoplastic Composites - Thermoplastic Pultrusion Process, Autoclave Processing.

UNIT IV

Joining of Composite Materials: Adhesive Bonding, Types of Adhesives, Advantages of Adhesive Bonding over Mechanical Joints, Adhesive Selection Guidelines, Mechanical Joints.

UNIT V

Machining and Cutting of Composites: Machining and Cutting of Composites, Challenges during Machining of Composites, Failure Mode during Machining of Composites, Cutting Tools, Types of Machining Operations, Drilling Operation.

TEXT BOOKS:

1. Isaac and M Daniel "Engineering Mechanics of Composite Materials" Oxford University Press.
2. R. M. Jones, "Mechanics of Composite Materials" McGraw-Hill Company.

REFERENCES :

1. B. D. Agarwal and L.J. Broutman, Wiley "Analysis and Performance of Fiber composites", Interscience.
2. Autar K. Kaw "Mechanics of Composite Materials" CRC Publications.
3. L. R. Calcote, Van NostrandRainfold "Analysis of Laminated Composite Structures".
4. Madhujit Mukhopadhyay "Mechanics of Composite Materials and Structures", Univ Press.

21ME3172 : AUTOMOBILE ENGINEERING
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year- I Sem. **L T P C**
3 0 0 3

Pre- requisites: Applied Thermodynamics-I.

Course Objectives: To Learn
- Study the components of automobile.
- Understand the importance of injection and ignition system.
- Study the functioning of the transmission and suspension
- Know the working of Steering and braking system.
- Recognize the disadvantages of emissions and emission standards.

Course Outcomes: After completion of this course, the students will be able to
- Classify various types of cooling systems, lubrication systems and discuss about various components of an automobile.
- Categorize the types of injection system, ignition system and study about electrical system of an automobile.
- Identify the importance of transmission and suspension system in an automobile.
- Analyze the various types of Steering and Breaking system.
- Examine the pollutants from exhaust and identify the various alternative fuels for an automobile.

UNIT-I

Introduction: Types of Automobiles, Components of four wheeler automobile – chassis, frame and body, types of layouts- rear wheel drive-front wheel drive- 4-wheel drive, types of automobile engines, engine construction, turbo charging and super charging, engine lubrication- splash and pressure lubrication systems, oil filters, oil pumps.

Cooling System: Cooling requirements, types of cooling, Air cooling, Water cooling- components-radiator-types-cooling fans-water pump-thermostat, evaporative cooling, liquid cooling.

UNIT-II

Injection System: Types of fuel injection System-Common rail direct injection system (CRDI)-Multipoint fuel injection system (MPFS), Carburetor, Nozzle, fuel filters, fuel pumps.

Ignition System: Function an Ignition system, Types-Battery ignition system-components- battery-contact breaker points-condenser-spark plug, Magneto ignition system, Transistor based coil ignition system, capacitive discharge ignition system.

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

UNIT-III

Transmission System: Clutches, principle, types-cone clutch-single plate clutch- multi plate clutch-magnetic and centrifugal clutches, fluid fly wheel, gear boxes-types-sliding mesh- construct mesh-synchro mesh gear boxes-epicyclic gear box, torque converter, propeller shaft –

Hotchkiss Drive-Torque tube drive, universal joint, differential rear axles – types, wheel and tyres.

Suspension System: Objects of suspension systems – rigid axle suspension System-Independent suspension system, torsion bar, shock absorber.

UNIT-IV

Steering System: Steering geometry – camber- castor-king pin rake-combined angle toe in &toe out-center point steering, types of steering mechanism – Ackerman steering mechanism- Davis steering mechanism, steering gears – types, steering linkages.
Braking System: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder, tandem master cylinder, and requirement of brake fluid, pneumatic and vacuum brakes, Antilock braking system, electronic brake force distribution and traction control.

UNIT-V
Engine Emission Control: Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification needed- exhaust gas treatment-thermal and catalytic converters.
Alternative Fuels for Emission Controls: Natural gas, LPG, bio diesel, bio ethanol, hydrogen fuels– National and International pollution standards.

TEXT BOOKS:
1. Automobile Engineering, Volume 1, Dr .Kripal Singh, Standard Publishers, 13th Edition,2020.
2. Automobile Engineering, Volume 2, Dr .Kripal Singh, Standard Publishers, 2020.

REFERENCES:
1. A Systems Approach to Automobile Technology, Jack Erjavec, Yessdee Publishers Pvt. Ltd, 2008.
2. Automotive Mechanics ,Heitner, CBS Publishers, Second edition, 2004.
3. Automobile Engineering , K.K Ramalingam ,Scitech Publications, 2011.
4. Automotive Engineering ,Newton steeds & Garrett, Butterworth- Heinemann Ltd, 2009.

21ME3173: INDUSTRIAL ENGINEERING &MANAGEMENT (PROFESSIONAL ELECTIVE – I)

B.Tech. III Year -I Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives: To learn
- To impart knowledge in concepts and tools of Industrial management.
- To understand applications of different types of layouts.
- To apply work-study and Method study techniques for finding standard time of jobs.
- To implement the line balancing techniques.
- To calculate the project completion time.

