

**BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED  
KURUKSHETRA UNIVERSITY KURUKSHETRA  
SCHEME OF STUDIES/EXAMINATION(Modified)  
SEMESTER III (w.e.f. session 2019-2020)**

S. No.	Course No.	Course Name	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	BS-201A	Optics & Waves	3:0:0	3	3	75	25	0	100	3
2	BS-204A	Higher Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
3	ES-203A	Basic Electronics Engineering	3:0:0	3	3	75	25	0	100	3
4	MEC-201A	Theory of Machines	3:1:0	4	4	75	25	0	100	3
5	MEC-203A	Mechanics of Solids-I	3:1:0	4	4	75	25	0	100	3
6	MEC-205A	Thermodynamics	3:1:0	4	4	75	25	0	100	3
7	MEC-207LA	Theory of Machines Lab	0:0:2	2	1	0	40	60	100	3
8	MEC-209LA	Mechanics of Solids Lab	0:0:2	2	1	0	40	60	100	3
9	*MEC-211A	Industrial Training-I	2:0:0	2	-	-	100	-	100	
10	**MC-901A	Environmental Sciences	3:0:0	3	-	75	25	0	100	3
<b>Total</b>				<b>30</b>	<b>23</b>	<b>450</b>	<b>230</b>	<b>120</b>	<b>800</b>	

\*MEC-211A is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2<sup>nd</sup> semester and students will be required to get passing marks to qualify.

\*\*MC-901A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

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KURUKSHETRA UNIVERSITY KURUKSHETRA  
SCHEME OF STUDIES/EXAMINATION(Modified)  
SEMESTER IV (w.e.f. session 2019-2020)**

S. No.	Course No.	Course Name	L:T:P	Hours / Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	ES-204A	Materials Engineering	3:0:0	3	3	75	25	0	100	3
2	MEC-202A	Applied Thermodynamics	3:0:0	3	3	75	25	0	100	3
3	MEC-204A	Fluid Mechanics & Fluid Machines	3:1:0	4	4	75	25	0	100	3
4	MEC-206A	Mechanics of Solids-II	3:1:0	4	4	75	25	0	100	3
5	MEC-208A	Instrumentation & Control	3:0:0	3	3	75	25	0	100	3
6	ES-206LA	Materials Engineering Lab	0:0:2	2	1	0	40	60	100	3
7	MEC-210LA	Fluid Mechanics & Fluid Machines Lab	0:0:2	2	1	0	40	60	100	3
8	*MC-902A	Constitution of India	3:0:0	3	-	75	25	-	100	3
<b>Total</b>				<b>24</b>	<b>19</b>	<b>375</b>	<b>205</b>	<b>120</b>	<b>700</b>	

\*MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

**Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4<sup>th</sup> semester which will be evaluated in 5<sup>th</sup> semester.**

**BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED**

**KURUKSHETRA UNIVERSITY KURUKSHETRA**

**SCHEME OF STUDIES/EXAMINATION**

**SEMESTER V (w.e.f. session 2020-2021 )**

S. No.	Course No.	Course Name	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-905A	Entrepreneurship	3:0:0	3	3	75	25	0	100	3
2	MEC-301A	Heat Transfer	3:1:0	4	4	75	25	0	100	3
3	MEC-303A	Production Technology	3:0:0	3	3	75	25	0	100	3
4	MEC-305A	Mechanical Vibrations and Tribology	3:0:0	3	3	75	25	0	100	3
5	MEC-307LA	Heat Transfer lab	0:0:2	2	1	0	40	60	100	3
6	MEC-309LA	Production Technology Lab	0:0:2	2	1	0	40	60	100	3
7	MEC-311LA	Mechanical Vibrations and Tribology Lab	0:0:2	2	1	0	40	60	100	3
8	MEC-313LA	Project-I	0:0:2	2	1	-	0	100	100	3
9	*MEC-315A	Industrial Training-II	2:0:0	2	-	-	100	-	100	-
10	**MC-903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	-	100	3
<b>Total</b>				<b>26</b>	<b>17</b>	<b>300</b>	<b>220</b>	<b>280</b>	<b>800</b>	

\*MEC-315A is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4<sup>th</sup> semester and students will be required to get passing marks to qualify.

\*\*MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

**BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING) CREDIT BASED**

**KURUKSHETRA UNIVERSITY KURUKSHETRA**

**SCHEME OF STUDIES/EXAMINATION**

**SEMESTER VI (w.e.f. session 2020-2021 )**

S. No.	Course No.	Course Name	L:T:P	Hours / Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-901A	Organizational Behaviour	3:0:0	3	3	75	25	0	100	3
2	MEC-302A	Manufacturing Technology	3:0:0	3	3	75	25	0	100	3
3	MEC-304A	Design of Machine Elements	2:4:0	6	6	75	25	0	100	4
4	MEC-306LA	Mechanical Engineering Lab-I	0:0:2	2	1	0	40	60	100	3
5	MEC-308LA	Mechanical Engineering Lab-II	0:0:2	2	1	0	40	60	100	3
6	MEC-310LA	Project-II	0:0:6	6	3	0	0	100	100	3
7	MEP*	Program Elective-I	3:1:0	4	4	75	25	0	100	3
8	MEP*	Program Elective -II	3:1:0	4	4	75	25	0	100	3
<b>Total</b>				<b>30</b>	<b>25</b>	<b>375</b>	<b>205</b>	<b>220</b>	<b>800</b>	

Course No.	Program Elective I	Course No.	Program Elective II
MEP-302A	Internal Combustion Engines	MEP-308A	Composite Materials
MEP-304A	Gas Dynamics and Jet Propulsion	MEP-310A	Refrigeration and Air Conditioning
MEP-306A	Design of Transmission Systems	MEP-312A	Product Engineering

**Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6<sup>th</sup> semester which will be evaluated in 7<sup>th</sup> semester.**

**\* The course of Program Elective will be offered at 1/3<sup>rd</sup> strength or 20 students (whichever is smaller) of the section.**

B. Tech (3 <sup>rd</sup> Semester) Mechanical Engineering								
Optics and Waves								
BS – 201A	L	T	P	Credit	Major Test	Minor Test	Total	Time
	3	-	-	3	75	25	100	3h
Purpose	To introduce the fundamentals of wave and optics for the applications in Engineering field.							
Course Outcomes								
CO 1	Familiarize with basic phenomenon used in propagation of waves.							
CO 2	Introduce the fundamentals of interference, diffraction, polarization and their applications.							
CO 3	To make the students aware to the importance of Laser in technology.							

### Unit - I

**Waves:** Travelling waves, Characteristics of waves, Mathematical representation of travelling waves, General wave equation, Phase velocity, Light source emit wave packets, Wave packet and Bandwidth, Group velocity and real light waves.

**Propagation of light waves:** Maxwell's equations, Electromagnetic waves and constitutive relations, Wave equation for free-space, Uniform plane waves, Wave polarization, Energy density, the pointing vector and intensity, Radiation pressure and momentum, Light waves at boundaries, Wave incident normally on boundary, Wave incident obliquely on boundary: law of reflection, Snell's law and reflection coefficients.

