III Year - I Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGME5T0122	Computer aided Manufacturing and 3D printing	3	-	-	3	30	70	100
2	PC	UGME5T0222	Thermal Systems	3	-	-	3	30	70	100
3	PC	UGME5T0322	Design of Machine Elements	3	-	-	3	30	70	100
4	OE/JOE	UGBS5T0122	Employability Skills	2	-	2	3	30	70	100
5	PE	**Professional Elective-I** UGME5T0422 UGME5T0522 UGME5T0622	Automobile engineering Production Planning and Control Advanced Mechanics of solids	3	-	-	3	30	70	100
6	PC LAB	UGME5P0722	Machine Tools lab	-	-	3	1.5	15	35	50
7	PC LAB	UGME5P0822	Thermal Engineering Lab	-	-	3	1.5	15	35	50
8	SOC	UGME5K0922	MAT lab and Programming for Mechanical Engineering problems	1	-	2	2	50	-	50
9	MC	UGMB5A0122	IPR & Patents	2	-	-	-	-	-	-
10	Internship	UGME5I1022	Summer Internship(after second year)	-	-	-	1.5	50	-	50
			Total	**17**	**0**	**10**	**21.5**	**280**	**420**	**700**
Honors/Minor Course (4 Credits)										

III Year - II Semester

S.No	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGME6T0122	Heat Transfer	3	-	-	3	30	70	100
2	PC	UGME6T0222	Design of Transmission Elements	3	-	-	3	30	70	100
3	PC	UGME6T0322	Finite Element Method	3	-	-	3	30	70	100
4	PE	**Professional Elective-II** UGME6T0422 UGME6T0522 UGME6T0622	Design for Manufacturing Vehicle Design & Data Characteristics Turbo Machinery	3	-	-	3	30	70	100
5	OE/JOE		Open elective/Job oriented elective	2	-	2	3	30	70	100
6	PC LAB	UGME6P0722	CAM & 3D printing Lab	-	-	3	1.5	15	35	50
7	PC LAB	UGME6P0822	Heat Transfer lab	-	-	3	1.5	15	35	50
8	PC LAB	UGME6P0922	Design Analysis Lab	-	-	3	1.5	15	35	50
9	SOC	UGBS6K0122	Advanced Communication skills	1	-	2	2	50	-	50
10	MC	UGBS6A0222	Essence of Indian Traditional Knowledge	2	-	-	-	-	-	-
			Total	**17**	**0**	**13**	**21.5**	**245**	**455**	**700**
Internship 2 Months (Mandatory) during Summer Vacation										
Honors/Minor Course (4 Credits)										

COMPUTER AIDED MANUFACTURING & 3D PRINTING

Subject Code: UGME5T0122	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION **08hrs**

Introduction to CAM, fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Features of CNC, Elements of CNC machines, the machine control unit for CNC , Direct Numerical Control(DNC) and Adaptive Controls.

UNIT-II Computer Numerical Control (CNC) : **08 hrs**

Computer Integrated manufacturing system, Group Technology, Flexible Manufacturing System, Computer aided process planning-Retrieval and Generative System.

UNIT-III: INTRODUCTION to 3D printing **12 hrs**

Introduction to 3D Printing / Rapid Prototyping, Historical development, Fundamentals, Advantages and Limitations of 3D Printing, Commonly used Terms, Classification, Process chain, Applications in various industries.

Industry 4.0 Introduction, Design Principles, Challenges in implementation of Industry 4.0, 6Cs of Industry 4.0, Impact of Industry 4.0

UNIT-IV: LIQUID AND SOLID BASED SYSTEMS **10hrs**

LIQUID - BASED SYSTEMS:

Stereo Lithography Apparatus (SLA): Process, working principle, Applications, Advantages and Disadvantages. Solid Ground Curing (SGC): Process, working principle, Applications, Advantages and Disadvantages.

SOLID - BASED SYSTEMS:

Laminated Object Manufacturing (LOM): Process, working principle, Applications, Advantages and Disadvantages.

Fused Deposition Modeling (FDM): Process, working principle, Applications, Advantages and Disadvantages.

Paper Lamination Technology (PLT): Models,Process,workingprinciple, applications, Advantages and Disadvantages.

UNIT-V: **10 hrs**

POWDER BASED SYSTEMS:

Selective Laser Sintering (SLS): Process, working principle, Applications, Advantages and Disadvantages. Three-Dimensional Printing(3DP):Models, Process, working principle, applications, Advantages and Disadvantages.

Laser Engineered Net Shaping (LENS): Models, Process, working principle, applications, Advantages and Disadvantages.

COURSE OUTCOMES:

After completion of this course, the students should be able to:

CO1: Identify the fundamental concepts and need of Computer Aided Manufacturing
CO2: Identify the fundamental concepts of Computer Numerical Control systems
CO3: Build geometrical models by using distinguished modeling techniques
CO4: Perceive the importance of Industry 4.0
CO5:Assess the need of 3D Printing or Rapid Prototyping in product development
CO6:Apply the working principles & applications of liquid, solid and powder-based systems

Mapping of COs to POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2										2		2	
CO2	3	3	3	3	3							3	2	
CO3	3	3	3		3							3	3	3
CO4	3	3	2		3					3	3		3	3
CO5	3	3	3		3								3	3
CO6	3	3	3		3								3	3

TEXT BOOKS:

1. CAD / CAM by A. Zimmers and P. Groover; Publisher: Prentice Hall International/Pearson Education
2. CAD/CAM Principles and Applications by PNRao; Publisher:TataMcGrawHill
3. CAD/CAM Theory and Practice by Ibrahim Zeid; Publisher:TataMcGrawHill
4. "RapidPrototyping:PrinciplesandApplications",Chua,C.K.,K.F.LeongandC.S.Lim,World Scientific, River Edge, NJ., 2003.
5. "RapidPrototyping-ABriefIntroduction",AmitabhGhosh,AffiliatedEast WestPress Pvt. Ltd., 1997.

REFERENCES:

1. CAD / CAM / CIM by Radhakrishnan and Subramanian; Publisher: PearsonEducation
2. Principles of Computer Aided Design and Manufacturing by Farid Amirouche; Publisher: Pearson Education
3. CAD/CAM: Concepts and Applications by Alavala; Publisher: Prentice HallInternational
4. "Rapid Prototyping: Theoryand Practice", Ali K. Kamrani, Emad AbouelNasr,Springer, 2006.
5. "Rapid Prototyping and Engineering applications: A tool box for prototype development", Liou W. Liou, Frank W. Liou, CRC Press, 2007.

THERMAL SYSTEMS

	L	T	P	C
Subject Code: UGME5T0222				
III Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: 9 hrs

STEAM BOILERS - Classification – Working principles of H.P. and L.P Boilers. Performance, equivalent evaporation, efficiency and heat balance –Boiler Draught- Classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced. Functions of mountings and accessories.

UNIT-II: 9 hrs

STEAM NOZZLES - Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation - Wilson line.

UNIT- III: 12 hrs

STEAM CONDENSERS - Requirements of steam condensing plant – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirements and types.

IMPULSE 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-pressure compounding, Velocity and Pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency.

UNIT-IV: 8 hrs

REACTION TURBINES: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency, calculation of blade height.

UNIT-V: 10 hrs

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, types of combustion chambers.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Analyze the performance of Thermal Systems using Thermodynamics concepts.