Course Outcomes: After completion of this course, the students will be able to

- Outline the functions and importance of Industrial Management.
- Analyze the different organization structures and developing suitable organization structures for different organizations.
- .Identify different types of production systems and Plant layouts.
- Identify suitable method and standard time for different jobs.
- Identify the critical path and project completion time for different projects.

UNIT I

Introduction to Management: Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor‟s Scientific Management Theory, Fayol‟s Principles of Management, Maslow‟s Theory of Human Needs, Douglas McGregor‟s Theory X and Theory Y, Herzberg‟s Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

UNIT II

Designing Organizational Structures: Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT III

Operations Management: Objectives- product design process- Process Selection-Types of production system (Job, batch and Mass Production),Plant location-factors- Urban- Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method)

Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram.

UNIT IV

Work Study: Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations
– work sampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- X chart, R chart, -Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT V

Job Evaluation: methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (Simple problems).

TEXT BOOKS:

1. O.P. Khanna“Industrial Engineering and Management”Dhanpat Rai Publishers, 2018.
2. NVS Raju“Industrial Engineering Management” Cengage Learning, 2013.

REFERENCE BOOKS:

1. T.R. Banga and S.C.Sarma "Industrial Engineering and Management Science"Khanna Publishers,2017.
2. Ralph M. Barnes"Motion and Time Study Design and Measurement of Work" Wiley, Seventh Edition, 2009
3. Paneer Selvam "Production & Operation Management" PHI Publisher, Third Edition, 2012.
4. ILO, Geneva"Introduction to Work study"Oxford&IBHPublisher, Third Edition, 2015.

21ME3174: ADVANCED MECHANICS OF SOLIDS
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year -I Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Engineering Mechanics, Mechanics of Solids.

Course Objectives:

- Understand the nature of stresses developed in shafts for various types of loads according to theories of failure.
- Know different types of principal stresses considered in design of structural members.
- Understand how to calculate stresses and deformations in a bar due to axial loading under uniform and non-uniform conditions.
- Understand the nature of stresses developed in columns for various types of loads.
- Understand the nature of stresses developed in springs under different loading conditions.

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

- Describe the concept, principle and performance calculations, relative to the strength and twist.
- Analyze various situations involving in structural members subjected to plane and shear stresses by Mohr‟s circle method.
- Evaluate the strain and deformation caused due to elastic stresses developed within the materials during simple loading.
- Analyze strength and stability of structural members subjected to Direct and bending stresses.
- Analyze the behavior of the springs (Leaf and Helical) under different loading conditions.

UNIT I

TORSION OF CIRCULAR SHAFTS: Theory of pure torsion – Derivation of Torsion equations: $T/J = \tau/r = G\theta/L$ – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion- according to Maximum normal and Shear stress theory.

UNIT II

PRINCIPAL STRESSES AND STRAINS: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr‟s circle of stresses – Principal stresses and strains – Analytical and graphical methods.

UNIT III

BENDING OFCURVED BEAMS: Introduction - Assumptions for the Stresses during Bending of Curved Bars. Types of Curved Bars on the Basis of initial curvature. Bars with Small and
Large Initial Curvature (no derivation for Large Initial Curvature). Link Radius for Standard Sections - Value of Link Radius for a Rectangular Section - Value of Link Radius for a Triangular Section - Value of Link Radius for a Circular Section.

UNIT IV

COLUMNS AND STRUTS: Introduction – Types of columns – Shortened long columns – Axially loaded compression members – Crushing load – Euler‟s theorem for long columns assumptions- derivation of Euler‟s critical load formulae for various end conditions – Equivalent length of a column – slenderness ratio – Euler‟s critical stress – Limitations of Euler‟s theory– Long columns subjected to loading – Empirical formulae — Rankine formula.

UNIT V

SPRINGS: Introduction - Stiffness of a Spring. Types of Springs, Bending Springs, Torsion Springs, Forms of Springs - Carriage Springs or Leaf Springs (Semi-elliptical Type).Helical Springs. Close-coiled Helical Springs, Close-coiled Helical Springs Subjected to an Axial Load. Open-coiled Helical Springs. Springs in Series and Parallel.

TEXT BOOKS:

1.R.S. Khurmi and Gupta–Strength of materials – S. Chand & Company Ltd – Revised edition–2008.
2. R.K Rajput– Strength of materials – S. Chand & Company Ltd – Fourth edition – 2008.

REFERENCES:

1. Dr. R. K. Bansal– Strength of materials – Lakshmi Publications House Pvt. Ltd – Fourth edition –2009.
2.S. S. Rattan– Strength of materials – Tata McGraw Hill Education PvtLtd – Second edition –2011.
3. S.R
4.
5. amamrutham and R. Narayanan– Strength of materials – Dhanpat Rai Publishing Company – Eighteenth edition –2014.
4. Timoshenko and Gere– Strength of materials – CBS Publishers– Latest edition –2001.

21ME3151- THERMAL ENGINEERING LAB

B.Tech. III Year - I Sem.