### Unit - II

**Interference:** Principle of Superposition, Conditions for Sustained interference, Young's double slit experiment, Division of wave-front: Fresnel's Biprism and its applications, Division of amplitude: Interference due to reflected and transmitted light, Wedge-shaped thin film, Newton's rings and its applications, Michelson Interferometer and its applications.

### Unit – III

**Diffraction:** Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and secondary minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

**Polarization:** Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent 's half shade polarimeter, Biquartzpolarimeter.

### Unit – IV

**Laser:** Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein's Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, Gas lasers (He-Ne, CO<sub>2</sub>), Solid state lasers (Ruby, Neodymium, semiconductor), Dye laser, Characteristics of Laser, Applications of Laser.

#### Text/Reference Books:

1. P.K. Diwan, Applied Physics for Engineers, *Wiley India Pvt. Ltd., India*
2. N. Subrahmanyam, B. Lal, M.N. Avadhanulu, A Textbook of Optics, *S. Chand & Company Ltd., India.*
3. A. Ghatak, Optics, *McGraw Hill Education(India) Pvt. Ltd., India.*
4. E. Hecht, A.R. Ganesan, Optics, *Pearson India Education Services Pvt. Lt., India.*

**Note:** The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BS-204A	HIGHER ENGINEERING MATHEMATICS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 h
<b>Purpose</b>	The objective of this course is to familiarize the prospective Engineers with Laplace Transform, partial differential equations which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution. More precisely, the objectives are as under:						
<b>Course Outcomes</b>							
<b>CO 1</b>	<b>Introduction about the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems.</b>						
<b>CO 2</b>	<b>To introduce the Partial Differential Equations, its formation and solutions for multivariable differential equations originated from real world problems.</b>						
<b>CO 3</b>	<b>To introduce the tools of numerical methods in a comprehensive manner those are used in approximating the solutions of various engineering problems.</b>						
<b>CO 4</b>	<b>To familiar with essential tool of Numerical differentiation and Integration needed in approximate solutions for the ordinary differential equations.</b>						

#### UNIT-1

##### Laplace Transform

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

#### UNIT-2

##### Partial Differential Equations

Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit's method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

#### UNIT-3

##### Numerical Methods-1

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method, Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

#### UNIT-4

##### Numerical Methods-2

Numerical Differentiation using Newton's forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules, Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations.

##### Textbooks/References:

1. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993. AICTE Model Curriculum in Mathematics.
2. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
3. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
4. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
8. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
9. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
10. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
11. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.

**Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.**

B. Tech (3 <sup>rd</sup> Semester) Mechanical Engineering							
ES-203A	Basic Electronics Engineering						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	0	0	3	75	25	100	3
<b>Purpose :</b>	To provide an overview of electronic devices and components to Mechanical engineering students.						
<b>Course Outcomes</b>							
<b>CO 1</b>	To introduce the basic electronics devices along with their applications.						
<b>CO 2</b>	To become familiar with basic operational amplifier circuits with applications and oscillators.						
<b>CO 3</b>	To understand the fundamentals of digital electronics.						
<b>CO 4</b>	To become familiar with basic electroniccommunication system.						

#### UNIT-I

**Semiconductor Devices and Applications:** Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. BJT structure, its input-output and transfer characteristics, BJT as a Common Emitter amplifier, frequency response and bandwidth.

#### UNIT-II

**Operational amplifier and its applications:** Introduction to operational amplifiers, inverting, non-inverting and differential modes, basic parameters of Op-amp, Op-amp in open loop configuration, study of practical op-amp IC 741, Op-amp applications: adder, subtractor, scale changer, averaging amplifier, comparator, integrator and differentiator.

**Timing Circuits and Oscillators:** IC 555 timer pin diagram: Astable and mono-stable operation, Barkhausen's criteria for oscillations, R-C phase shift and Wein bridge oscillators using BJT and Op-Amp and their frequency of oscillation.

#### UNIT-III

**Digital Electronics Fundamentals :** Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- maps, Logic ICs, half and full adder, multiplexers, de-multiplexers, flip-flops, basic counters.

#### UNIT-IV

**Electronic Communication Systems:** The elements of communication system, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

#### **Text Books:**

1. Integrated Electronics, Millman & Halkias (Mc-Graw Hill)
2. Electronics Devices & Circuit Theory, RL Boylestad & L Nashelsky (PHI)

#### **Reference Books:**

1. Modern Digital Electronics, R P Jain, Tata McGraw Hill.
2. Electronic Communication Systems, G. Kennedy, McGraw Hill, 4th Edition

**Note: The paper setter will set the paper as per the question paper templates provided.**

B. Tech (3 <sup>rd</sup> Semester) Mechanical Engineering							
MEC-201A	THEORY OF MACHINES						
Lecture	Tutorial	Practica	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	1	0	4	75	25	100	3
<b>Purpose:</b>	To familiarize the students with design of various types of linkage mechanisms for obtaining specific motion, their analysis and applicability for optimal functioning.						
Course Outcomes							
<b>CO 1</b>	To understand the kinematics of simple mechanisms and methods of determining the link velocities.						
<b>CO 2</b>	To understand the acceleration of different mechanisms and profile generation of cams and followers.						
<b>CO 3</b>	To understand the concepts of static and dynamic force analysis of different mechanisms and balancing of different components.						
<b>CO 4</b>	To familiarize with gear, gear trains, belts and chain drives.						

#### UNIT-I

**Simple Mechanisms:** Introduction to mechanism and machine, Kinematic links, pairs and chains, Mobility of mechanisms, Equivalent mechanisms, Four bar chain, Inversion of four bar chain, slider crank chain and inversions.

**Velocity Analysis:** Determination of link velocities, Relative velocity method, Velocities in four bar mechanism, Slider crank mechanism, crank and slotted lever mechanism and quick return motion mechanism, Instantaneous center method: Types & location of instantaneous centers, Arnold Kennedy theorem, methods of locating instantaneous centers, steering gear mechanisms. Problems.

#### UNIT-II

**Acceleration Analysis:** Acceleration of a point on a link, four bar mechanism and slider crank mechanism, Coriolis component of acceleration, Klein's construction, Problems.

**Cams and Followers:** Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, simple harmonic, constant acceleration and deceleration and cycloidal motion of followers, Problems.

#### UNIT-III

**Static and Dynamic Force Analysis:** constraints and applied forces, static equilibrium, equilibrium of two and three-force member, equilibrium of four-forces and torque, free body diagrams. Dynamic Force Analysis: D'Alembert's principle, equivalent offset inertia force, Dynamic analysis of four-link, Dynamic analysis of slider-crank mechanisms, velocity and acceleration of piston, angular velocity and angular acceleration of connecting rod, turning moment on crank shaft, turning moment diagrams, fluctuation of energy, flywheels, Problems.

**Balancing:** rotating masses: Static and Dynamic Balancing, Single Rotating mass, Many Masses rotating in same plane and in different planes. Analytical method for balancing of rotating masses. Reciprocating masses: Balancing of reciprocating engine, Balancing of Multi-cylinder in line engines, balancing machines.