CO2: Illustrate the working of various types of boilers, their mountings & accessories and determine their efficiencies.

CO3: Analyze the flow through nozzles by using mollier diagram.

CO4: Evaluate the performance of the steam turbines and Steam Condensers.

CO5: Calculate the performance of Gas Turbines.

Mapping of COs to PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2										
CO2	2	2		2			2							
CO3	2	3		3										
CO4	2	3		3										
CO5	3	3		3			2							

TEXT BOOKS:

1. Mahesh M Rathore, Thermal Engineering McGraw Hill Education, April 2010.
2. P. L. Bellaney, Thermal Engineering Khanna Publishers, January 1966.
3. V. Ganesan Gas Turbines,3/e, McGraw Hill Education, July 2017.
4. D. S. Kumar, Thermal Science and Engineering,1/e, S.K. Kataria & Sons, January 2013.

REFERENCES:

1. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot
2. Gas Turbines and Propulsive Systems – P. Khajuria & S. P. Dubey & Dhanpatrai
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman
4. Thermal Engineering-M. L. Marthur & Mehta/Jain bros.

DESIGN OF MACHINE ELEMENTS
(Design data book allowed)

Subject Code: UGME5T0322	**L**	**T**	**P**	**C**
III Year /I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION- STRESSES IN MACHINE MEMBERS 12hrs

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

STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending stresses – impact stresses – stress strain relation – Various theories of failure – factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations – Static strength design based on fracture toughness.

UNIT-II: DESIGN FOR DYNAMIC LOADING & POWER SCREWS 10hrs

DESIGN FOR DYNAMIC LOADING: Stress concentration - Theoretical stress concentration factor - Fatigue stress concentrations factor,Notch sensitivity – Design for fluctuating stresses - Endurance limit – Estimation of Endurance strength – Goodman's line – Soderberg's line –Modified goodman's line.

POWER SCREWS

Types - Mechanics of power screws, efficiency, self-locking of screw and stresses in screw.

UNIT-III: DESIGN OF RIVETED, WELDED AND BOLTED JOINTS 14hrs

DESIGN OF RIVETED JOINTS – types, failure of joints, and efficiency of joint.– Design of joints with initial stresses – eccentric loading - Boiler joints

DESIGN OF WELDED JOINTS -- types, failure of joints, and efficiency of joint. Strength of butt, parallel fillet and transverse fillet welded joints Stresses, Design of joints with initial stresses – eccentric loading

BOLTED JOINTS

Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – both of uniform strength, different seals. Torque requirement for bolt tightening. Eccentrically loaded bolted joints. Fluctuating loads on bolted joints. Joints with combined stresses

UNIT-IV: KEYS, COTTERS AND KNUCKLE JOINTS 10hrs

Design of Keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints.

UNIT-V: MECHANICAL SPRINGS **10hrs**

Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1: Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constraints.
CO2: Evaluate the stresses in machine members subjected to static and dynamic loading ensure safe design.
CO3: Design permanent joints for static and eccentric loading conditions.
CO4: Design temporary joints subjected to static and eccentric loading conditions.
CO5: Analyze the stresses for designing a spring.

Mapping of COs to POs

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	3	3	2								2	3	
CO 2	3	3	3	2								2	3	
CO 3	3	3	3	2								2	3	
CO 4	3	3	3	2								2	3	
CO 5	3	3	3	2								2	3	

TEXTBOOK:

1. Machine Design, 2017, 4th edition by V.Bandari Publishers McGraw Hill Education India Private Limited
2. Machine Design, 2010 by S MD Jalaludeen, Anuradha Publishers
3. Machine Design,2005, 14th edition by RS Khurmi, JK Gupta, S Chand, Publisher: Eurasia Publishing House (Pvt.) Ltd.
4. Machine Design,2021, 2nd edition by P. Kannaiah Publisher: Scietech.
5. Design Data hand Book, S MD Jalaludeen, Anuradha Publishers
6. Machine Design,2002, 21st edition by N.C. Pandya & Shaw, Charotar publishers

REFERENCES:

1. Machine Design, 2011, 4th edition by R.N. Norton, Publisher: Pearson Education, Inc.
2. Data Books: (I) P.S.G. College of Technology (ii) Mahadevan Mech. Engg. Design / JE Shigley.

EMPLOYABILITY SKILLS
(English, Aptitude and Logical Reasoning)
(Common to All Branches**)**

Subject Code: UGBS5T0122	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**2**	**3**

PREREQUISITE : Basic competency in understanding passages and the use of grammar & words correctly

COURSE OBJECTIVES:

- To expose students to enhance their verbal ability and interpersonal skills
- To prepare students to acquire skills in aptitude for careers prospects
- To prepare students to develop logical reasoning for employment

SYLLABUS

UNIT I: (9 Hours)

High frequency words: Selected 101 words with their ***basic*** meaning, commonly used synonyms and 101 words usage in sentences

UNIT II: (9 Hours)

Reading Comprehension passages: Tactics in understanding the given Comprehension passages & Practice tests

UNIT III: (9 Hours)

Interpersonal Skills: Verbal & Non-verbal Communication & Team Work

Percentages -Percentage-Conversion of fraction to percentage and Percentage to Fraction-percentage excess & shortness, Effect of percentage change on a Number-Effect of two step change-Effect of percentage change on product.

UNIT IV: (9 Hours)

Time & Work: Rate of work -Work as a single unit -No. of persons working together – No. of man days.

Time & Distance: Speed - Average Speed - problems on trains – Relative speed - Boats and streams

UNIT V: (9 Hours)

Coding, Decoding, Letter and Number Series: Letter Coding, Direct Letter coding, Number / Symbol coding, Substitution Coding, Deciphering message word coding and its types, Number series, Letter Series.

Data Analysis and Interpretation: Tabulation- Pie Charts – Bar Diagrams – LineGraphs.

COURSE OUTCOMES:

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

CO1: Make effective use of words in receptive as well as productive communication (L3)

CO2: Examine the Reading comprehension passages to understand and later, answer the questions correctly (L2)

CO3: Develop team work and interpersonal skills with groups as well as the skill of calculating percentages (L3)

CO4: Apply the knowledge of math in distance, time related concepts (L3)

CO5: Develop proficiency in numerical reasoning. (L3)

Mapping of COs to POs:

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

Text Books:

1. Objective English – Hari Mohan Prasad & Uma Rani
2. Professional Communication – Globarena – IEG publications
3. A Modern Approach to Verbal and Non-verbal Reasoning by Dr.R.S.Aggarwal
4. Quantitative aptitude and Reasoning by R V Praveen (3rd edition)

Reference:

1. High frequency 101 word list: https://crunchprep.com/gre/101-high-frequency-gre-words
2. Quantitative Aptitude by Abhijit Guha – TMH Publishers

AUTOMOBILE ENGINEERING
(PROFESSIONAL ELECTIVE - I)

Subject Code: UGME5T0422	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT I: **8 hrs**

INTRODUCTION: Classification of Automobiles, Components of four wheeler automobile – chassis, Layout of Chassis, Types of Automobile Chassis, Body, Types of Automobile body– Drive Layouts of Automobiles – rear wheel drive, front wheel drive, 4 wheel drive.