L	T	P	C
0	0	3	1.5

Pre-Requisite: Thermodynamics & Thermal Engineering – I.

Course Objectives: To learn

1. Understand the working principles of IC Engines
2. Understand the working principles of Reciprocating Air Compressors.
3. Understand the mechanism of valve and ports in IC Engines.
4. Understand various Heat energy losses in IC Engines.
5. Study Different types of Boilers.

Course Outcomes: At the end of the laboratory Student will be able to:

1. Determine the valve timing and port timing of four stroke and two stroke engines
2. Conduct constant speed tests on internal combustion engines and interpret their performance.
3. Analyze the reciprocating air compressor characteristics.
4. Apply the concept of Morse test and Retardation test to determine frictional power.
5. Demonstrate the different parameters of Boilers.

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, Test on 4 stroke Multi Cylinder engine
5. I.C. Engine Heat Balance on 4 stroke single cylinder CI Engines.
6. I.C. Engines Retardation Test on 4 stroke single cylinder CI engine
7. I.C. Engines test for effect of A/F Ratio CI engine.
8. IC engine Performance Test on a 4 Stroke CI engine.
9. Volumetric efficiency of Air – Compressor Unit.
10. Dis-assembly / Assembly of Engines.
11. IC engines performance test on 4stroke Multi Cylinder engine
12. Study of Boilers.

NOTE: Perform any 10 out of the 12 Exercises.

21ME3152: MACHINE TOOLS &METROLOGY LAB

B.Tech. III Year - I Sem. **L T P C**
0 0 3 1.5

Prerequisites: Theoretical exposure to machine tools.

Course Objectives: To learn

- Understand the parts of various machine tools and operate them.
- Import practical exposure to use Machine Tools.
- Understanding the basic characteristics of a typical instrument. Identifying errors and their types that would occur in an instrument

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

- Demonstrate the configuration, function and working principle of lathe, drilling machine, milling machine, shaper, planing machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
- Use the Lathe machine to perform various operations on it.
- Operate drilling machine.
- Characterize and calibrate measuring devices.
- Identify and analyze errors in measurement.

List of Experiments:

1. Step turning on lathe machine.
2. Taper turning and Knurling on lathe machine.
3. Thread cutting and grooving on lathe machine.
4. Preparation of Single point Cutting tool on Tool and Cutter Grinder
5. Performing of drilling operations using Drilling machine.
6. Spur Gear cutting on milling machine.
7. Grinding of Flat Surfaces Using Surface Grinder.
8. Grinding of Cylindrical Surfaces Using Cylindrical Grinder.
9. .Key way cutting on Slotting Machining.
10. Grooving and dovetail cutting on Shaper.
11. Alignment test on Lathe.
12. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
13. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
14. Angle and taper measurements by bevel protractor and sine bar.
15. Thread measurement by 2-wire and 3-wire method.
16. Surface roughness measurement by Tally Surf.

21HS3153: ADVANCED ENGLISH COMMUNICATION LABORATORY

B.Tech. III Year - I Sem. **L T P C**
0 0 2 1

Pre -requisites: Nil

Introduction

A course on Advanced English Communication Skills (AECS) Lab is considered essential at the third year level of B.Tech and Pharmacy courses. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

Course Objectives:

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

- To improve students' fluency in spoken English.
- To enable them to listen to English spoken at normal conversational speed.
- To help students develop their vocabulary.
- To read and comprehend texts in different contexts.
- To communicate their ideas relevantly and coherently in writing.
- To make students industry-ready.
- To help students acquire behavioral skills for their personal and professional life.
- To respond appropriately in different socio-cultural and professional contexts.

Course Outcomes:

- Acquire vocabulary and use it contextually.
- Listen and speak effectively.
- Develop proficiency in academic reading and writing.
- Increase possibilities of job prospects.
- Communicate confidently in formal and informal contexts.

Syllabus

The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

UNIT-I:

Inter-personal Communication and Building Vocabulary –Starting a Conversation–Responding Appropriately and Relevantly –Using Appropriate Body Language –Role Play in Different Situations – Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.

UNIT-II:

Reading Comprehension –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.

UNIT-III:

Writing Skills –Structure and Presentation of Different Types of Writing –Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.

UNIT-IV: Presentation Skills –Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ emails/Assignments…etc.,

UNIT-V: Group Discussion and Interview Skills –Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation-Concept and Process, Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

REFERENCES:

1. Kumar, Sanjay and Pushp Lata. English for Effective Communication, Oxford University Press, 2015.
2.Konar, Nira. English Language Laboratories –A Comprehensive Manual, PHI Learning Pvt. Ltd., 2011.

APTITUDE AND LOGICAL REASONING

B.Tech. III Year I Sem.	**L T P C**
Course Code: 21MC0006	**3** 0 0 0

Course Objectives:

1.Student learns the techniques to solve all the problems in his real life.
2.It can improve the numerical ability.
3.The quicker methods are useful to solve the problems within the time and it is helpful in his duties.
4.Quantative Aptitude helps in solving the practical life problems.
5.Students can use Quantitative Aptitude in everyday life to figure out mathematically.
6.Student can improve his mental capacity.
7.It helps in sharpening their minds.