#### UNIT-IV

**Belts and Chain Drives:** classifications of belt, law of belting, Length of open and cross flat belt, Ratio of tensions, Centrifugal tension, power transmission, condition for maximum power transmission, creep of belt, V-belt drives: driving tensions, Chain drives: classifications, terminology of chains, kinematics of chains, Problems.

**Gears and Gear Trains:** Classification & terminology, Law of gearing, Tooth forms & comparisons, Length of path of contact, Contact ratio, Interference & undercutting in involute gear teeth, Minimum number of teeth on gear and pinion to avoid interference. Gear Trains: simple, compound, reverted and planetary gear trains, Problems.

**Text Books:**



1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
2. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
3. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005. 3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
4. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.

**Reference Books:**

1. Mechanism and Machine Theory: J.S. Rao and R.V. Duddipati Second Edition New age International.
2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.
3. Kinematics of Machines-Dr. Sadhu Singh, Pearson Education

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

B. Tech. (3 <sup>rd</sup> Semester) Mechanical Engineering							
MECHANICS OF SOLIDS-I							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	1	0	4	75	25	100	3
<b>Purpose</b>	The objective of this course is to make the students aware of Stress, Strain and deformation of solids with the applications to beams, shafts and column and struts. The course will help the students to build the fundamental concepts in order to solve engineering problems.						
Course Outcomes							
<b>CO1</b>	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering, determine centroid and moment of inertia of a different geometrical shapes and able to understand its importance. Explain the basic concepts of stress and strain and solve the problems						
<b>CO 2</b>	Determine and calculate the values of principal stresses. Express the concept of shear force and bending moment of beams. Construct shear force and bending moment diagram for beams.						
<b>CO 3</b>	Express the concept of torsion of circular shaft and able to solve the problems on torsion of circular shaft. Illustrate and solve the problems on bending and shear stresses on beams						
<b>CO 4</b>	Solve the problems on column and strut and Derive the derivations and solve the problems on slope and deflection.						

#### Unit-I

**Introduction:** Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces, forces in equilibrium, principle and laws of equilibrium, Free body diagrams, Lami's Theorem, equations of equilibrium, Concept of center of gravity and centroid, centroid of various shapes: Triangle, circle, semicircle and trapezium, theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures, polar moment of inertia. Numerical Problems

**Simple Stresses & Strains:** Concept & types of Stresses and strains, Poisson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hook's law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical problems.

#### Unit-II

**Principle Stresses:** Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stresses, Numerical Problems.

**Shear Force & Bending Moments:** Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Numerical Problems.

#### Unit-III

**Torsion of Circular Members:** Derivation of equation of torsion, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, Numerical problems.

**Flexural and Shear Stresses** – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I, T, Angle, channel sections, composite beams, shear stresses in beams with derivation, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections. combined bending and torsion, equivalent torque., Numerical problems.

#### Unit-IV

**Columns & Struts:** Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations, Numerical problems.

**Slope & Deflection** : Relationship between bending moment, slope & deflection, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical problems.

**Text Books:**

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.

**Reference Books:**

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert I. Mott, Pearson, New Delhi
3. Strength of Material – Shaums Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

B. Tech. (3 <sup>rd</sup> semester) Mechanical Engineering							
THERMODYNAMICS							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	1	0	4	75	25	100	3
<b>Purpose</b>	The objective of this course is to make the students aware of Energy, Entropy, and Equilibrium, various laws of thermodynamics, concepts and principles. The course will help the students to build the fundamental concepts to apply in various applications like IC engines and Air conditioning systems.						
<b>Course Outcomes</b>							
<b>CO 1</b>	Analyze the work and heat interactions associated with a prescribed process path and to perform an analysis of a flow system.						
<b>CO 2</b>	Define the fundamentals of the first and second laws of thermodynamics and explain their application to a wide range of systems.						
<b>CO 3</b>	Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.						
<b>CO 4</b>	Solve the problems related to Steam and plot the processes on H-S and T-S diagram. Understand thermodynamics relations.						

#### Unit-I

**Basic Concepts:** Thermodynamics: Macroscopic and Microscopic Approach, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Zeroth Law of Thermodynamic and its utility.

**First Law of Thermodynamics:** Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, 1st Law Applied to Non-Flow Process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process.

#### Unit-II

**Second Law of Thermodynamics:** Limitations of First Law, Thermal Reservoir Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and Their Equivalence, Perpetual Motion Machine of Second Kind. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot's Theorem and its Corollaries, Thermodynamic Temperature Scale, Numericals

**Entropy:** Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature-Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of thermodynamics.

#### Unit -III

**Availability, Irreversibility and Equilibrium:** High and Low Grade Energy, Available Energy and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility.

**Pure Substance:** Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheated Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.

#### Unit-IV

**Thermodynamic Relations:** TDS Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations.

**Gas Power Cycles:** Air standard efficiency, Otto cycle, Diesel cycle, Dual cycle, Atkinson cycle, Stirling and Ericsson cycles, Brayton or Joule cycle, Lenoir cycle

**Text Books:**

1. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
2. Engineering Thermodynamics – P K Nag, Tata McGraw Hill
3. Thermodynamics – An Engineering Approach; Y. A. Cengel, M. A. Boles; Tata McGraw Hill

**Reference Books:**

1. Thermal Science and Engineering – D S Kumar, S K Kataria and Sons
2. Engineering Thermodynamics -Work and Heat transfer – G F C Rogers and Maghew  
Y R Longman

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

B.Tech (3 <sup>rd</sup> Semester) Mechanical Engineering								
THEORY OF MACHINES LAB								
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs)
0	0	2	1	0	40	60	100	3
<b>Purpose :</b> To familiarize and practice the students with various kinds of mechanisms and machines.								
<b>Course Outcomes</b>								
<b>CO 1</b>	To learn about various types of basic mechanism & their applications in different machines.							
<b>CO 2</b>	To study the effect of static and dynamic force on the components of single slider crank mechanism.							
<b>CO 3</b>	To find gyroscopic couple of a motorized gyroscope experimentally.							
<b>CO 4</b>	To study the design and working of various gear, gear trains, steering systems, belt drives, brakes and dynamometers.							