TRANSMISSION SYSTEM: Introduction to Clutches, its types & principle, gear boxes, types, sliding mesh, construct mesh, synchromesh gear box, epicyclic gear box , over drive torque converter. Propeller shaft Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles –types – wheels and tyres.

UNIT II: **10 hrs**

STEERING SYSTEM: Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Components steering system and of steering linkages, Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, power steering, steering gears – types - Under steer and Over steer.

SUSPENSION SYSTEM: Objectives of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system - Pneumatic suspension system.

UNIT III: **12 hrs**

ELECTRIC AND HYBRID VEHICLES- History, Components of Electric Vehicle, Comparison with Internal combustion Engine : Technology, Benefits & Challenges, EV classification & EV Terminology, Types of Electric Vehicle and components, Electrical protection and system requirement, EV Architecture- (BEV), (HEV), (PHEV), (FCEV), Comparison of fuel vs Electric and solar power, Solar Power operated Electric vehicles.

Electric Drive and controller- Types of Motors, Selection and sizing of Motor, Motor Controllers, Component sizing, Electrical connection of motor.

8 hrs

UNIT IV:

ENERGY STORAGE & SAFETY STANDARDS FOR HEV-

Energy Storage Solutions (ESS)-Cell Types (Lead Acid/Li/NiMH), Battery charging and discharging, Cell Selection and sizing, Battery Pack Configuration, Battery selection criteria, BMS.

Charging Stations-Onboard-Off board chargers, Type of Charging station, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station.

8 hrs

UNIT V:

BRAKING SYSTEM: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

SAFETY SYSTEMS: Introduction to safety systems, seat belt, airbags, bumper Antilock brake system (ABS), Electronic Stability Program (ESP), wind shield, traction control.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Classify different types of automobile vehicles and their category

CO2: Select different components required for transmission.

CO3: Design the Vehicle Architecture and working of controlling system for IC & HEV Vehicles.

CO4: Apply free knowledge of Troubleshooting for Automobiles.

CO5: Transfer the technology of emission free vehicles to society.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO 1	3	2	2										2	
CO 2	3		2										1	
CO 3	3		2				3					3		
CO 4	3	3	2	2		3	3					3		
CO 5	3		2	3		3	3					2		

TEXT BOOKS:

1. Automobile Engineering – Vol. 1 & Vol. 2 / Kirpal Singh.
2. Automobile Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.

REFERENCES:

1. Automotive Engineering / Newton Steeds & Garrett
2. Automotive Mechanics / G.B.S. Narang
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.Automotive Engines / Srinivasan
4. Automobile Engineering – K.K. Ram lingam / SciTech Publications (India) PVT.

PRODUCTION PLANNING AND CONTROL

(PROESSIONAL ELECTIVE-I)

Subject Code: UGME5T0522	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: INTRODUCTION **8hrs**

Definition – Objectives of production planning and control – Functions of production planning and control – Elements of production control – Types of production

UNIT-II: **8hrs**

Forecasting - Importance of forecasting – Types of forecasting and their uses – General principles of forecasting - Forecasting techniques – qualitative methods and quantitative methods.

UNIT-III: **8hrs**

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model.

Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory.

UNIT–IV: **10hrs**

Routing – Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure.

Schedule – definition, Scheduling Policies – Techniques, Standard scheduling methods. Implement various scheduling techniques to schedule shop floor activities of the industry, Introduction to aggregate planning, Chase planning, Expediting.

UNIT-V: **8hrs**

Dispatching – Activities of dispatcher – Dispatching procedure – follow up – definition types of follow up, applications of computer in production planning and control.

Course Outcomes:

At the end of the course students are able to:

CO1:Corelate the strategic planning, materials requirements planning, aggregate production planning and scheduling with real time applications.

CO2: Develop forecasting models for demand forecasting

CO3: Solve various inventory management problems

market options

CO4: Apply various scheduling techniques to schedule shop floor activities of the industry.

CO5: Develop aggregate production plans to weekly assembly quantities for end items

Mapping of COs to POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	3										3	
CO2	3	3	3	3									3	
CO3	3	3	3	3									3	
CO4	3	3	3	3	3								3	
CO5	3	3	3	3	3								3	

TEXT BOOKS:

1. Elements of Production Planning and Control / SamuelEilon.
2. Modern Production/ operation managements / Baffa &RakeshSarin

REFERENCE BOOKS:

1. Operations Management – S.N.Chary.
2. Inventory Control Theory and Practice / Martin K. Starr and David W.Miller.
3. Production Control A Quantitative Approach / John E.Biegel.
4. Operations Management / JosephMonks.

ADVANCED MECHANICS OF SOLIDS
(PROFESSIONAL ELECTIVE-I)

Subject Code: UGME5T0622	**L**	**T**	**P**	**C**
III Year /I Semester	**3**	**-**	**-**	**3**

SYLLABUS:

UNIT-I: **10hrs**

FIXED BEAMS: Fixing moments for a fixed beam of uniform section, Effect of sinking support, slope and deflection.

CONTINUOUS BEAMS: Analysis, Reaction at the supports, Effect of sinking of supports.

UNIT-II: **8hrs**

BENDING OF CURVEDBEAMS:

Introduction, stresses in curved beams, Winkler-Bach formula, Expression for radius of neutral axis for rectangular, circular, trapezoidal, I and T-Section.

UNIT-III: **16hrs**

STRESSES DUE TO ROTATION: Wheel rim, disc of uniform thickness, disc of uniform strength.

GOVERNING EQUATIONS

Introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

UNIT-IV: CONSTITUTIVE EQUATIONS **10hrs**

Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems:
concepts of uniqueness and superposition.

UNIT-V: **8hrs**

Strain Energy methods: Solutions using potentials. Energy methods. Introduction to plasticity.

COURSE OUTCOMES:

Upon completion of this course, students will be able understand

CO1: Apply principles of equilibrium for determining shear force and bending moment for a given beam.

CO2: Determine the stresses resulting from bending of curved beams.

CO3: Determine stresses and displacements in axisymmetric rotating discs for different conditions at the surfaces.

CO4: Solve torsion problems in bars, thick cylinders and thin walled members.

CO5: Analyze solid mechanics problems using classical methods and energy method.

CO6: Propose materials and structural elements to the analysis of complex structures.

Mapping of COs to POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	3									2	2	
CO2	3	3	3	2								2	3	
CO3	3	3	3									2	2	
CO4	3	3	3									2	2	
CO5	3	3	3									2	2	
CO6	3	2	3									2	2	

TEXT BOOKS:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press,2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International,1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall International, 1969.

REFERENCE BOOKS:

1. Strength of Materials 2006 By Jindal, UmeshPublications.
2. Analysis of structures Vol1 1999 by M.M. Ratwani and S.K Duggal, Khanna Publishers.
3. Mechanics of Structures Vol-I, 2016, 32nd edition by S.B. Junnarkar, Publisher Paperback.
4. Strength of materials, 2013, 4th edition by Bhavikatti, Vikas publishing house.
5. Strength of Materials, 1990 by Andrew Pytel and Ferdinand L. Singer Publisher: Longman.