UNIT I

Number System, Percentages, Profit And Loss, Simple Interest - Compound Interest, Partnership Ratio And Proportion ,Chain Rule, Time And Work - Pipes And Cistern, Time And Distance - Problems On Trains, Boats And Streams, Races And Games Of Skill

UNIT II

Average, Alligation And Mixture, Permutation-Combination, Probability, Geometry (Co-Ordinate, Solid-2d Areas & 3d Volumes), D I (Tabulation, Bar Graphs, Pie Charts & Line Graphs), Elementary Statistics

UNIT III:

Series Completion, Analogy, Classification / Odd One Out, Coding – Decoding, Blood Relations, Deciphering Jumbled up Descriptions,

UNIT IV:

Relation Puzzle, Direction sense test, Number, Ranking & Time Sequence Test, Puzzle Test, Seating Arrangements Comparison Type Questions, Sequential Order of Things, Selection Based on gave conditions,

UNIT V

Family – Based Puzzles, Jumbled Problems. Logical Venn Diagrams
Alpha Numeric Sequence Puzzle, Cubes, Dice, Clocks, Calendar, Data Sufficiency, Syllogism.

TEXT BOOKS:

1. Quantitative Aptitude by R.S.Agarwal

2. Quantitative Aptitude by Abhijit Guha

3. Quantitative Aptitude for Competative Examinations, U.Mohan Rao, Scitech Publication.

21MC0005: INDIAN CONSTITUTION

B. Tech. III Year I Sem **L T P C**

3 0 0 0

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments.

The Constitution of India reflects the idea of "Constitutionalism" –a modern and progressive concept historically developed by the thinkers of "liberalism" –an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

COURSE CONTENT:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status

6. The Directive Principles of State Policy –Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Unionand the States
8. Parliamentary Form of Government in India –The constitution powers and status of thePresident of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government –Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

21ME3211: DESIGN OF MACHINE MEMBERS - II

B. Tech. III Year- II Semester

L	T	P	C
3	0	0	3

NOTE: Design Data handbook is permitted into the examination. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

Pre-requisites: Kinematics of Machinery, Design of Machine Members-I.

Course Objectives: To learn

- Knowledge about designing the commonly used important machine members such as bearings, engine parts, springs, belts, gears etc.
- Designing of various machine members under static and dynamic loads.
- Design the components using the data available in design data books
- Design power transmission systems
- Analyze gears and Gear systems.

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

- Illustrate Journal bearings under various lubricating conditions with respect to loads for strength and rigidity using ABMA.
- Select Rolling contact bearings under static and dynamic loads, bearing life.
- Examine design of IC engine parts Piston, Connecting rod, Stress analyses under loads.
- Analyze design of Gears by AGMA, Stress analyses, wear strength.
- Evaluate design of springs and Belt drives and Stress analysis and load calculations.

UNIT I:

Sliding contact bearings: Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

UNIT II:

Rolling contact bearings: Ball and roller bearings – static load – dynamic load – life of bearing, Reliability factor, equivalent radial load – design and selection of ball & roller bearings.

UNIT III:

Design of Connecting Rod: Introduction, function, Design and thrust in connecting rod – stress due to whipping action on connecting rod ends.

Design of Pistons: Forces acting on piston – Introduction, functions, Construction, Piston design and proportions of piston.

UNIT IV:

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

Design of Bevel and Worm gears: Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

UNIT V:

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 – Design of leaf springs**.**

Belts & Pulleys: Transmission of power by Belt and Rope ways, Transmission efficiencies, Belts– Flat and V types – Ropes - pulleys for belt and rope drives.

TEXT BOOKS:

1. V. Bhandari "Design Machine Elements" Mc GrawHill 4th Edition 2016.
2. Pandya & Shah "Machine Design" Charotar 20th Edition 2015.
3. UC Jindal "Machine Design" Pearson.1st Edition 2010.
4. S.Md.Jalaludeen, "Design Data Hand book", Anuradha Publications.

REFERENCES:

1. R.S. Khurmi, J.K. Gupta "Machine Design" S Chand Publishers 25th Edition 2018.
2. JE Shigley "Mechanical Engineering Design" Mc Graw Hill 11th Edition 2020.
3. P.C. Sharma & D.K. Aggarwal, "Machine Design", 10th ed., S.K. Kataria & sons, , 2019.
4. T. Krishna Rao "Design of Machine Elements (Vol.1)" IK International Publishing House 3rdEdition Vol 1&2 2021.

21ME3212: HEAT TRANSFER

B.Tech. III Year- II Sem.

L	T	P	C
3	0	0	3

NOTE: Heat Transfer Data Book is permitted.

Pre-requisite: Thermodynamics.

Course Objectives: To learn

- Provide knowledge about applications of conduction, convection, and radiation
- Discuss the fundamental principles and laws of heat transfer
- Explore the implications of these principles for system behavior; to formulate the models necessary
- Study, analyze and design heat transfer systems through the application of these principles
- Develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications.