### List of experiments

1. To study inversions of 4 bar mechanisms, single and double slider crank mechanisms.
2. To determine the ratio of times and tool velocities of Whitworth quick-return mechanism.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find out experimentally the Coriolis component of acceleration and compare with theoretical value.
5. To determine the moment of inertia of a flywheel.
6. To plot follower displacement v/s cam rotation for various cam follower systems.
7. To find gyroscopic couple on motorized gyroscope and compare with applied couple.
8. To calculate the torque on planet carrier and torque on internal gear using epicycle gear train and holding torque apparatus.
9. To determine the coefficient of friction between belt and pulley and plot a graph between  $\log_{10} T_1/T_2$  v/s  $\theta$
10. To study the different types of centrifugal and inertia governor with demonstration.
11. To study different types of brakes and dynamometers with demonstration.
12. To study various types of steering mechanisms.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

B.Tech. (3 <sup>rd</sup> semester) Mechanical Engineering								
MEC-209LA	MECHANICS OF SOLIDS LAB							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	2	1	0	40	60	100	3
<b>Purpose</b>	To make the students aware of different properties of material using different experiments.							
<b>Course Outcomes</b>								
<b>CO1</b>	Ability to design and conduct experiments, acquire data, analyze and interpret data							
<b>CO 2</b>	Ability to determine the behavior of ferrous metals subjected to normal and shear stresses by means of experiments.							
<b>CO 3</b>	Ability to determine the behavior of structural elements, such as bars subjected to tension, compression, shear, bending, and torsion by means of experiments.							
<b>CO 4</b>	Physical insight into the behavior materials and structural elements, including distribution of stresses and strains, deformations and failure modes.							
<b>CO5</b>	Write individual and group reports: present objectives, describe test procedures and results, synthesize and discuss the test results.							

#### List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod&Charpy).
6. To study the Universal testing machine and perform the tensile, compression & bending tests.
7. To perform the shear test on UTM.
8. To study the torsion testing machine and perform the torsion test.
9. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under point and distributed Loads.
10. To prepare the composite specimen using hot compression molding machine and test for different mechanical properties.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

B.Tech. (3 <sup>rd</sup> semester) Mechanical Engineering								
INDUSTRIAL TRAINING-I								
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
2	0	0	--	--	100	--	100	
<b>Purpose</b>	To provide comprehensive learning platform to students where they can enhance their employ ability skills and exposure to the industrial environment.							
<b>Course Outcomes</b>								
<b>CO1</b>	Capability to acquire and apply fundamental principles of engineering.							
<b>CO 2</b>	Become updated with all the latest changes in technological world.							
<b>CO 3</b>	Capability and enthusiasm for self-improvement through continuous professional development and life-long learning							
<b>CO 4</b>	Awareness of the social, cultural, global and environmental responsibility as an engineer.							

**Note:** MEC-211 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2<sup>nd</sup> semester and students will be required to get passing marks to qualify.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.



MC-901A	Environmental Sciences						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	0	75	25	100	3 Hrs.
<b>Purpose</b>	To learn the multidisciplinary nature, scope and importance of Environmental sciences.						
<b>Course Outcomes (CO)</b>							
<b>CO1</b>	The students will be able to learn the importance of natural resources.						
<b>CO2</b>	To learn the theoretical and practical aspects of eco system.						
<b>CO3</b>	Will be able to learn the basic concepts of conservation of biodiversity.						
<b>CO4</b>	The students will be able to understand the basic concept of sustainable development.						

#### UNIT 1

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

- Forest Resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.
- Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- Food Resources: World Food Problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.
- Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

#### UNIT II

**Ecosystem-Concept of an ecosystem.** Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

#### UNIT III

**Biodiversity and its conservation:** Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity of global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

**Environmental Pollution Definition:** Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards Solid waste management- cause, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

#### UNIT IV

**Social Issues and the Environment.** From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness,

Human population and the Environment, Population growth, variation among nations, Population explosion- Family Welfare Programme, Environment and human health. Human rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressant drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

**Suggested Books**

- Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
- Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
- Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
- Environmental Science- Botkin and Keller. 2012. Wiley , India

**Note: The Examiner will be given the question paper template to set the question paper.**

W.e.f. Session 2019-20

B.Tech. (4 <sup>th</sup> Semester) Mechanical Engineering							
MATERIALS ENGINEERING							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	75	25	100	3
<b>Purpose:</b>	To understand internal structure- properties relationship of different types of materials and learn about Metallographic analysis and Characterization.						
Course Outcomes							
<b>CO 1</b>	To understand the Crystal structures and deformation mechanism in various materials.						
<b>CO 2</b>	To study various types of phase diagrams, TTT curve and Iron carbon diagram. To learn about different heat treatment processes.						
<b>CO 3</b>	To learn about the failure mechanisms like Creep and Fatigue and designation of materials.						
<b>CO 4</b>	To study Basics of Metallography and Basic Principle involved in the working of various types of Material characterization techniques.						

#### UNIT I

**Crystallography:** Review of Crystal Structure, Space Lattice, Co-ordination Number, Number of Atoms per Unit Cell, Atomic Packing Factor; Numerical Problems Related to Crystallography.

**Imperfection in Metal Crystals:** Crystal Imperfections and their Classifications, Point Defects, Line Defects, Edge & Screw Dislocations, Surface Defects, Volume Defects.

**Introduction to Engineering materials and Standard Materials Designation:** Introduction to Engineering materials, Steel Terminology, Standard Designation System for Steels, Indian Standard specifications for steels as per BIS: Based on Ultimate Tensile Strength and based on Composition, AISI-SAE standard designation for Steels and Aluminium Alloys

#### UNIT II

**Phase Diagrams:** Alloy Systems, Solid solutions, Hume Rothery's Rules, Intermediate phases, Phase Diagrams, Gibbs Phase Rule, Cooling curves, The Lever Rule, binary phase diagrams, Applications of Phase Diagrams, Phase Transformation, Micro constituents of Fe-C system, Allotropic Forms of Iron, Iron-iron carbide phase diagram, Modified Iron Carbon Phase Diagrams, Isothermal Transformation, TTT Curve, **Heat Treatment:** Heat treatment of steels, Annealing, Normalising, Hardening, Tempering, Case Hardening, Ageing, Aus tempering and Mar tempering, Surface Hardening, Mass Effect, Equipments for Heat Treatment, Major Defects in Metals or Alloys due to faulty Heat treatment.

#### UNIT III

**Deformation of Metal:** Elastic and Plastic Deformation, Mechanism of Plastic Deformation, Slip; Critical Resolved Shear Stress, Twinning, Conventional and True Stress Strain Curves for Polycrystalline Materials, Yield Point Phenomena, Bauschinger Effect, Work Hardening.

**Failure of Materials:** Fatigue, Fatigue fracture, fatigue failure, Mechanism of Fatigue Failure, Fatigue Life calculations, Fatigue Tests, Theories of Fatigue.

**Creep:** Creep Curve, Types of Creep, Factors affecting Creep, Mechanism of Creep, Creep Resistant Material, Creep Fracture, Creep Test, Stress Rupture test.

#### UNIT IV

**Introduction to Metallography:** Metallography, Phase analysis, Dendritic growth, Cracks and other defects Corrosion analysis, Intergranular attack (IGA), Coating thickness and integrity, Inclusion size, shape and distribution, Weld and heat-affected zones (HAZ), Distribution and orientation of composite fillers, Graphite nodularity, Intergranular fracturing

**Materials Characterization Techniques:** Characterization techniques such as X-Ray Diffraction (XRD), Scanning Electron Microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, Atomic absorption spectroscopy.