MACHINE TOOLS LAB

Subject Code: UGME5P0722	L	T	P	C
III Year / I Semester	0	0	3	1.5

Experiments:

Lathe operations :

1. Perform a plain turning and facing operations on the given work piece by using lathe machine.

2. Perform a Step turning operation on the given work piece by using lathe machine.

3. Perform a Taper turning operation on the given work piece by using Tail stock set over method.

4. Perform a Taper turning operation on the given work piece by using a by using a broad nose form tool method.

5. Perform a Taper turning operation on the given work piece by using a by swiveling compound rest method.

6. Perform a Knurling operation on the given work piece by using lathe machine.

7. Perform a Tapping operation on the given work piece by using lathe machine.

8. Perform a Drilling operation on the given work piece by using lathe machine.

9. Produce grooves in the given work piece by performing shaping operation using shaping machine.

10. Produce a keyway slot in a given work piece by performing slotting operation over a slotting machine.

11. Machine a Spur gear to a given module and number of teeth in the given work piece by using Milling Machine.

12. Prepare a flat surface by using Surface Grinding machine.

13. Perform a Drilling operation by using Radial drilling Machine.

14. Perform reaming and tapping operations by using drilling machine.

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Demonstrate comprehensive proficiency in various machining techniques and machine tools, enabling them to plan, execute, and evaluate a wide range of machining operations.

CO2: Demonstrate proficiency in performing plain turning, facing, step turning, taper turning (tailstock set-over and broad nose form tool methods), knurling, tapping, and drilling operations on a lathe machine

CO3: Exhibit competence in producing grooves using a shaping machine and creating keyway slots via slotting machine operations.

CO4: Develop expertise in machining spur gears to specified modules and tooth counts using a milling machine.

CO5Acquire the skills necessary to prepare flat surfaces effectively using a surface grinding machine.

CO6: Proficiently execute precise drilling, reaming, and tapping operations using a radial drilling machine.

Mapping of COs to POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3	3		2	2	2				3	3	2
CO2		2	3	3								3	2	2
CO3		2	3									3	2	3
CO4		2	3									3	3	3
CO5		2										3		3
CO6		2	3	3								3		2

REFERENCE BOOKS:

1. Machine tools college lab manual.

THERMAL ENGINEERING LAB

Subject Code: UGME5P0822	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP1: Valve Timing Diagram on 4 Stroke Diesel Engine.

EXP2: Port Timing Diagram on 2 Stroke Petrol Engine.

EXP3: Performance Test on 4 -Stroke Single Cylinder Diesel Engine.

EXP4: Performance Test on 2-Stroke Single Cylinder Petrol Engine.

EXP5: Heat Balance Test on 4 Stroke Single Cylinder Diesel Engine.

EXP6: Determination of Frictional Horse Power by retardation and motoring test on I. C. Engine

EXP7: Performance Test on Variable Compression Ratio Engine by economical speed test.

EXP8: Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Petrol engine

EXP9: Performance Test on 4 -Stroke Single Cylinder Petrol Engine.

EXP10: Study of Boilers.

EXP11: Determination of Frictional Horse Power by Willian's line method on I. C. Engine

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Evaluate and analyze the engine performance parameters

CO2: Identify and draw valve & port timing diagrams for four stroke and two stroke engines

CO3: Calculate the Performance parameters, various efficiencies and energy balance for diesel and petrol engines

CO4: Comprehend different types of Boilers and their working.

Mapping of COs to POs:

	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2
CO1		1	2	3					2					
CO2			2	3					2					
CO3		1	2	3					2					
CO4			2	3					2					

REFERENCE BOOKS:

1. Thermal engineering college lab manual
2. I.C. Engines / V. GANESAN-TMH
3. I.C. Engines / Heywood /Mc Graw Hil

MATLAB and Programming for Mechanical Engineering problems

Subject Code: UGME5K0922	**L**	**T**	**P**	**C**
III Year / I Semester	**1**	**0**	**2**	**2**

Experiments:

EXP 1:	Develop a program to determine the whether the given data belongs to a thin cylinder or thick cylinder and estimate the stresses developed in it.
EXP 2:	Program for riser design in casting using CAINEs equation
EXP 3:	Python program to design a Helical Compression Springs
EXP 4:	Program to determine the capacity of air conditioner
EXP 5:	Program to determine the arrival rate, service rate, length of the queue, length of the system and waiting time of the system in Queuing theory
EXP6:	Write a MATLAB program for a 1-Dimensional Steady State Heat Conduction
EXP7:	Write a MATLAB program to plot the deflection of a Beam
EXP8:	Write a MATLAB program to plot the tensions of the cables for a given truss element
EXP9:	Write a MATLAB program to calculate and plot the position, velocity and acceleration of a piston of a slider crank mechanism
EXP10:	Write a MATLAB program to plot the response of an undamped single degree spring mass system when subjected to given initial conditions
EXP11:	Write a MATLAB program to plot the response of a spring mass system with damping when subjected to given initial conditions
EXP12:	Write a MATLAB program to plot the Break Power, Specific Fuel Consumption and Break Thermal Efficiency Vs Speed of an Engine

Course Outcomes:

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

CO1: Apply Python to solve mechanical and design problems, showing proficiency in engineering and programming.

CO2: Use Python to simulate heat conduction and calculate beam deflection, demonstrating engineering and programming integration.

CO3: Apply MATLAB for modeling and analysis in various engineering applications, showcasing proficiency in engineering software.

CO4: Use MATLAB for data analysis and visualization in engineering, demonstrating proficiency in MATLAB's engineering applications.

CO5: Proficiently apply engineering principles and programming tools (Python and MATLAB) to solve diverse mechanical engineering challenges, showcasing comprehensive problem-solving abilities.

Mapping of COs to POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											3	3
CO2	2	2											3	3
CO3	2	2											3	3
CO4	2	2											3	3
CO5	3	3											3	3

References:

1. College Lab Manual

INTELLECTUAL PROPERTY RIGHTS & PATENTS
(Common to all branches)

Subject Code: UGMB5A0122	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**0**	**0**

Course Objectives: This course introduces about intellectual property laws, trademarks, copyrights and patents.

Syllabus:

UNIT-I: (6 Hours)
Intellectual Property Law: Basics, Types, Agencies Responsible for IP Registration, International Organizations, Agencies and Treaties, Importance of IPR.
Trademark Law: Purpose of Trademarks, Types, Acquisition, Common Law Rights, Laws and Treaties Governing Trademarks, Categories, Trade Names and Business Names, Protectable Matter, Exclusions from Trademark Protection, Selecting and Evaluating a Mark, Trademark Search.

UNIT-II: (5 Hours)
Copyright Law: Common Law Rights, Originality of Material, Fixation of Material, Works of Authorship, Exclusions, Compilations, Collections and Derivative Works.
Rights Afforded by Copyright Law: Rights of Reproduction, Derivative Works, Distribution and the First Sale Doctrine, Work Publicly, Rights to Display the Work Publicly, Other Limitations on Exclusive Rights, Moral Rights and the Visual Artists Rights, Compulsory Licenses.

UNIT-III: (7 Hours)
Copyright Ownership and Transfers: Ownership Issues, Joint Works, Ownership in Derivative or Collective Works, Works Made for Hire, Transfers, Termination of Transfers and Duration.
Copyright Infringement: Elements, Contributory and Vicarious Infringement, Defences to Infringement, Infringement Actions.
New Developments: Protection for Computer Programs and Automated Databases, Copyright in the Electronic Age, Entertainment Notes, Recent Developments, Terms of the Trade, Semiconductor Chip Protection.