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

- Demonstrate the heat transfer through basic geometric elements and composite systems and able to formulate heat transfer equations.
- Demonstrate the heat transfer through unsteady state, extended surface and geometric shapes of variable thermal conductivity and able to formulate heat transfer equations equations.
- Explain about concept of continuity, momentum and energy equations and analyze natural and forced convection heat transfer and interpret forced convective heat transfer.
- Design the Heat exchangers using LMTD and NTU methods for Parallel and counter flow Heat Exchangers
- Explain and Analyze the Basic principles of boiling, condensation and radiation heat transfer.

UNIT – I

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –Important applications of heat transfer.

Conduction Heat Transfer: Fourier`s law of heat conduction – General heat conduction equations 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 Heat Conduction: Plane walls, hollow cylinders, and spheres-Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation, -Concept of Variable Thermal conductivity.

UNIT – II

Systems with internal heat generation: Extended surface – Long Fin, Short Fin with Insulated tip and Short Fin with free end, Application to error measurement of Temperature.

One Dimensional Transient Heat Conduction: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite Systems, Concept of Semi-infinite System , General Unsteady systems- Chart solutions.

UNIT – III

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – BuckinghamTheorem and method, application for developing semi – empirical 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.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate -Use of empirical relations for Vertical plates and pipes.

Forced convection: **External Flows**: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders

UNIT – 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.

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, Concept of Compact heat exchanger.

UNIT - V

Boiling, Condensation and Radiation Heat Transfer:

Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation –Nusselt`s Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities –Radiation laws- Planck distribution law, Stefan- Boltzman law, Wien`s distribution law ,Kirchoff`s law, Lamberts cosine law,– 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 / J.P.Hollman& S Bhattacharya/ Mc Graw Hill/ Eight Edition.
2. Heat and Mass Transfer / D.S.Kumar/ S. K. Kataria& Sons/2009.

REFERENCE BOOKS:

1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastidar / Oxford/ Second Edition
3. Heat and mass Transfer Fundamentals and Applications/ A J Ghajar& Y A. Cengel/ Mc Graw Hill/4th Edition
4. A Text book on Heat transfer/S.P.Sukhatme/Universities Press(India) Pvt lid/2005 4th Edition

21ME3213: CAD/CAM

B.Tech. III Year –II Sem **L T P C**
3 0 0 3

Pre-Requisites: DMM-I & II, MT.

Course Objectives:

- To illustrate the basics of CAD/CAM concepts.
- To explain computer graphics, wire and surface modeling techniques
- To explain the solid modeling techniques
- To demonstrate part programs and group technology techniques
- To discuss latest advances in the manufacturing perspectives.

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

- Apply the CAD standards for geometrical modeling
- Apply the Solid modeling techniques
- Develop part programs for solid models
- Apply group technology concept in manufacturing product
- ========Analyze the FMS and CIM concepts for manufacturing industry

UNIT I

Introduction to CAD and computing standards: Fundamentals of CAD, Design process, Applications and Benefits of CAD, Computer peripherals for CAD, CAD and software, Design workstation, Graphic software, CAD database types, CAD Data exchange formats (IGES, PDES,GKS,STEP)

2-D Transformations: Definition and types-Translation, Scaling, Rotation, Reflection, Shearing and Concatenation.

UNIT II

Geometric Modeling Methods

Wire frame modeling: Wire frame entities and their definitions, Interpolation and approximation of curves, concepts of parametric and non-parametric representation of curves, Development of synthetic curves (Cubic curve, Bezier and B-splines)

Surface Modeling: Analytical surfaces: Definitions of planar surface, cylindrical surface, ruled surface, Spherical surface, composite surface and surface of revolution.

Synthetic surfaces: Definitions of Cubic and Bezier surfaces with mathematical form.

Solid Modeling: Definitions of Solid entities, Cell decomposition, sweep representation, CSG-Boolean operations and B-Rep.

UNIT III

Numerical Controlled Machine Tools: Introduction to NC, Elements, Structure, Advantages, disadvantages and Applications.

CNC Machines, Elements, Structure, Part programming methods, manual part programming, canned cycles and computer assisted part programming for 2-D machining only.

DNC, Definition, Types of Adaptive control systems.

UNIT IV

Role of Information Systems in Manufacturing: Group Technology: Definition-part families, parts classification and coding systems, Optiz, MICLASS, CODE systems, production flow analysis.

Computer aided process planning: Problems in traditional process planning, Types of CAPP, Retrieval and Generative type, Advantages, Limitations and Applications.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning and capacity requirement planning.

UNIT V

Automated Manufacturing Systems: Flexible Manufacturing Systems: Automation, Manufacturing types-Job, Batch, And Mass, FMS equipment, layouts and benefits.

Computer aided quality control: Automated inspection, off-line, on-line, contact and non-contact, CMM and machine vision.

Computer Integrated Manufacturing: Definition of CIM, Need of integration, Benefits of CIM.

TEXT BOOKS:

1. Chennakesava R Alavala"CAD/CAM concepts and applications" Prentice Hall India Learning, New Edition, 2020.
2. P N Rao "CAD/CAM: Principles and Applications" Tata McGraw Hill, India, New edition, 2020.