#### Text Books:

1. Material Science by S.L.Kakani, New Age Publishers.
2. The Science and Engineering of Materials, Donald R. Askeland, Chapman & Hall.
3. Fundamentals of Material Science and Engineering by W. D. Callister, Wiley.
4. Fundamentals of Light Microscopy and Electronic Imaging by Douglas B. Murphy, Kindle Edition 2001
5. Materials Science and Engineering, V. Raghvan
6. Phase Transformation in Metals and Alloys, D. A. Porter & K.E. Easterling

**Reference Books:**

7. Material Science by Narula, TMH
8. Metallographic Handbook by Donald C. Zipperian, Pace Technologies, USA.
9. Robert Cahn Concise Encyclopedia of Materials Characterization, Second Edition: 2nd Edition (Advances in Materials Science and Engineering) Elsevier Publication 2005.
10. Smart Materials and Structures by Gandhi and Thompson, Chapman and Hall.

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

B. Tech. (4 <sup>th</sup> Semester) Mechanical Engineering							
APPLIED THERMODYNAMICS							
MEC-202A							
Lecture	Tutorial	Practica	Credits	Major Test	Minor Test	Total	Time (Hrs.)
	I	I					
3	0	0	3	75	25	100	3
<b>Purpose :</b>	This course aims to provide a platform to students to understand, model and analyze concept of dynamics involved in thermal energy transformation. To prepare them to carry out experimental investigation and analysis of problems related to applied thermodynamics.						
<b>Course Outcomes</b>							
<b>CO1</b>	Understand the working of boilers, types of boilers, accessories and mountings used on boilers.						
<b>CO 2</b>	Learn about simple and modified Rankine cycles.						
<b>CO 3</b>	Understand the design and analysis of steam flow through steam nozzles. To learn about the working of different types of condensers.						
<b>CO 4</b>	Analyze the working and design of the steam turbine and apply the knowledge in solving the engineering problems of turbines.						

#### UNIT I

**Steam Generators:** Introduction; classification of boilers; comparison of fire tube and water tube boiler; their advantages; description of boiler; Lancashire; locomotive; Babcock; Wilcox etc.; boiler mountings; stop valve; safety valve; blow off valve; feed check etc.; water level indicator; fusible plug; pressure gauge; boiler accessories; feed pump; feed water heater; preheater; super heater; economizer; natural draught chimney design; artificial draught; steam jet draught; mechanical draught; calculation of boiler efficiency and equivalent evaporation.

#### UNIT II

**Vapour Power Cycles:** Simple and modified Rankine cycle; effect of operating parameters on Rankine cycle performance; effect of superheating; effect of maximum pressure; effect of exhaust pressure; reheating and regenerative Rankine cycle; types of feed water heater; reheat factor; binary vapour cycle. Simple steam engine, compound engine; function of various components.

#### UNIT III

**Steam Nozzle:** Function of steam nozzle; shape of nozzle for subsonic and supersonics flow of stream; variation of velocity; area of specific volume; steady state energy equation; continuity equation; nozzle efficiency; critical pressure ratio for maximum discharge; physical explanation of critical pressure; super saturated flow of steam; design of steam nozzle. Advantage of steam condensation; component of steam condensing plant; types of condensers; air leakage in condensers; Dalton's law of partial pressure; vacuum efficiency; calculation of cooling water requirement; air expansion pump.

#### UNIT IV

**Steam Turbines:** Introduction; classification of steam turbine; impulse turbine; working principle; compounding of impulse turbine; velocity diagram; calculation of power output and efficiency; maximum efficiency of a single stage impulse turbine; design of impulse turbine blade section; impulse, reaction turbine; working principle; degree of reaction; parsons turbine; velocity diagram; calculation of power output; efficiency of blade height; condition of maximum efficiency; internal losses in steam turbine; governing of steam turbine.

#### **Text Books:**

1. Thermal Engineering – P L Ballaney, Khanna Publishers.
2. Thermodynamics and Heat Engines vol II – R Yadav, Central Publishing House

3. Engineering Thermodynamics Work and Heat Transfer - G. F. C Rogers and Y. R. Mayhew, Pearson.

4. Applied Thermodynamics for Engineering Technologists - T. D. Eastop and A. McConkey, Pearson.

**Reference Books:**

1. Applied Thermodynamics for Engineering Technologists – T D Eastop and A. McConkey, Pearson Education

2. Heat Engineering – V P Vasandani and D S Kumar, Metropolitan Book Co Pvt Ltd.

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

B. Tech. (4 <sup>th</sup> Semester) Mechanical Engineering							
FLUID MECHANICS&FLUID MACHINES							
Lecture	Tutorial	Practica I	Credits	Major Test	Minor Test	Total	Time
3	1	0	4	75	25	100	3
<b>Purpose:</b> To build a fundamental understanding of concepts of Fluid Mechanics and their application in rotodynamic machines.							
<b>Course Outcomes</b>							
<b>CO1</b>	Upon completion of this course, students will be able to apply mass and momentum conservation laws to mathematically analyze simple flow situations.						
<b>CO2</b>	The students will be able to obtain solution for boundary layer flows using exact or approximate methods.						
<b>CO3</b>	The students will be able to estimate the major and minor losses through pipes and learn to draw the hydraulic gradient and total energy lines.						
<b>CO4</b>	The students will be able to obtain the velocity and pressure variations in various types of simple flows.						
<b>CO5</b>	They will be able to analyze the flow and evaluate the performance of pumps and turbines.						

### Unit I

**Fluid Properties:** Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, weight density, specific volume, specific gravity, viscosity, compressibility, surface tension and capillarity.

**Fluid Kinematics:** Types of fluid flows, stream, streak and path lines; flow rate and continuity equation, differential equation of continuity in cartesian and polar coordinates, rotation and vorticity, circulation, stream and potential functions, flow net. Problems.

**Fluid Dynamics:** Concept of system and control volume, Euler's equation, Navier-Stokes equation, Bernoulli's equation and its practical applications, Impulse momentum equation. Problems.

### Unit II

**Viscous Flow:** Flow regimes and Reynold's number, relationship between shear stress and pressure gradient. Exact flow solutions, Couette and Poiseuille flow, laminar flow through circular conduits. Problems.

**Turbulent Flow Through Pipes:** Darcy Weisbach equation, friction factor, Moody's diagram, minor losses in pipes, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Problems.

**Boundary Layer Flow:** Concept of boundary layer, measures of boundary layer thickness, Blasius solution, von-Karman momentum integral equation, laminar and turbulent boundary layer flows, separation of boundary layer and its control. Problems.

### Unit III

**Dimensional Analysis:** Need for dimensional analysis – methods of dimension analysis – Dimensionless parameters – application of dimensionless parameters. Problems.

**Hydraulic Pumps:** Introduction, theory of Rotodynamic machines, Classification, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles; Centrifugal pumps, working principle, work done by the impeller, minimum starting speed, performance curves, Cavitation in pumps, Reciprocating pumps, working principle, Indicator diagram, Effect of friction and acceleration, air vessels, Problems.