UNIT-IV: (6 Hours)
Patent Law: Introduction, Patentability, Design Patents, Plant Patents, Double Patenting.
Patent Searches and Application: Searching, Application Process, Prosecuting the Application, Post-issuance Actions, Term and Maintenance of Patents.
Patent Ownership and Transfer: Ownership Rights, Sole and Joint Inventors, Disputes, Inventions made by Employees and Independent Contractors, Assignment of Rights, Licensing, Invention Developers and Promoters.

UNIT-V: (6 Hours)
Patent Infringement: Direct Infringement, Inducement to Infringe, Contributory Infringement, First Sale Doctrine, Indirect Infringement, Infringement Abroad, Claims Interpretation, Defences, Remedies, Resolving a Dispute and Litigation.

New Developments: International Patent Protection, Patent Cooperation Treaty, European Patent Organization, Patent Prosecution Highway, Agreement on Trade-Related Aspects of IPR, Patent Law Treaty, Foreign Filing Licenses.
Intellectual Property Audits: Practical Aspects of Intellectual Property Audits, Conducting the Audit, Postaudit Activity.

Course Outcomes:
Upon completion of this course, the students will be able to:
CO1: Understand the intellectual property law.
CO2: Understand the need of trademark and its use.
CO3: Familiar with copyright laws and its rights, ownership, transfers and copyright Infringement.
CO4: Acquire the knowledge on various aspects of patents.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	-	-
CO3	3	3	3	-	-	-	-	3	-	3	-	-
CO4	3	3	3	-	-	3	3	3	-	3	-	-

TEXT BOOKS:
1. Deborah E. Bouchoux, "Intellectual Property", Cengage Learning
2. Asha Vijay, Durafe Dhanashree and K. Toradmalle, "Intellectual Property Rights", Wiley India
3. Neeraj Pandey and Khushdeep Dharni, "Intellectual Property Rights", PHI Learning, 2014.

REFERENCE BOOKS:
1. Kompal Bansal & Parishit Bansal, "Fundamentals of IPR for Engineers", BS Publications.
2. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw Hill, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian, "Intellectual Property Rights", Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali, "Intellectual Property Right", Serials Pub.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
6. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand.
8. Dr. A. Srinivas, "Intellectual Property Rights (Patents & Cyber Law)", Oxford University Press, New Delhi.

HEAT TRANSFER

Subject Code: UGME6T0122	L	T	P	C
III Year / II Semester	3	0	0	3

SYLLABUS:

UNIT-I: ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER:10 hrs

Modes and mechanisms of heat transfer – Basic laws of heat transfer. General discussion about applications of heat transfer.

Conduction Heat Transfer: General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Initial and boundary conditions.

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation. Systems with variable Thermal conductivity – systems with heat sources or Heat generation.

UNIT-II: EXTENDED SURFACE (FINS) AND TRANSIENT CONDUCTION: 10 hrs

Extended Surface (Fins) – 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 - Chart solutions of transient conduction systems.

Dimensional Analysis: as a tool for experimental investigation – Buckingham Pi Theorem for forced and free convection, application for developing semi – empirical non- dimensional correlation for convection heat transfer. Significance of non-dimensional numbers.

UNIT- III: FORCED AND FREE CONVECTION: 10 hrs

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer-Concepts of Continuity, Momentum and Energy Equations and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

Internal flows: Concepts about hydrodynamic and thermal entry lengths-Division of internal flow based on this- Use of empirical relations for Horizontal Pipe Flow and annulus flow.

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

UNIT-IV: BOILING AND CONDENSATION: 9 hrs

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.

HEAT EXCHANGERS: 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.

UNIT-V: RADIATION HEAT TRANSFER: 9 hrs

Emission characteristics and laws of black-body radiation – Irradiation–total and monochromatic quantities- laws of Planck, Wien, Kirchoff, 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.

COURSE OUTCOMES:

At the end of the course students are able to:

CO1: Utilize your comprehension to grasp the fundamental modes of heat transfer.

CO2: Analyze problems involving steady state and transient heat conduction.

CO3: Interpret and analyze free & forced convection heat transfer.

CO4: Employ their understanding to comprehend the principles of radiation and gauge the exchange of radiation between distinct surfaces.

CO5: Exercise their cognitive skills to grasp the phenomena of the boundary layer concept and the distinct flow regimes involved in boiling and condensation

CO6: Design heat exchangers for improving its performance .

Mapping of COs to PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3								2		
CO2	3	3		2								2		
CO3	3	3		2								2		
CO4	3	3		2								2		
CO5	3	2		2								2		
CO6	3	3		2								2		

TEXT BOOKS:

1. Heat Transfer / HOLMAN/TMH
2. Fundamentals of Engg. Heat and Mass Transfer / R.C.Sachdeva / New Age International
3. Heat and Mass Transfer –Cengel- McGraw Hill.

REFERENCE BOOKS:

1. Heat Transfer – Ghoshdastidar – Oxford University Press – II Edition
2. Heat Transfer – P.K.Nag/ TMH
3. Heat and Mass Transfer – R.K. Rajput – S.Chand & Company Ltd.
4. Heat and Mass Transfer – D.S.Kumar / S.K.Kataria & Sons
5. Heat and Mass Transfer Data Book- Kondandaraman
6. Fundamentals of Heat Transfer & Mass Transfer- Incropera & Dewitt/John Wiley Pub.

DESIGN OF TRANSMISSION ELEMENTS

(Design data book allowed)

Subject Code: UGME6T0222	**L**	**T**	**P**	**C**
III Year /II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: BEARINGS **12hrs**

Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design – Ball and roller bearings – Static loading of ball & roller bearings, Bearing life.

UNIT-II: ENGINE PARTS **10hrs**

Connecting Rod: Thrust in connecting rod – stress due to whipping action on Connecting rod ends – Cranks and Crankshafts, strength and proportions of overhung and center cranks – Crank pins, Crankshafts. Pistons, Forces acting on piston – Construction Design and proportions of piston. Cylinder, Cylinder liners.

UNIT-III: SHAFTS & SHAFT COUPLING **10hrs**

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

UNIT-IV: POWER TRANSMISSIONS SYSTEMS, PULLEYS **18hrs**

Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials, Chain drives.

SPUR & HELICAL GEAR DRIVES

Spur gears- Helical gears – Load concentration factor – Dynamic load factor. Surface compressive strength – Bending strength – Design analysis of spur gears – Estimation of center distance, module, and face width, check for plastic deformation.

UNIT-V: FRICTION CLUTCHES & BRAKES **10hrs**

Friction Clutches- Function, Types, friction materials Torque transmitting capacity of the disc, cone, and centrifugal clutches -Uniform Wear theory and Uniform pressure theory.

Brakes - Energy equations block brake with short shoe and long shoe, Pivoted block brake with the long shoe, Internal expanding brake, Disc Brake, self-locking and self-energizing brakes.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Evaluate and Select the suitable bearing

CO2: Design the primary components of an internal combustion engine components.

CO3: Investigate the Design of shafts and couplings.

CO4: Evaluate and select an appropriate power transmission system.

CO5: Engineer toothed gears for safe design

CO6: Design clutches and brakes.

