

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P	C	CIE	SEE	Total
1	Professional Core courses	20APC0317	Heat Transfer	3	0	0	3	30	70	100
2	Professional Core courses	20APC0316	Design of Machine Elements	3	0	0	3	30	70	100
3	Professional Core courses	20APC0318	Dynamics of Machines	3	0	0	3	30	70	100
4	Professional Elective courses	20APE0311	Refrigeration & Air Conditioning	3	0	0	3	30	70	100
		20APE0305	Composite materials							
		20APE0301	Automobile Engineering							
5	Open Elective Course/Job oriented elective	OEC	Introduction to Research	3	0	0	3			100
			Numerical Methods for Engineers							
			Fundamentals of Artificial Intelligence							
6	Professional Core courses Lab	20APC0328	CAM Lab	0	0	3	1.5	30	70	100
7	Professional Core courses Lab	20APC0318	Heat Transfer Lab	0	0	3	1.5	30	70	100
8	Professional Core courses Lab	20APC0330	CAE Lab	0	0	3	1.5	30	70	100
9	Skill advanced course/ soft skill course*	20ASC0303	CNC	1	0	2	2	100	-	100
10	Mandatory course (AICTE)	20AMC9901	Biology for Engineers	2	0	0	0	30	-	30
			Total credits				21.5	370	560	930
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4		0	4	30	70	100
Industrial/Research Internship (Mandatory) 2 Months during summer vacation										

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0317	Heat Transfer	3	0	0	3

Course Outcomes:

- 1 To understand the concept of modes of heat transfer and to solve problems on conduction heat transfer.
- 2 To understand heat transfer through extended surfaces and solve the problems in 1-D transient conduction heat transfer.
- 3 To understand concept of the convection heat transfer and to solve practical problems on forced and natural convection heat transfer.
- 4 Calculate heat transfer in boiling, condensation and understand principle behind heat exchangers and solve problems using LMTD and NTU methods.
- 5 Understand basic concepts of radiation heat transfer from black and gray bodies and solve problems involving radiation shields.

Unit I

Introduction: Modes and Mechanisms of Heat Transfer – Basic Laws of Heat Transfer – General Applications of Heat Transfer.

Conduction Heat Transfer: Fourier Rate Equation – General Heat Conduction Equation In Cartesian, Cylindrical and Spherical Coordinates. Simplification and Forms of the Field Equation – Steady, Unsteady and Periodic Heat Transfer – Boundary and Initial Conditions.

One Dimensional Steady State Heat Conduction: In Homogeneous Slabs, Hollow Cylinders and Spheres.

Unit II

Heat Transfer in Extended Surface (Fins) – Types, Fin Materials, Applications, efficiency, effectiveness and temperature distribution on Long Fin, Fin with Insulated Tip and Short Fin, Application to Errors in Temperature Measurement.

One Dimensional Transient Heat Conduction: In Systems with Negligible Internal Resistance – Significance of Biot and Fourier Numbers – Chart Solutions of Transient Conduction Systems – Problems on Semi-infinite Body.

Unit III

Heat Convective Transfer: Dimensional Analysis – Buckingham II Theorem and its Application for Developing Semi – Empirical Non-Dimensional Correlations for Convective Heat Transfer – Significance of Non-Dimensional Numbers – Concepts of Continuity, Momentum and Energy Equations.

Forced Convection: External Flows: Concepts of Hydrodynamic and Thermal Boundary Layer and Use of Empirical Correlations for Convective Heat Transfer for Flow Over – Flat Plates, Cylinders and Spheres.

Free Convection: Development of Hydrodynamic and Thermal Boundary Layer along a Vertical Plate – Use of Empirical Relations for Convective Heat Transfer on Plates and Cylinders in Horizontal and Vertical Orientation.

Unit IV

Heat Transfer with Phase Change:

Boiling: Pool Boiling – Regimes, Determination of Heat Transfer Coefficient in Nucleate Boiling, Critical Heat Flux and Film Boiling.

Condensation: Filmwise and Dropwise Condensation – Nusselt's Theory of Condensation on a Vertical Plate – Film Condensation on Vertical and Horizontal Cylinders Using Empirical Correlations.

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Unit V

Radiative Heat Transfer: 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 Gray Bodies – Radiation Shields – Electrical Analogy for Radiation Networks.

Text Books:

1. Heat and Mass Transfer, by Sachdeva, New age International.
2. Heat and Mass Transfer by Y.A Cengel, A J Ghajar, Mc Graw Hill education, 2011.
3. Heat and Mass Transfer, R.K.Rajput, S.Chand & Company Ltd, 2001.