### Unit IV

**Hydraulic Turbines:** Introduction, Classification of water turbines, heads and efficiencies, velocity triangles, Axial, radial and mixed flow turbines, Pelton wheel, Francis turbine and Kaplan turbines, working principles, work done, design of turbines, draft tube and types, Specific speed, unit quantities, performance curves for turbines, governing of turbines. Problems.

**Text Books:**

1. Introduction to Fluid Mechanics – R.W. Fox, Alan T. McDonald, P.J. Pritchard, Wiley Publications.
2. Fluid Mechanics – Frank M. White, McGraw Hill
3. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
4. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
5. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, Tata McGraw Hill.

**Reference Books:**

1. Mechanics of Fluids – I H Shames, Mc Graw Hill
2. Fluid Mechanics: Fundamentals and Applications - YunusCengel and John Cimbala, McGraw Hill.
3. Fluid Mechanics: Pijush K. Kundu, Ira M. Cohen and David R. Rowling, Academic Press.

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20



B. Tech. (4 <sup>th</sup> Semester) Mechanical Engineering							
MECHANICS OF SOLIDS-II							
MEC-206A	Lecture	Tutorial	Practica I	Credits	Major Test	Minor Test	Time (Hrs.)
	3	1	0	4	75	25	100
<b>Purpose</b>	The objective of this course is to show the development of strain energy and stresses in springs, pressure vessel, rings, links, curved bars under different loads. The course will help the students to build the fundamental concepts in order to solve engineering problems						
<b>Course Outcomes</b>							
<b>CO1</b>	Identify the basics concepts of strain energy and various theories of failures and solve the problems						
<b>CO 2</b>	Differentiate different types of stresses induced in thin pressure vessel and solve the problems. Use of Lamé's equation to calculate the stresses induced in thick pressure vessel.						
<b>CO 3</b>	Able to compute stresses in ring, disk and cylinder due to rotation. Classify the different types of spring and analyze the stresses produced due to loading						
<b>CO 4</b>	Determine the stresses in crane hook, rings, chain link for different cross section and also the deflection of curved bars and rings. Analyze the stresses due to unsymmetrical bending and determine the position of shear centre of different section.						

#### Unit I

**Strain Energy & Impact Loading:** Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's theorem, Numerical.

**Theories of Elastic Failures:** Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

#### Unit II

**Thin Walled Vessels:** Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire wound cylinders, Numericals.

**Thick Cylinders & Spheres:** Derivation of Lamé's equations, radial & hoop stresses and strains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, hub shrunk on solid shaft, Numericals.

#### Unit III

**Rotating Rims & Discs:** Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (i) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solid cylinders. Numericals.

**Springs:** Stresses in closed coiled helical springs, Stresses in open coiled helical springs subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

#### Unit IV

**Bending of Curved Bars :** Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano's theorem, stresses in simple chain links, deflection of simple chain links, Problems.

**Unsymmetrical Bending:** Introduction to unsymmetrical bending, stresses due to unsymmetrical bending, deflection of beam due to unsymmetrical bending, shear center for angle, channel, and I-sections, Numericals.

**Text Books:**

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.

**Reference Books:**

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert I. Mott, Pearson, New Delhi
3. Strength of Material – Shaums Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

<b>B. Tech. (4<sup>th</sup> Semester) Mechanical Engineering</b>							
<b>MEC-208A</b>	<b>Instrumentation &amp; Control</b>						
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Total</b>	<b>Time(Hrs)</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>75</b>	<b>25</b>	<b>100</b>	<b>3</b>
<b>Purpose</b>	To understand the basics of the measurement of various quantities using instruments, their accuracy and range and the techniques for controlling devices automatically.						
<b>Course Outcomes</b>							
<b>CO1</b>	Students will have basic knowledge about measurement systems and their components.						
<b>CO2</b>	Students will learn about various sensors used for measurement of mechanical quantities.						
<b>CO3</b>	Students will have basic knowledge of process monitoring and control.						

### Unit I

**Instrumentation System:** introduction, typical applications of instrument systems, functional elements of a measurement system, classification of instruments, standards and calibration, static and dynamic characteristics of measurement systems.

**Statistical Error Analysis:** statistical analysis of data and measurement of uncertainty: probability, confidence interval or level, mean value and standard deviation calculation, standard normal distribution curve and probability tables, sampling and theory based on samples, goodness of fit, curve fitting of experimental data.

### Unit II

**Sensors and Transducers:** introduction and classification, transducer selection and specifications, primary sensing elements, resistance transducers, variable inductance type transducers, capacitive transducers, piezo-electric transducers, strain gauges. Smart Sensors: Introduction, architecture of smart sensor, bio sensor and physical sensor, Piezo-resistive pressure sensor, microelectronic sensor.

**Measurement of force, torque, shaft power, speed and acceleration:** force and weight measurement system, measurement of torque, shaft power, speed and velocity: electrical and contactless tachometers, acceleration: vibrometers, seismic and piezo-electric accelerometer.

### Unit III

**Measurement of pressure, temperature and flow:** Basic terms, Pressure: Liquid column manometers, elastic type pressure gauges, electrical types for pressure and vacuum, temperature measuring instruments: RTD sensors, NTC thermistor, thermocouples, and semiconductor based sensors. Flow Measurement: drag force flow meter, turbine flow meter, electronic flow meter, electromagnetic flow meter, hot-wire anemometer.

**Instruments for measuring Humidity, Density, and Viscosity:** Humidity definitions, Humidity measuring devices, Density and Specific Gravity, Basic terms, Density measuring devices, Density application considerations, Viscosity, Viscosity measuring instruments, basic terms used in pH, pH measuring devices, pH application considerations. Problems.

### Unit IV

**Basic Control System:** Introduction, basic components of control system, classification : closed loop and open loop control system, transfer function, block diagram representation of closed loop system and its reduction techniques, mathematical modelling of various mechanical systems and their analogy with electrical systems, signal flow graph and its representation.

**Mechanical Controllers:** Basics of actuators: pneumatic controller, hydraulic controller and their comparison.

### Text Books:

1. Instrument and control by Patranabis D., PHI Learning.
2. Fundamental of Industrial Instrumentation and Process control by W.C.DUNN, McGrawHill,
3. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition), Pearson Education India, 2007
4. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York, 1999.

**Reference Books:**

1. Mechanical Measurement and Control by A K Sawhney
2. Modern control Engineering by Katsuhiko Ogata, PHI publication

**Note: The paper setter will set the paper as per the question paper templates provided.**

W.e.f. Session 2019-20

B. Tech. (4 <sup>th</sup> Semester) Mechanical Engineering								
ES- MATERIALS ENGINEERING LAB								
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	2	1	-	40	60	100	3
<b>Purpose</b>	To make the students aware of material structure and properties of material using different experiments.							
<b>Course Outcomes</b>								
<b>CO 1</b>	Ability to design and conduct experiments, acquire data, analyze and interpret data							
<b>CO 2</b>	Ability to determine the grain size and microstructure in different Ferrous alloys by means of experiments.							
<b>CO 3</b>	Ability to learn about microstructures of different Non-Ferrous alloys by means of experiments.							
<b>CO 4</b>	To learn about heat treatment processes through experiments.							
<b>CO 5</b>	Ability to Analyze microstructure of Heat-treated specimens and perform Fatigue and creep test on different materials.							