Mapping of COs to POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	3	3									2	3	
CO2	3	3	3									2	3	
CO3	3	3	3									2	3	
CO4	3	3	3									2	3	
CO5	3	3	3									2	3	
CO6	3	3	3									2	3	

TEXTBOOK:

1. Machine Design, 2017, 4th edition by V.Bandari Publishers McGraw Hill Education India Private Limited
2. Machine Design, 2010 by S MD Jalaludeen, Anuradha Publishers
3. Machine Design,2005, 14th edition by RS Khurmi, JK Gupta, S Chand, Publisher: Eurasia Publishing House (Pvt.) Ltd.
4. Machine Design,2021, 2nd edition by P. Kannaiah Publisher: Scietech.
5. Design Data hand Book, S MD Jalaludeen, Anuradha Publishers
6. Machine Design,2002, 21st edition by N.C. Pandya & Shaw, Charotar publishers

REFERENCES:

1. Machine Design, 2011, 4th edition by R.N. Norton, Publisher: Pearson Education, Inc.
2. Data Books: (I) P.S.G. College of Technology (ii) Mahadevan Mech. Engg. Design / JE Shigley.

FINITE ELEMENT METHOD

Subject Code: UGME6T0322	L	T	P	C
III Year / II Semester	3	0	0	3

SYLLABUS

UNIT-I: INTRODUCTION TO FINITE ELEMENT METHOD 13hrs

Discretization of the domain, element shapes, discretization procedures, assembly of stiffness matrix, bandwidth, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, and treatment of boundary conditions. stress and equilibrium, strain–displacement relations, stress–strain relations, variational and weighted residual methods, and the concept of potential energy.

UNIT-II: 1D ELEMENTS 11hrs

Types of 1D elements, Displacement function, Global and local coordinate systems, Order of elements, shape functions, and its properties. Formulation of elemental stiffness matrix and load vector for spring and bar. Assembly of global stiffness matrix and load vector, Stress calculations

UNIT -III: ANALYSIS OF TRUSSES 11hrs

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

ANALYSIS OF BEAMS

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

UNIT –IV: AXISYMMETRIC PROBLEMS 13hrs

plane stress and plane strain conditions ,Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.

UNIT-V: **ISOPARAMETRIC ELEMENTS 18hrs**

One-dimensional quadratic and cubic elements in natural coordinates, two dimensional four noded isoparametric elements, and numerical integration.

STEADY STATE HEAT TRANSFER ANALYSIS: Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions, and solving for temperature distribution.

DYNAMIC ANALYSIS

Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Achieve an understanding of the core concepts of FEM and then apply these concepts, which encompass the minimum potential energy principles and weighted residual methods, to address challenges in structural mechanics.
CO2: Utilize finite element techniques to address 1-D element challenges.
CO3: Implement the finite element methodology for stress analysis and for load-bearing structures
CO4: Apply the FEM procedures to solve axisymmetric problems.
CO5: Employ finite element procedures for iso-parametric elements and numerical integration
CO6: Estimate Eigenvalues and eigenvectors to find natural frequency and mode shapes for simple dynamic systems and 1-D heat transfer analysis.

Mapping of COs to PO

Course Outcomes	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3			2							2	3	
CO2		3			2							2	2	
CO3	3	3			2							2	3	
CO4		3			2								3	
CO5		3			2								2	
CO6		3			2								3	

TEXTBOOKS:

1. Introduction to Finite Elements in Engineering, 2002, 2E, by Tirupathi R. Chandrupatla, Ashok D. Belegundu; Publisher: Prentice Hall of India.

REFERENCES:

1. Finite Element Method 7th edition 2013 by Zienkiewicz, Publisher: Butterworth-Heinemann Ltd.
2. An Introduction to Finite Element Methods 2017 3rd edition by J. N. Reddy, Publisher: McGraw Hill Education.
3. Finite Element Method, 2010, 5th edition by S. S. Rao, Publisher: Butterworth-Heinemann Ltd.

DESIGN FOR MANUFACTURING
(PROFESSIONAL ELECTIVE-II)

Subject Code: UGME6T0422	**L**	**T**	**P**	**C**
III B. Tech/I Sem.	**3**	**-**	**-**	**3**

SYLLABUS

UNIT-I: 8 hrs

INTRODUCTION: Steps in the design process, General design rules for manufacturability, Basic principles of designing for economical production

MATERIALS: Selection of materials for design, Criteria for material selection, Material selection interrelationship with process selection, and Process Selection charts.

UNIT-II: 6 hrs

METAL CASTING: Appraisal of various casting processes, General design considerations for casting, Casting tolerances, Use of solidification simulation in casting design, Product design rules for sand casting

UNIT-III: 10hrs

MACHINING PROCESS: Overview of various machining processes, General design rules for machining, Dimensional tolerance and surface roughness, and Design for machining ease.

METAL JOINING: Appraisal of various welding processes, Factors in the design of weldments, General design guidelines - Pre and post-treatment of welds, Effects of thermal stresses in weld joints, Design of brazed joints.

UNIT-IV 10 hrs

FORGING: Design factors for Forging, Closed die forging design, Parting lines of die drop forging die design, General design recommendations.

EXTRUSION AND SHEET METAL WORK: Design guidelines for extruded sections, Design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram.

UNIT-V: 10hrs

DESIGN OF MANUAL ASSEMBLY: General design guidelines for manual assembly, Development of the systematic DFA methodology, Assembly efficiency, Classification system for manual handling, Classification system for manual insertion and fastening,

Effect of part symmetry on handling time, Effect of part thickness and size on handling time, Effect of weight on handling time.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1: Outline the principles behind DFM (Design for Manufacturing) and delineate a structured procedure for the meticulous selection of materials

CO2: Describe the diverse design considerations relevant to casting

CO3: Apply the design guidelines for machining processes and metal joining processes

CO4: Provide an overview of the design procedures applicable to metal forming applications and sheet metal working

CO5: Make use of design guidelines for manual handling of parts and their assembly.

Mapping of COs to POs:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	3	3											3	
CO2	3	3		2									3	
CO3	3	3		2									3	
CO4	3	3		2									3	
C05	3	3		2									3	

TEXTBOOKS:

1. Assembly Automation and Product Design by Geoffrey Boothroyd, Marcel Dekker Inc.,
2. Engineering Design – Material and Processing Approach by George E. Dieter, McGraw Hill Intl.

REFERENCES:

1. Hand Book of Product Design by Geoffrey Boothroyd, Publisher: Marcel and Dekker
2. Computer Aided Assembly Planning by A. Delchambre, Publisher: Springer

VEHICLE DESIGN AND DATA CHARACTERISTICS
(Professional Elective - II)

Subject Code: UGME6T0522	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: 8 hrs

INTRODUCTION - Assumptions to be made in designing a vehicle, Range of values for Gross Vehicle Weight, Frontal Area, maximum speed, maximum acceleration, gradability in different gears, Basics of Automobile Design.

UNIT II 10 hrs

RESISTANCE TO VEHICLE MOTION - Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation

UNIT III 12 hrs

PERFORMANCE CURVES-I - Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram.

PERFORMANCE CURVES-II - Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length

UNIT IV 9hrs

PERFORMANCE CURVES – III - Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.

UNIT V 9 hrs

GEAR RATIOS - Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance

Course Outcomes:

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

CO1: Apply the fundamental knowledge to assess the vehicle performance.

CO2: Generate the performance curves related to transmission.