REFERENCES:

1. Ibrahim Zeid "Mastering CAD/CAM" McGraw Hill, New Edition, 2020.
2. James A. Rehg, Henry W. Kraebber "Computer Integrated Manufacturing" Pearson Education, 2012.
3. Mikell P Groover "Automation, production system and computer aided manufacturing" Pearson, Fourth edition, 2018.
4. P. Radhakrishnan, S. Subramanian and V.Raju, CAD/CAM/CIM, 3rd Edition, New Age publications, 2018.

21ME3214: INSTRUMENTATION AND CONTROL SYSTEM

B.Tech. III Year -II Sem

L	T	P	C
3	0	0	3

Prerequisite: Thermodynamics, Basics of Electrical and electronics Engineering.

Course Objectives:

- Understanding the basic characteristic of a typical instrument.
- Identifying errors and their types that would occur in an instrument.
- Identifying properties used for evaluating the thermal systems.
- Understanding the concept of a transducer and its types with their characteristics.
- Understand the different types of control systems.

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

- Describe various measurement systems, Static and Dynamic Characteristics which would occur in instruments.
- Explain the principles of different typical instruments related to Temperature and Pressure.
- Summarize the measuring instrument theories of Speed, Level and Flow measurement.
- Interpret the correct usage of machine parameters with the help of Acceleration & Vibration instruments.
- Categorize the relationships and interaction between the different types of Control Systems and calculate transfer functions.

UNIT I

Definition–Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics – sources of errors, Classification and elimination of errors.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

UNIT II

Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals.

Measurement of Pressure: Different principles used- Classification: Manometers, Dead weight pressure gauge. Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

UNIT III:

Measurement of Level: Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators – Bubbler level indicators.

Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non- contact type- Stroboscope

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

UNIT IV

Stress-Strain measurements: Various types of stress and strain measurements –Selection and installation of metallic strain gauges- electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes. Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter.

Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT V

Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems.

TEXT BOOKS:

1. Dr. D.S. Kumar," Mechanical Measurements & Control", Metropolitan Book Co.(P) Ltd., New Edition 2015.

2. Chennakesava .R. Alavala," Principles of Industrial Instrumentation and Control Systems",1st Edition, Cengage Learning,2009.

REFERENCES:

1. A.Anand Kumar," Control Systems",2nd Edition, PHI Learning, 2014.

2. B C Nakra, K K Chaudhry, "Instrumentation, Measurement and Analysis ", 4th Edition McGraw Hill Education India Private Limited, 2016.

3. R.S. Sirohi , H.C. Radhakrishna, "Mechanical Measurements", 3rd Edition, John Wiley &Sons, 1993.

21ME3271: APPLICATIONS OF MACHINE LEARNING
(PROFESSIONAL ELECTIVE-II)

B.Tech. III Year II Sem. **L T P C**

3 - - 3

Course Objectives:

1. To prepare students for career in computer science & engineering where knowledge of AI & ML techniques leading to the advancement of research and technology.
2. Identify problems where artificial intelligence techniques are applicable.
3. To explore the use of Genetic algorithms and Reinforcement learning.
4. Judge applicability of more advanced techniques.
5. Participate in the design of systems that act intelligently and learn from experience.

Course Outcomes:

At the end of the course the students will be able

1. To understand the fundamentals of Artificial Intelligence(AI)
2. To understand the fundamentals of Machine Learning(ML)
3. To learn different classifiers and apply them on various datasets.
4. To learn and apply different unsupervised learning algorithms
5. Design models to solve the problems in various domains.

UNIT I

INTRODUCTION TO AI: AI definition, categories of AI (Narrow AI, General AI, Super AI) and their applications, Intelligent Agents.

PROBLEM-SOLVING BY SEARCH: Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepening Depth-first search, Bidirectional search, informed (Heuristic) Search Strategies: Greedy best-first search, A*search.

UNIT II

INTRODUCTION TO MACHINE LEARNING: A concept learning task, conceptlearning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination

SUPERVISED LEARNING: Regression-Linear-Simple, Multiple, Logistic Regression--Case Study

Classification- Naive Bayes Classifier, k-NN classifier, Support Vector Machines -Linear, Non Linear--Case Study

UNIT III

Decision Trees-ID3(Iterative Dichotomiser3), Random forest, Ensemble methods- Bagging, Boosting, Stacking--Case Study

UNSUPERVISED LEARNING: Measures of Distance, Clustering: K-means, Hierarchical Clustering: Agglomerative and Divisive--Case Study

UNIT IV

Artificial Neural Networks– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm, Remarks on the Back-Propagation algorithm--Case Study

UNIT V

Genetic Algorithms – Motivation, Genetic algorithms, an illustrative example

Reinforcement Learning – Introduction, the learning task, *Q*–learning, non-deterministic, rewards and actions, temporal difference learning, an illustrative example

TEXT BOOKS:

1.Artificial Intelligence A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

2.Machine Learning –Tom M. Mitchell,- Tata McGraw-Hill

REFERENCE BOOKS:

1.S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

2."Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.