#### List of Experiments:

1. To Study various Crystal Structures through Ball Models.
2. To study the components and functions of Metallurgical Microscope.
3. To learn about the process of Specimen Preparation for metallographic examination.
4. To perform Standard test Methods for Estimation of Grain Size.
5. To perform Microstructural Analysis of Carbon Steels and low alloy steels.
6. To perform Microstructural Analysis of Cast Iron.
7. To perform Microstructural Analysis of Non-Ferrous Alloys: Brass & Bronze.
8. To perform Microstructural Analysis of Non-Ferrous Alloys: Aluminium Alloys.
9. To Perform annealing of a steel specimen and to analyze its microstructure.
10. To Perform Hardening of a steel specimen and to analyze its microstructure.
11. To perform Fatigue test on fatigue testing machine.
12. To perform Creep test on creep testing machine.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

<b>B. Tech. (4<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-210LA FLUID MECHANICS &amp; FLUID MACHINES LAB</b>								
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total</b>	<b>Time</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Purpose</b>	To familiarize the students with the equipment and instrumentation of Fluid Mechanics and Machines							
<b>Course Outcomes</b>								
<b>CO1</b>	Operate fluid flow equipment and instrumentation.							
<b>CO2</b>	Collect and analyse data using fluid mechanics principles and experimentation methods.							
<b>CO3</b>	Determine the coefficient of discharge for various flow measurement devices.							
<b>CO4</b>	Calculate flow characteristics such as Reynolds number, friction factor from laboratory measurements.							
<b>CO5</b>	Analyze the performance characteristics of hydraulic pumps.							
<b>CO6</b>	Analyze the performance characteristics of hydraulic turbines.							

#### **List of Experiments:**

1. To verify the Bernoulli's Theorem.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Venturimeter.
4. To determine the coefficient of discharge of Notch.
5. To find critical Reynolds number for a pipe flow.
6. To determine the friction factor for the pipes.
7. To determine the meta-centric height of a floating body.
8. Determination of the performance characteristics of a centrifugal pump.
9. Determination of the performance characteristics of a reciprocating pump.
10. Determination of the performance characteristics of a gear pump.
11. Determination of the performance characteristics of Pelton Wheel.
12. Determination of the performance characteristics of a Francis Turbine.
13. Determination of the performance characteristics of a Kaplan Turbine.
14. Determination of the performance characteristics of a Hydraulic Ram.

**Note:** At least ten experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

<b>B. Tech. (4<sup>th</sup> Semester) Mechanical Engineering</b>							
<b>MC-902A</b>	<b>Constitution of India</b>						
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Total</b>	<b>Time</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>-</b>	<b>75</b>	<b>25</b>	<b>100</b>	<b>3 Hrs.</b>
<b>Purpose</b>	To know the basic features of Constitution of India						
<b>Course Outcomes</b>							
<b>CO1</b>	The students will be able to know about salient features of the Constitution of India.						
<b>CO2</b>	To know about fundamental duties and federal structure of Constitution of India.						
<b>CO3</b>	To know about emergency provisions in Constitution of India.						
<b>CO4</b>	To know about fundamental rights under constitution of India.						

#### **UNIT I**

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India. Scheme of the fundamental rights

#### **UNIT II**

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

Parliamentary Form of Government in India – The constitution powers and status of the President of India

#### **UNIT III**

Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.

Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

#### **UNIT IV**

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom

under Article 19.

Scope of the Right to Life and Personal Liberty under Article 21.

#### **Text Books**

1. Constitution of India. Prof. Narender Kumar (2008) 8<sup>th</sup> edition. Allahabad Law Agency.

#### **Reference Books:**

1. The constitution of India. P.M. Bakshi (2016) 15<sup>th</sup> edition. Universal law Publishing.

# **Fifth Semester**



B. Tech (5 <sup>th</sup> Semester) Mechanical Engineering							
HM-905A	ENTREPRENEURSHIP						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time (Hrs)
3	0	0	3	75	25	100	3
<b>Purpose</b>	To acquaint the knowledge about the entrepreneurship and entrepreneurial process in context of economic development, formalities required in launching a small enterprise, venture capital financing schemes and IPR.						
<b>Course Outcomes</b>							
<b>CO1</b>	Students will be able to understand: who the entrepreneurs are? what competencies are required to become an Entrepreneur?						
<b>CO2</b>	Students will have insights into the management, opportunity search, identification of a product, process of project finalization etc. required for small business enterprises.						
<b>CO3</b>	Students will be able to understand the meaning of small scale enterprise (SSE) and the setup formalities, operational and project management issues in the SSE.						
<b>CO4</b>	Students be able to know the different financial assistances available for the establishment of small scale industrial units and the IPR related issues.						

### UNIT-I

**Entrepreneurship:** Concept and definitions, Entrepreneurship and economic development, classification and types of entrepreneurs, entrepreneurial competencies, factor affecting entrepreneurial Growth– economic, non-economic factors, EDP programmes, entrepreneurial training, traits/qualities of an entrepreneurs, manager vs entrepreneur, entrepreneurial challenges.

### UNIT-II

**Establishing Small Scale Enterprise:** Opportunity scanning and identification, creativity and product development process, market survey and assessment, choice of technology and selection of site.

**Planning a Small Scale Enterprises:** Financing new/small enterprises, techno-economic feasibility assessment, preparation of business plan, forms of business organization/ownership.

### UNIT-III

**Small Enterprises and Enterprise Launching Formalities:** Definition of small scale, rationale, objective, scopes, SSI, registration, NOC from pollution board, machinery and equipment selection, MSMEs – definition and significance in Indian economy, MSME schemes, operational issues in SSE: financial management issues, operational/project management issues in SSE, marketing management issues in SSE.

### UNIT-IV

**Institutional Interface for Small Scale Industry/Enterprises, Venture Capital:** Concept, venture capital financing schemes offered by various financial institutions in India, legal issues– forming business entity, requirements for formation of a private/public limited company, entrepreneurship and Intellectual property rights: IPR and their importance (Patent, Copy Right, Trademarks), case studies-at least one in whole course.

#### **Text books:**

1. Entrepreneurship Development Small Business Enterprises by Poornima M Charantimath, Pearsons pub.

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2. Entrepreneurship by Roy Rajiv, Oxford University Press.
3. Innovation and Entrepreneurship by Drucker. F, Peter, Harper business.
4. Entrepreneurship by Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, Tata Mc-Graw Hill Publishing Co. ltd. New Delhi.

**Reference books:**

1. Entrepreneurial Development by Dr. S.S. Khanka, S. Chand Publishing Company.
2. Entrepreneurship and Management of Small and Medium Enterprises by Dr. Vasant Desai, Himalaya Publishing House.