CO3: Illustrate the performance curves pertain to Engine

CO4: Determine Gear Ratios required for a vehicle to overcome various resistances acting on vehicle

Mapping of COs to PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3		2								2
CO2	2	3	2	3										2
CO3	2	2	2	3		2	2							2
CO4	3	3	2	2										2

REFERENCES:

1. Giri. N. K., "Automotive Mechanics", Khanna Publishers, New Delhi, 2005.
2. Gupta. R.B., "Automobile Engineering", Sathya Prakashan, 8 edition., 2013.

Heldt, P.M., "High Speed Combustion Engines", Oxford and I.B.H. Publishing Co., Kolkata, 2002.

TURBO MACHINERY
(Professional Elective - II)

Subject Code: UGME6T0622	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

SYLLABUS:

UNIT-I: Gas Turbines: 9 hrs

Axial Flow Gas turbines, Stage Performances, Multi Staging, Stage Loading and flow co efficient – Degree of Reaction, Stage Temperatures and Pressure Ratios, Blade Cooling, Single stage Reaction Turbines

UNIT-II: 9 hrs

Gas Turbine Combustion systems, requirements of combustion chambers, structure and working of combustion chamber, combustion chamber arrangements, factors affecting design and performance. Fuel injection nozzles, combustion emissions, cooling combustion chamber

UNIT-III: RECIPROCATINGCOMPRESSORS: 12hrs

COMPRESSORS –Classification. **Reciprocating Compressors**: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.

ROTARY (POSITIVE DISPLACEMENT TYPE): Roots Blower, vane sealed 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 – power.

UNIT-IV: AXIAL FLOW COMPRESSORS 9 hrs

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, advancements in compressor technologies.

UNIT-V: JET PROPULSION **9 hrs**

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, Thrust Augmentation – Methods.

ROCKETS: Application – Classification - Working Principle, Propellant Type Solid and Liquid propellant Rocket Engines.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Apply thermodynamic concepts to Turbomachines.
CO2: Analyze the Stage performance of Impulse and Reaction gas turbines.
CO3: Assess the performance of combustion chambers within gas turbines.
CO4: Evaluate the power and efficiencies of different types of compressors.
CO5: Calculate various performance parameters of Jet and Rocket propulsion engines.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2		3										
CO 2	2	2		3										
CO 3	3	3		3			2							
CO 4	2	3		3			2							
CO 5	2	3		3										

TEXT BOOKS:

1. Thermal Engineering / R. K. Rajput / Lakshmi Publications
2. Thermal Engineering-P. L. Bellaney/ Khanna publishers.
3. Gas Turbines – V. Ganesan /TMH
4. Thermal Science and Engineering – D. S. Kumar
5. Gas Turbines and Propulsive Systems – P. Khajuria & S. P. Dubey - / Dhanpatrai

REFERENCES:

1.Thermodynamics and Heat Engines / R. Yadav / Central Book Depot
2.Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman
3.Thermal Engineering-M. L. Marthur & Mehta/Jain bros.

COMPUTER AIDED MANUFACTURING
&
3D PRINTING LABORATORY

Subject Code: UGME6P0722	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**1.5**

Computer Aided Manufacturing Experiments:

CNC LATHE

EXP1: Part programming using Fixed or Canned Cycles for Plain Turning and Facing operations.
EXP2: Part programming using Fixed or Canned Cycles for Step Turning operation.
EXP3: Part Programming for Pattern Repeated Cycle.
EXP4: Part Programming for Thread Cutting operation.

CNC MILLING

EXP5: Part Programming for Circular Interpolation.
EXP6: Part Programming for Linear and Circular Interpolation.
EXP7: Part Programming for Circular Pocketing.
EXP8: Part Programming for Rectangular Pocketing.
EXP9: Part Programming for Peck Drilling.
EXP10: Part Programming for Mirroring.

3D Printing

EXP11: To Study about 3D Printing
Introduction to the Process of fabricating a prototype using FDM 3D Printing machine

i. Generate STL files from the CAD Models
ii. Process the CAD data in the software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
iii. Fabricate the given physical part on FDM 3D Printing machine
iv. Remove the supports & post processing (cleaning the surfaces)

EXP12: To design and print a simple Box on FDM 3D Printing machine
EXP13: To design and print a basic helix shape on FDM 3D Printing machine
EXP14: To design and print U Bracket sheet metal on FDM 3D Printing machine

Any 10 experiments from the above

Course Outcomes:

After completion of the course, the students would be able to:

CO1: Prepare part programs for turning and milling operations using simulation software.
CO2: Produce components with different features using CNC machines and machining centres.
CO3: Generate 3D model by using modeling software and develop the part on 3D Printing machine
CO4: Select appropriate process parameters of FDM machine to improve the quality of the parts produced.
CO5: Solve the problem of complex engineering assemblies of plastic materials with less process planning.

Mapping of COs to POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2										3	
CO2	3	3	3										3	
CO3	3	2	2										3	
CO4	3	2	2										3	
CO5	3	3	3										3	

REFERENCE BOOKS:

1. CAD / CAM by A. Zimmers and P. Groover; Publisher: Prentice Hall International/ Pearson Education
2. CAD/CAM Principles and Applications by P N Rao; Publisher: Tata McGraw Hill
3. Cam Lab College Manual.
4. 3D Printing Lab College Manual.

HEAT TRANSFER LAB

Subject Code: UGME6P0822	L	T	P	C
III Year / II Semester	0	0	3	1.5

Experiments:

EXP 1**:** Determination of Thermal Conductivity of a composite wall.
EXP 2: Determination of Heat Transfer Through Lagged pipe
EXP 3: Determination of Thermal Conductivity of a Metal Rod.
EXP 4: Transient Heat Conduction.
EXP 5: Determination of Heat Transfer Coefficient In Forced Convection
EXP 6: Determination of Heat Transfer Coefficient in Natural Convection.
EXP 7: Determination of Effectiveness of a Parallel & Counter Flow Heat Exchangers.
EXP 8: Determination of Surface Emissivity of a given surface.
EXP 9: Determining Stefan Boltzmann's Constant.
EXP 10: Determining Heat Transfer In Dropwise & Filmwise Condensation
EXP 11: Determining Critical Heat Flux Apparatus.
EXP 12: Determination of Thermal Conductivity of an Insulating material using concentric sphere.
EXP 13: Determination of Efficiency and Effectiveness of Pin Fin Apparatus.
EXP 14: Demonstration of heat pipe.

Course Outcomes:

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

CO1: Perform experiments in the different modes of heat transfer conduction, convection and radiation.

CO2: Apply the concepts of heat transfer & validating the results with theoretical values.

CO3: critically examine the instrumentation employed in heat transfer experiments, considering their operational principles, capabilities, and the impact on experimental outcomes.

CO4: Identify the procedures for finding material constants in the area of heat transfer.

CO5: Analyse the experimental results of condensation.

CO6: Perform experiments and asses experimental results in different types of heat exchangers.

Mapping of COs to POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	3		2								
CO2	3			3		2								
CO3	3			3		2								
CO4	3		3	3		2								
CO5	3		3	3		2								
CO6	3		3	3		2								

REFERENCES:

1. Heat Transfer Lab College Manual

DESIGN ANALYSIS LAB

Subject Code: UGME6P0922	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**1.5**

Experiments:

EXP1: Structural analysis of stepped bar and tapered bar

EXP2: Determine the nodal deflections, reaction forces, and stress for the truss system using Ansys simulation

EXP3: Structural Analysis of a 2D Plane Stress Bracket

EXP4: Structural Analysis in beams with different loads (UVL, UDL).