21ME3272: UNCONVENTIONAL MACHINING PROCESSES
(PROFESSIONAL ELECTIVE-II)

B.Tech. III Year - II Sem **L T P C**
3 0 0 3

Pre-requisites: Machine Tools.

Course Objectives: To learn
- Modeling technique for machining processes.
- Interpretation of data for process selection.
- Mechanics and thermal issues associated with chip formation.
- Effects of tool geometry on machining force components and surface finish.
- Machining surface finish and material removal rate.

Course Outcomes: At the end of the course Student will be able to
- Understand the basic techniques of Unconventional Machining processes modeling.
- Understand the Abrasive, water jet machining and electro chemical processes.
- Analyze the EDM process and its input and response parameters.
- Understand the importance of non thermal processes.
- Understand the applications of various unconventional machining processes.

UNIT – 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.

UNIT - 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.

UNIT – 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 and machine tool selection. Wire EDM, principle, applications.

UNIT – IV

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

Laser beam machining: General Principle and applications, thermal features, cutting speed and accuracy of cut.

UNIT - 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 - applications.

Finishing processes: Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling and shaped tube electrolyte machining.

TEXT BOOKS:

1. V.K. Jain "Advanced Machining Processes" Allied publishers Ltd, 2nd Edition,2002.
2. P. C. Pandey, H. S. Shan "Modern Machining Processes" Tata Mc Graw Hill Education,1st Edition,1980.

REFERENCES:

1. M.K Singh "Unconventional Manufacturing Process" New Age Publishers, 2nd Edition,.2008.
2. J.A. Mc Geough "Advanced Methods of Machining" Publisher, Springer International, 3rd Edition, 1988.
3. Gary.F Benedict "Non-Traditional Manufacturing Processes" Publisher, CRC Press, 1st Edition, 1987.
4. Mishra P.K. "Non-Conventional Machining Process" Narosa Publishing House, 2nd Edition, 2006.

21ME3273: FINITE ELEMENT METHODS
(PROFESSIONAL ELECTIVE-II)

B.Tech. III Year - II Sem **L T P C**
3 0 0 3

Pre-requisites: Mechanics of Solids, Empirical Mathematics of Matrices, Heat Transfer, Mechanical Vibrations.

Course Objectives: To learn

- Basic principles of finite element analysis procedure.
- Concepts of Mathematical Modelling of Engineering Problems.
- Applying finite element solutions to structural, thermal& dynamic analysis problems.
- Knowledge and skills needed to effectively evaluate finite element analysis.
- Appreciate the use of FEM to a range of Engineering Problems.

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

- Summarize the basics of finite element formulation.
- Apply finite element formulations to solve one dimensional Problems.
- Apply finite element formulations to solve two dimensional scalar Problems.
- Apply finite element method to solve Heat Transfer problems.
- Apply finite element method to solve problems dynamic analysis Problems.

UNIT I

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

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

UNIT II

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

Analysis of Beams: Stiffness matrix for two noded elements, two degrees of freedom per node beam element, Load Vector, Deflection.

UNIT III

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Estimation of Load Vector, Stresses

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded isoperimetric elements and numerical integration.

UNIT IV

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

UNIT 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.

TEXT BOOKS:

1. Tirupathi R. Chandrupatla, Ashok D.Belegundu "Introduction to Finite Elements in Engineering", 4th Edition, Pearson Publications, 2015.
2. J. N. Reddy"An Introduction to the Finite Element Method", 4th Edition,McGrawHill, 2020.

REFERENCES:

1. G. Ramamurthy "Applied Finite Element Analysis",2nd Edition,Ik International Publications, 2010.
2. Chennakesava R. Alavala,"Finite Element Methods: Basic Concepts and applications", 1stEdition, PHI publications, 2012
3. U.S. Dixit"Finite Element Method for Engineers"1st Edition, Cengage Publications, Edition, 2009.
4. S.S. Bhavikatti"Finite Element Analysis" 3rd Edition, New Age International Publishers, 2015.

21ME3274: LEAN MANUFACTURING
(PROFESSIONAL ELECTIVE – II)

B.Tech. III Year - II Sem

L	T	P	C
3	0	0	3

Pre-Requisites: Nil.

Course Objectives: To learn

- Concepts of Lean Manufacturing
- Different layouts and JIT,TPM concepts etc 3 To get an idea about 5S & TQM
- Concepts of Six sigma
- Details about manufacturing companies where lean manufacturing concepts are implemented.

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

- Understand the difference between conventional manufacturing versus lean manufacturing & apply the principles of lean manufacturing.
- Explain Lean Manufacturing Tools.
- Classify the of layouts and apply JIT, TPM Principles.
- Understand and Practice TQM, 5S principles.
- Explain the concept of six sigma and Practice.

UNIT I

INTRODUCTION TO LEAN MANUFACTURING: Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II

CELLULAR MANUFACTURING, JIT, TPM: Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity – Kaizen training - TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III

SET UP TIME REDUCTION, TQM, 5S, VSM: Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV

SIX SIGMA: Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.