Reference Books:

1. Heat Transfer, P.K.Nag, 3/e, TMH, 2011.
2. Fundamentals of Heat and Mass Transfer, Kondandaraman, C.P., 3/e, New Age Publ.
3. Heat Transfer, Holman.J.P, 10/e, TMH, 2012.
4. Introduction to Heat Transfer, by Incropera and Dewitt, Wiley Publishers, 2001.
5. Heat Transfer, M. Necati Ozisik, A Basic Approach, McGraw Hill, New York, 2005.

Note: - Heat and mass transfer data book by C.P. kothandaraman, New age publications is permitted for internal and external examinations.

COs	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO 5: Modern tool usage	5.2	5.2.2
CO2	PO 1: Engineering knowledge	1.2	1.2.2
CO3	PO 5: Modern tool usage	5.2	5.2.2
CO4	PO 5: Modern tool usage	5.2	5.2.2
CO5	PO 1: Engineering knowledge	1.6	1.3.1

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Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0316	Design of Machine Elements	3	0	0	3

Course Outcomes:

- 1 To apply design procedures using theories of failure for different elements
- 2 Able to design simple components under cyclic loading using Goodman's and Soderberg's criterions
- 3 Able to design riveted joints with different configuration, boiler shell joint design and eccentric loading design of riveted joints
- 4 To design cotter joint, knuckle joint and shafts
- 5 To design various rigid and flexible shaft couplings

UNIT I

INTRODUCTION: General considerations of design, design process. Selection of Engineering Materials - properties –Manufacturing considerations in the design. BIS codes of materials, preferred numbers and interchangeability. STRESSES IN MACHINE MEMBERS: Simple stresses – Combined stresses – Torsional and bending Stresses – impact stresses – stress -strain relation – Theories of failure – factor of safety.

UNIT II

DESIGN FOR FLUCTUATING LOADS: Stress concentration –notch sensitivity – Design for fluctuating stresses – Estimation of Endurance strength – Goodman's line – Soderberg's line. Design of components for finite and infinite life.

UNIT III

DESIGN OF RIVETED JOINTS: Types of riveted joints, design of riveted joints. Boiler shell riveting design and eccentric loading design of riveted joints. DESIGN OF BOLTED JOINTS: Forms of Screw threads. Stresses in Screw fasteners. Design of bolts with pre-stresses, Design of bolted joints under eccentric loading, Bolts of uniform strength.

UNIT IV

DESIGN OF COTTERS AND KNUCKLE JOINTS: Design of Cotter joints: spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints DESIGN OF SHAFTS: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads.

UNIT V

DESIGN OF KEYS AND COUPLINGS: Design of Rigid couplings: Muff, Split muff and Flange couplings- Design of flexible couplings.

Text Books:

1. Machine Design, Schaum'sseries, TMH Publishers, NewDelhi, 1st edition, 2011
2. Machine Design, R.S. Kurmi and J.K. Gupta, S.Chand Publishers, NewDelhi

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Reference Books:

1. Machine Design, R.K.Jain, KhannaPublishaers,New Delhi.
2. Machine Design, SadhuSingh, KhannaPublishers, NewDelhi
3. Mechanical Engineering Design, JosephE.Shigely,TMH Publishers,NewDelhi, 9th edition, 2011 R
4. Design of Machine Elements, M.F. Spotts, PHIPublishers, NewDelhi.
5. Machine Design, Pandya and Shah, CharotarPublishers,Anand, 17th edition, 2009
6. Machine Design, R.L. Norton, Tata McGrawHillPublishers, 2nd edition, 2002
7. Machine Design by Groover – CBS Publications, 5th edition, 2012.
8. Machine Design Data Book, V B Bhandari, McGraw Hill,2014

COs	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO 5: Modern tool usage	5.2	5.2.2
CO2	PO 1: Engineering knowledge	1.2	1.2.2
CO3	PO 5: Modern tool usage	5.2	5.2.2
CO4	PO 5: Modern tool usage	5.2	5.2.2
CO5	PO 1: Engineering knowledge	1.6	1.3.1
	PO 7: Environment and sustainability	7.2	7.2.1

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Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0318	Dynamics of Machines	3	0	0	3

Course Outcomes:

- 1 To understand the application of friction in pivots, collars, clutches, brakes, and dynamometers, and also to solve the numerical problems
- 2 To understand gyroscopic effect on Aeroplane, ship, four wheel and two-wheel vehicles. To design a flywheel for reciprocating engine and punching press.
- 3 To understand the working of various types of governors and to analyze the forces acting on them. To solve numerical problems on balancing of rotating masses
- 4 To understand that effect of primary and secondary balancing of reciprocating masses in locomotive engines, V-engine, inline engines and Radial engines
- 5 To understand the concept of different types of vibratory systems and to perform simple calculations of vibration systems

UNIT I**Friction:**

Types of friction, inclined plane, screw friction, screw jack, Journal bearing, concept of uniform pressure and uniform wear, pivot bearings – flat, conical and trapezoidal, flat collar bearings, friction clutches – flat, conical and centrifugal, Brakes – Block or Shoe Brake, Band Brake, Band and Block Brake, Internal Expanding Shoe Brake, Effect of Braking on vehicle, general description and method of operation of Dynamometers.

UNIT II**Gyroscope:**

Effect of gyroscopic couple on the stability of moving Aeroplane, ship, motor car and motor cycle.

Fluctuation of Energy:

Turning moment diagrams for steam engine, IC Engine and multi cylinder engine, coefficient of Fluctuation of energy, coefficient of Fluctuation of speed, design of Fly wheels for reciprocating engines, design of Fly wheels for punching machines.

UNIT III**Governors:**

Watt governor, dead weight governor – Porter and Proell governors. Spring loaded governors – Hartnell, Hartung and Wilson Hartnell governors. Sensitiveness, isochronism and hunting. Effort and power of a governor.

Balancing of rotating masses:

Single in single plane, multiple masses in single plane, multiple masses indifferent planes.

UNIT IV**Balancing of Reciprocating masses:**

Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Balancing of Locomotives, Effects of Partial Balancing in Locomotives, Balancing of Inline Engines, V-engines, and Radial Engines. Unbalanced forces and couples for primary and secondary balancing.

UNIT V**Vibrations:**

Free Longitudinal Vibrations, Inertia Effect of the Mass of Spring, Damped Vibrations, Forced Vibrations, Forced-damped Vibrations, Transverse Vibrations of Shaft due to Single Load, uniformly distributed Load and Several Loads, Dunkerly's method, Raleigh's method, Whirling of Shafts, Free Torsional Vibrations in

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MECHANICAL ENGINEERING (ME)

Single Rotor, Two-rotor and Three-rotor Systems, Inertia Effect of Mass of Shaft, Torsionally Equivalent Shaft.

Text Books:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hill.
2. Kinematics and Dynamics of Machinery R.L. Norton, Tata McGraw Hill.

Reference Books:

1. Theory of Machines, Thomas Bevan, Pearson.
2. The theory of Machines, Ballaney, Kanna Publishers
3. Theory of Machines and Mechanisms of Shigley et.al. Oxford International.
4. Theory of Machines, Kinematics and Dynamics sadhu gingham, Pearson
5. A Text Book of Theory of Machines. R. K. Bansal, Laxmi Publications
6. Theory of Mechanisms and Machines, Jagadish Lal, Metropolitan company pvt. Ltd

List of COs	PO no. and keyword	Competency	Performance Indicator
CO 1	PO 1: Engineering knowledge	1.4	1.4.1
CO 2	PO 2: Problem analysis	2.1	2.1.3
CO 3	PO 4: Conduct investigations of complex problems	4.1	4.1.2
CO 4	PO 2: Problem analysis	2.1	2.1.2
CO 5	PO 1: Engineering knowledge	1.4	1.4.1

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0311	Refrigeration & Air Conditioning	3	0	0	3

Course Outcomes:

- 1 Illustrate the fundamental principles and applications of refrigeration and air conditioning system.
- 2 Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems.
- 3 Present the properties, applications and environmental issues of different refrigerants
- 4 Calculate cooling load for air conditioning systems used for various
- 5 Operate and analyze the refrigeration and air conditioning systems

UNIT – I

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP

UNIT – II

VAPOUR COMPRESSION REFRIGERATION SYSTEM:

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system - low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT – III

OTHER REFRIGERATION SYSTEMS:

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT – IV

PSYCHROMETRIC PROPERTIES AND PROCESSES

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT – V

AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TEXT BOOK:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010

Reference Books:

1. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
2. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.