EXP5: Stress analysis of axi-symmetric components.

EXP6: Analyze the Mode frequency analysis of beams.

EXP7: Fatigue analysis of two dimensional components

EXP8: Analyze the temperature distribution of a simple 2D plate with mixed boundary

EXP9: Analyze the temperature distribution of a transient conduction problem with varying thermal conductivity and internal Heat generation

EXP10: Analyze the temperature distribution of a Composite slabs/cylinders/spheres problem.

EXP11: Coupled analysis of a beam using Ansys simulation.

EXP12: Buckling of Columns with Effects of Boundary Conditions

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

CO1: Apply basic tools for finite element analysis using ansys.

CO2: Analyze the stresses and strains induced in brackets and beams

CO3: Examine the heat transfer analysis for Two Dimensional problems

CO4: Create 2D models and analyze fatigue and buckling analysis

CO5: Model axisymmetric components for stress analysis.

Mapping of COs to POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					3							2		
CO2	2		3	3	3							2		
CO3	2	2	3	3	3							2		
CO4	2	2	3	3	3							2		
CO5	2	2	3	3	3							2		

REFERENCES:

1. Finite Element Analysis College Lab Manual

ADVANCED COMMUNICATION SKILLS

Subject Code: UGBS6K0122	**L**	**T**	**P**	**C**
III Year / II Semester	**1**	**0**	**2**	**2**

Prerequisite: Basic competency skills in English for effective communication at work place.

Course Objectives:

- To expose students to LSRW skills at an advanced level.
- To prepare students to acquire correct body language for better oral communication.
- To prepare students to develop debatable skills, presentation as well as interview skills.

Syllabus:

UNIT-I :	Business E-mail Writing	(9 Hours)
UNIT-II :	Presentation skills	(9 Hours)
UNIT-III :	Group Discussion	(9 Hours)
UNIT-IV :	Resume Writing	(9 Hours)
UNIT-V :	Interviews	(9 Hours)

Course Outcomes:

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

CO1: Develop the skill of writing business e-mails. (L3)
CO2: Apply presentation skills for effective presentations. (L3)
CO3: Employ various aspects of group discussion and apply in discussions. (L3)
CO4: Develop the skill of writing resumes contextually and effectively. (L3)
CO5: Discover techniques for various types of interview for facing career interviews. (L3)

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	-	3	-	3
CO2	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-

TEXT BOOKS:

1. Soft Skills – Key to Success in Workplace and Life – Meenakshi Raman & Shalini UpadhyayCengage publications
2. Interact – Orient BlackSwan

REFERENCE BOOKS:

1. Fluency Development Course – Kev Nair (Kerala)
2. Speaking English Effectively – Krishna Mohan & N P Singh – Macmillan Indian Ltd. Group Discussion for Admissions & Jobs – Anand Ganguly – Pustak Mahal Publishers, New Delhi

INTERNET SOURCES:

1. BBC Learning English at work:
   http://www.bbc.co.uk/learningenglish/features/english-at-work/18-writing-an-email

2. Talkenglish.com:
   https://www.google.com/search?client=firefox-b-&q=talk+english.com
   Actual English – Jennifer (Video lessons)

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
(Common to all branches)

Subject Code: UGBS6A0222	**L**	**T**	**P**	**C**
III Year / II Semester	**2**	**0**	**0**	**0**

Course Objectives:

This course offers an introduction to Indian philosophy, tradition of Indian Science and Mathematics, holistic approach to health and gender sensitization.

Syllabus:

UNIT-I: INDIAN PHILOSOPHY

Origin of Indian philosophy- philosophy of Charvaka, Samkhya, Nyaya, Mimensa, Buddist and Jaina.

UNIT-II: TRADITION OF INDIAN SCIENCE

Historical evolution of medical tradition in ancient India.
Ayurveda: Principles of Ayurvedic Healing -Treating diseases to restore health.
Environmental Knowledge: Nature, flora and fauna, Manusmriti.

UNIT-III: TRADITION OF INDIAN MATHS

Early Historical period, Classical period, Vedic mathematics, Baskaracharya, Lilavati Bijaganitha, Srinivasa Ramanujan - Magic squares.

UNIT-IV: HOLISTIC HEALTH

History, Holistic approach: Enhance living – Mind fullness skills- Spirituality and Healing, Stress Management - Food—Work and Life style.
Yoga –Healthy Body: Introduction to Yoga, - Pranayamam, Surya Namaskara and Personality Development.

UNIT-V: GENDER SENSITIZATION

Basic Gender concepts and terminology, Exploring attitudes towards Gender, Making Women, Making Men, Preparing for Womanhood.
Struggles with discrimination, Gender Roles and Relations, Gender and Human Rights, Types of Gender-based violence, Gender-based violence from a Human Rights perspective, Sexual Harassment, Gender and Media.

Course Outcomes:

Upon completion of this course, the students will be able to:

CO 1. Summarize the essence of Indian philosophy.
CO 2. Outline the tradition of Indian Science and Mathematics.
CO 3. Make use of holistic health practices, spirituality, stress management techniques for healthy life Style and Yoga practices to attain good personality.
CO 4. Develop awareness with regard to issues of gender.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	-	3	-	-	-	-
CO2	-	-	-	-	-	3	-	-	-	-	-	3
CO3	-	-	-	-	-	3	-	-	-	-	-	3
CO4	-	-	-	-	-	3	-	3	-	-	-	-

TEXT BOOKS:

1. "Traditional Knowledge System in India" by Amit Jha, 2009.
2. "Traditional Knowledge System and Technology in India", Basanta Kumar Mohantra, Vipin Kumar Singh, Pratibha Prakashan publisher, 2012.
3. "Towards a World of Equals: A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi.
4. "Gender Sensitization" by C. Rajya Lakshmi Kalyani, D.S. Vittal, published by Himalaya Publishing House Pvt. Ltd.

REFERENCES:

1. "Knowledge Traditions and Practices of India", Kapil Kapoor, Michel Danino.
2. S. Radhakrishna, Indian Philosophy, Vol. 1 (London: George Allen and Unwin,1962), 287.
3. J. P. Jain, Religion and Culture of the Jains (Delhi: Bhartiya Jnanpith, 1977) 168
4. D. P. Sen Gupta, Current Science, 78 (12), 1569 (2000)
5. C.N.Srinivasa Iyengar, History of Indian Mathematics, World Press, Calcutta, 1967.
6. G. H Hardy, Ramanujan (Cambridge, 1940).
7. Nutritive Value of Indian Foods, C.Gopalan, B.V.Raman Sastri & S.C. Balasubramanian.
8. George Feuerstein: The Yoga Tradition (Its history, literature, philosophy and practice)
9. Swami Sivananda, Practice of Karma Yoga (The Divine Life Society, Shivananda Nagar, P.O., U.P., Himalayas, India)
10. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
11. IGNOU : Gender Sensitization: Society, Culture and Change (2019) BGSE001, New Delhi IGNOU
12. Jane Pilcher and Imelda Whelehan (2005) : Fifty Key Concepts in Gender Studies