UNIT V

CASE STUDIES: Various case studies of implementation of lean manufacturing at industries.

TEXT BOOKS:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin& Jeffrey B. Goldberg, John Wiley & Sons, 2003.
2. Mikell P. Groover (2002) _Automation, Production Systems and CIM.

REFERENCES:

1. Rother M. and Shook J, 1999 _Learning to See: Value Stream Mapping to Add Value and Eliminate Muda,, , Lean Enterprise Institute, Brookline, MA.
2. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities By S.R. Devadasan,V. Mohan Sivakumar, R. Murugesh& P.R. ShalijDevadasan S.R PHI Learning Pvt. Ltd., 12-Jun-2012.
3. The Toyota Way: 14 Management Principles from the World's Greatest **M**anufacturer Hardcover – January 7, 2004**,**byJeffrey Liker.
4. Kaizen Express: Fundamentals for Your Lean Journey , 2009,by Toshiko Narusawa.

21ME3251: HEAT TRANSFER LAB

B.Tech. III Year-II Sem

L	T	P	C
0	0	3	1.5

Pre-requisite: Thermodynamics

Course Objectives:

- To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications.

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

- Perform steady state conduction experiments to estimate thermal conductivity of different materials
- Perform transient heat conduction experiment
- Estimate heat transfer coefficients in forced convection, free convection, Condensation and correlate with theoretical values
- Obtain variation of temperature along the length of the pin fin under forced and free Convection.
- Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann‟s constant and compare with theoretical value

List of Experiments

1. Heat Transfer Through composite Materials
2. Thermal Conductivity of a Metal Rod
3. Parallel and Counter Flow Heat Exchanger
4. Stefan Boltzmann`s Constant Apparatus
5. Transient Heat Conduction
6. Heat Pipe Demonstration Apparatus
7. Thermal Conductivity of Insulating Material
8. Heat Transfer Through Lagged Pipe
9. Heat Transfer in Forced Convection
10. Heat Transfer Through Natural Convection
11. Measurement of Surface Emissivity
12. Heat Transfer Through Pin-Fin
13. Critical Heat Flux Apparatus
14. Boiling & condensation Apparatus

Note: Perform any 12 out of the 14 Exercises

21ME3252: CAD/ CAM LAB

B.Tech.III Year -II Sem. **L T P C**
0 0 3 1.5

Pre-Requisites: CADCAM

Course Objectives:

- To gain practical experience in handling 2D drafting and 3D modeling software.
- To gain experience in handling simulation software apply for engineering components.
- To expose students to modern control systems (Fanuc, Siemens etc,)
- To prepare the part programs for CNC lathe and CNC milling machine.

Course Outcomes:

To understand the analysis of various aspects in of manufacturing design

- Draw the 2D and 3D drawings by using CAD software.
- Assemble the 3D parts for view the physical model.
- Demonstrate the various features of CNC machines.
- Demonstrate manual part programming with G and M codes using CAM.
- Implement the CAPP methods to CNC machines.

Note: conduct any 12 exercises from the list given below:

(I) Geometric Modeling

Introduction of 3D Modeling software: Creation of any **4** assembly models of following machine elements using 3D Modeling software

- Flange Coupling
- Plummer Block
- Screw Jack
- Lathe Tailstock
- Universal Joint
- Machine Vice
- Stuffing box
- Crosshead
- Connecting rod
- Piston
- Eccentric

(II) Simulation experiments: conduct any 3 experiments from this list

1. Determination of deflection and stresses in 2D and 3D trusses and beams.
2. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
3. Determination of stresses in 3D and shell structures (at least one example in each case).
4. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
5. Study state heat transfer analysis of plane and axi-symmetric components.

(III) Manual Part Programming: conduct any 2 experiments from each section

I. Part Programming –CNC Milling Centre

1. Linear Cutting.
2. Circular cutting.
3. Cutter Radius Compensation.
4. Canned Cycle Operations.

II. Part Programming – CNC Turning Centre

1. Straight, Taper and Radius Turning.
2. Thread Cutting.
3. Rough and Finish Turning Cycle.
4. Drilling and Tapping Cycle.

(IV) Computer Aided Part Programming: Conduct any 1 experiment

1. Development of NC code for free form and sculptured surfaces using CAM software.
2. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM Software.

Software's used: PRO-E/ANSYS/FUSION 360/MASTER CAM

21MC0007: YOGA AND INDIAN PHILOSOPHY

B.Tech.III Year II Sem.

L	T	P	C
3	0	0	0

L TP C

Unit-1

Bhagavad Gita, chapter 2 SankhyaYoga slokas 54-72 about emotional intelligence(Stitaprajnata)

Unit-2

Bhagavad Gita, chapters 3-7

Unit-3

Bhagavad Gita, chapters 8-11

Unit-4

Bhagavad Gita, chapters 12-15

Unit-5

Bhagavad Gita, chapters 16-18

10 quotes from each chapter of ref.(2)

References:

1) Bhagavad Gita By Swami Swarupananda, R K Math Publication
2) Vivekananda-His Call to the Nation, R K Math Publication