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3. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986

List of COs	PO no. and keyword	Competency	Performance Indicator
CO 1	PO 1: Engineering knowledge	1.4	1.4.1
CO 2	PO 2: Problem analysis	2.1	2.1.3
CO 3	PO 4: Conduct investigations of complex problems	4.1	4.1.2
CO 4	PO 2: Problem analysis	2.1	2.1.2
CO 5	PO 1: Engineering knowledge	1.4	1.4.1

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0305	Composite materials	3	0	0	3

Course Outcomes:

- 1 To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites..
- 2 To develop knowledge on manufacturing methods of composites
- 3 To develop knowledge on processing techniques and applications of PMCs
- 4 To develop knowledge on processing techniques and applications of PMCs
- 5 To develop knowledge on processing techniques and applications of CMCs and Carbon- carbon composites

Unit I: Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites

Unit II: Manufacturing methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface. Measurement of interface strength, Characterization of systems; carbon fibre /epoxy, glass fibre / polyester, etc.

Unit III: Processing of Polymer Matrix Composites: Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding.

Unit IV: Processing of Metal Matrix Composites: Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

Unit V: Processing of Ceramic Matrix Composites and Carbon-carbon Composites: Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, mechanical properties and applications of CMCs – Carbon-carbon Composites –applications.

Text Books and Reference Books:

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford University Press, 1994
2. Mechanics of Composite Materials, R. M. Jones, Mc GrawHill Company, New York, 1975
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering)- Autar K. Kaw, Publisher: CRC
4. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers,2003.
5. Seamour, E.B. Modern Plastics Technology, Prentice Hall,2002
6. ASM Handbook – Composites, Vol-21, 2001, ISBN: 978-0-87170-703-1.
7. Composite Materials Science and Engineering, Krishan K. Chawla, Springer, 2009

Additional Sources

Youtube: <https://nptel.ac.in/courses/112/104/112104229/>

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 1: Engineering knowledge	1.3	1.3.1
CO: 2	PO 1: Engineering knowledge	1.3	1.3.1

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CO: 3	PO 1: Engineering knowledge	1.3	1.3.1
CO: 4	PO 1: Engineering knowledge	1.3	1.3.1
CO: 5	PO 1: Engineering knowledge	1.3	1.3.1

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APE0301	Automobile Engineering	3	0	0	3

Course Outcomes:

- 1 Recognize the various parts of the automobile and their functions and materials.
- 2 Discuss the engine auxiliary systems and engine emission control.
- 3 Distinguish the working of different types of transmission systems.
- 4 Explain the Steering, Brakes and Suspension Systems.
- 5 Predict possible alternate sources of energy for IC Engines

UNIT – I

VEHICLE STRUCTURE AND ENGINES

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).

UNIT – II

ENGINE AUXILIARY SYSTEMS

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT – III

TRANSMISSION SYSTEMS

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive

UNIT – IV

STEERING, BRAKES AND SUSPENSION SYSTEMS

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT – V

ALTERNATIVE ENERGY SOURCES

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

Text Books:

1. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.

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- Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014

References:

- Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
- Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
- Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
- Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.
- Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0328	CAM Lab	0	0	3	1.5

Course Outcomes:

- 1 To introduce fundamentals of the analysis software, its features and applications.
- 2 To learn the basic element types in Finite Element analysis.
- 3 To understand the stress analysis on different load conditions.
- 4 To know the concept of discretization of continuum, Loading conditions.
- 5 To analyze the structure using pre-processor and postprocessor conditions.

List of Experiments:

1. Static Analysis of 2D Transmission Tower
2. Static Analysis of 2D Four bar Truss
3. Static Analysis of 3D Space Truss
4. Static Analysis of Beam with UDL, UVL and moment
5. Static Structural Analysis of a Steel Bracket using Plane stress condition
6. Analysis of Pressure vessel using Plane Strain condition
7. Static analysis of an axisymmetric pressure vessel
8. Static analysis of a curved shell due to internal pressure

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MECHANICAL ENGINEERING (ME)

Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0318	Heat Transfer Lab	0	0	3	1.5

Course Outcomes:

- 1 Estimate heat transfer coefficients in forced and natural convection and determine the effectiveness of heat exchangers and heat pipe.
- 2 Perform the transient heat conduction experiment and obtain the variations of temperature along length of pin-fin.
- 3 To determine overall heat transfer coefficient for composite walls
- 4 Perform experiment to determine thermal conductivity of metal rod.
- 5 Perform radiations experiments and determine the surface emissivity and Stefan boltzman's constant and compare the theoretical values.

List of Experiments:

1. Heat transfer coefficient in forced convection.
2. Heat transfer coefficient in natural convection
3. Thermal conductivity of insulating powder material through Concentric Sphere apparatus.
4. Thermal conductivity of insulating material through lagged pipe apparatus
5. Overall heat transfer co-efficient through Composite Slab Apparatus
6. Thermal Conductivity of metal (conductor).
7. Heat transfer in pin-fin
8. Experiment on Transient Heat Conduction
9. Experiment on Parallel and counter flow heat exchanger.
10. Emissivity of a gray body through Emissivity apparatus.
11. Experiment on Stefan Boltzman Apparatus.
12. Experiment on Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Study of Two – Phase flow.

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Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20APC0330	Machine Tools – 2 Lab	0	0	3	1.5

Course Outcomes:

- 1 Learn the Step turning and taper turning
- 2 Learn the thread cutting Drilling and Tapping on the lathe machine
- 3 The operations of Shaping and Planning and milling
- 4 Understand the basics of surface grinding operations.
- 5 To analyze the surface finish on planar machine.

List of experiments:

1. Job on counter boring on drilling machine.
2. Job on counter sinking on drilling machine.
3. Job on drilling operations.
4. Job on tapping on drilling machine.
5. Preparation of key ways using slotting machine.
6. Job on internal and external surfaces using slotting machine.
7. Study of types of abrasive tools in tools and cutter grinder.
8. Preparation of single point cutting tool in tools and cutter grinder.
9. Process parameters influence on surface finish in surface grinding.
10. Job on planner machine.

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Year : III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20ASC0303	Crystal structure Analysis Lab	1	0	2	2

Course Outcomes:

- 1 Determination of mechanical properties of different materials.
- 2 Establish the constitutive relations in metals using destructive methods.
- 3 Understand the behavior of micro structures in specimens.
- 4 Familiarize with standard test specimens.
- 5 Prepare samples for investigating micro structure of different materials

List of experiments:

1. Preparation and study of the micro-Structure of pure metals like iron, cu and al.
2. Preparation and study of the microstructure of mild steels, low carbon steels, high-C steels.
3. Study of the micro structures of cast irons.
4. Study of the micro structures of non-ferrous alloys.
5. Study of the micro structures of heat-treated steels.
6. To find out the Hardness of various treated and untreated steels.
7. To determine the Hardenability of a given steel.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(Autonomous)

Course structure for Four Year Regular B.Tech. Degree Program

(Effective for the batches admitted from 2020-21)

MECHANICAL ENGINEERING (ME)

Year: III

Semester : II

Branch of Study : ME

Subject Code	Subject Name	L	T	P	Credits
20AMC9901	Biology for Engineers	3	0	0	0

Course Outcomes:

- CO: 1 Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
- CO: 2 Explain about biomolecules, their structure, function and their role in the living organisms. How biomolecules are useful in Industry.
- CO: 3 Brief about human physiology.
- CO: 4 Explain about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.
- CO: 5 Know about application of biological principles in different technologies for the production of medicines and pharmaceutical molecules through transgenic microbes, plants and animals

UNIT I

Evolution: Different patterns of evolution, Darwin's theory of evolution, Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cell. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Brief introduction to five kingdoms of classification, Tissue Engineering.

UNIT II

Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

UNIT III

Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle, Central Nerves System and Excretory system.

UNIT IV

Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. DNA technology. Introduction to gene cloning.

UNIT V

Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Vaccines and antibodies. Basics of biosensors, Properties and Classification of virus, Immune response to virus, Definitions-Pandemic, Epidemic and outbreak, pandemic alert system ranges, Prevention of pandemic disease and pandemic preparation.

TEXT BOOKS :

1. P.K.Gupta, Cell and Molecular Biology, 5th Edition, Rastogi Publications.
2. U. Satyanarayana. Biotechnology, Books & Allied Ltd 2017.

REFERENCE BOOKS :

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A Global Approach", Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology 2nd ed.. Panima Publications. PP 434.
4. David Hames, Instant Notes in Biochemistry –2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology – 2014.

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6. Richard Dawkins, River Out of Eden: A Darwinian View of Life Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 1: Apply the knowledge of basic science	1.2	1.2.1
CO: 2	PO 1: Apply the knowledge of basic science	1.2	1.2.1
CO: 3	PO 1: Apply the knowledge of basic science	1.2	1.2.1
CO: 4	PO 1: Apply the knowledge of basic science	1.2	1.2.1
CO: 5	PO 1: Apply the knowledge of basic science	1.2	1.2.1