**Note: The paper setter will set the paper as per the question paper template provided.**

B. Tech (5 <sup>th</sup> Semester) Mechanical Engineering							
MEC- 301A	HEAT TRANSFER						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time (Hrs)
3	1	0	4	75	25	100	3
<b>Purpose</b>	To build a solid foundation in heat transfer and rigorous treatment of governing equations and solution procedures.						
Course Outcomes							
<b>CO1</b>	After completing the course, students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.						
<b>CO2</b>	Students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.						
<b>CO3</b>	Students will be able to classify and evaluate the design parameters of devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.						

### UNIT-I

**Introduction:** Definition of heat, modes of heat transfer, basic laws of heat transfer, application of heat transfer, simple problems.

**Conduction:** Derivation of heat balance equation - steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, steady one dimensional heat conduction without internal heat generation, the plane slab, the cylindrical shell, the spherical shell, conduction through composite wall, critical insulation thickness, variable thermal conductivity, steady one dimensional heat conduction with uniform internal heat generation, the plane slab, the cylindrical and spherical systems, heat transfer through fins of uniform cross-section, governing equation, temperature distribution and heat dissipation rate, effectiveness and efficiency of fins.

**Transient conduction:** Lumped system approximation and Biot number, approximate solution to unsteady conduction heat transfer by the use of Heisler charts.

### UNIT-II

**Convection:** Heat convection, basic equations, boundary layers, forced convection, external and internal flows, natural convective heat transfer, dimensionless parameters for forced and free convection heat transfer, boundary layer analogies, correlations for forced and free convection, approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow, estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. Boiling and Condensation heat transfer, pool boiling curve, Nusselt theory of laminar film condensation.

### UNIT-III

**Radiation:** Interaction of radiation with materials, definitions of radiative properties, monochromatic and total emissive power, Planck's distribution law, Stefan Boltzman's law, Wien's displacement law, Kirchoff's law, intensity of radiation, Lambert's cosine law, heat transfer between black surfaces, radiation shape factor, heat transfer between non-black surfaces: infinite parallel planes, infinite long concentric cylinders, small gray bodies and small body in large enclosure, electrical network approach, radiation shields.

### UNIT-IV

**Heat exchangers:** Types of heat exchangers; overall heat transfer coefficient, fouling factor, analysis and design of heat exchangers using logarithmic mean temperature difference, and NTU

w.e.f. 2020-21

method, effectiveness of heat exchangers, multipass heat exchangers, applications of heat exchangers.

**Text books:**

1. Fundamentals of Heat and Mass transfer – Frank P. Incropera, David P. Dewitt, T.L. Bergman and A.S. Lavine, Sixth Edition, Wiley Publications, 2007.
2. Heat Transfer: A Practical Approach - Yunus A Cengel, McGraw Hill, 2002.
3. Heat and Mass Transfer – P.K. Nag, Tata McGraw Hill.
4. Heat Transfer – J.P. Holman, Eighth Edition, McGraw Hill, 1997.

**Reference books:**

5. Heat Transfer – A. Bejan, John Wiley, 1993.
6. A Text book of Heat Transfer - S.P Sukhatme, University press.
7. Principles of Heat Transfer – Massoud Kaviany, John Wiley, 2002.
8. Heat and Mass Transfer - D.S Kumar, S.K. Kataria & Sons.
9. Heat Transfer – Y.V.C. Rao, University Press.

**Note: The paper setter will set the paper as per the question paper template provided.**

B. Tech (5 <sup>th</sup> Semester) Mechanical Engineering							
MEC-303A	PRODUCTION TECHNOLOGY						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	0	0	3	75	25	100	3
<b>Purpose:</b>	To acquaint the knowledge of different type of machines and machine tools used in machining of metals, cutting tools used in different operations, work holding devices and CNC machines.						
Course Outcomes							
<b>CO 1</b>	After completing the course, students will be able to explain the working of different machines, machine tools and analyze the forces in machining operations.						
<b>CO 2</b>	Students will be able to explain different types of cutting tools and cutting fluids used in machining.						
<b>CO 3</b>	Students will be able to describe metrology and working of inspection tools for different applications.						
<b>CO 4</b>	Students will be able to explain various thread operations, different workholding devices and different gear manufacturing processes.						
<b>CO 5</b>	Students will be able to distinguish between the advancements in CNC and conventional machining methods and develop programming for parts production.						

### UNIT-I

**Theory of metal machining:** Overview of machining technology: types of machining operation, cutting tools, cutting conditions, theory of chip formation in metal cutting: orthogonal cutting model, actual chip formation, forces relationships and the merchant equation: forces in metal cutting, the merchant equation, power and energy relationships in machining, cutting temperatures.

**Machine tools and machining operations:** Turning and related operations: cutting conditions, operations related to turning, engine lathe, other lathes and turning machines, boring machines, drilling and related operations: cutting conditions, operations related to drilling, drill presses, Milling: types of milling operations, cutting conditions, milling machines, high speed machining, grinding machines: types, wet and dry grinding, abrasives, grit, grade and structure of wheels, selection of grinding wheels.

### UNIT-II

**Technology and materials of cutting tools:** Tool life, tool wear, taylor tool life equation, tool materials: high speed steels, cast cobalt alloys, cemented carbides, cermets and coated carbides, ceramics, synthetic diamonds and cubic boron nitrides, tool geometry: single point tool geometry, effect of tool material on tool geometry, multiple-cutting-edge tools, cutting fluids: types of cutting fluids, applications and selection of cutting fluids.

**Metrology and inspection:** Limits, fits, and tolerances, gauge design, interchangeability, linear, angular, and form measurements (straightness, squareness, flatness, roundness, and cylindricity) by mechanical and optical methods, inspection of screw threads, surface finish measurement by contact and non-contact methods, tolerance analysis in manufacturing and assembly.

### UNIT-III

**Threads:** Standard forms of screw threads, methods of making threads, thread cutting on lathe, thread chasing, thread milling, thread rolling, thread grinding, thread tapping, automatic screw cutting machines, inspection and measurement of threads.

**Workholding devices for machine tools:** Introduction, conventional fixture design, tool design steps, clamping considerations, chip disposal, unloading and loading time, example of jig design, types of jigs, conventional fixtures, modular fixturing, setup and changeover: single-minute-exchange-of-die (SMED), clamps, other workholding devices: assembly jigs, magnetic workholders, electrostatic workholders, economic justification of jigs and fixtures.

### UNIT-IV

**Gear manufacturing and finishing:** Introduction to different types of gears, terminology, methods of gears manufacturing, gear forming: selecting a form gear cutter for cutting spur gears, selecting gear cutter for cutting helical or spiral gear, broaching of gears, generating methods: gear

shaper process, rack planning process, gear hobbing process. Gear finishing operations: Shaving, burnishing, grinding, lapping, honing, gears inspection.

**Computer numerical control (CNC) machines:** Classification of CNC machines, modes of operation of CNC, Working of Machine Structure, Automatic tool changer (ATC), Automatic pallet changer (APC), CNC axis and motion nomenclature, CNC toolings – tool pre-setting, qualified tool, tool holders and inserts, Axes Identification in CNC turning and Machining centers, CNC part programming: Programming format and Structure of part programme, ISO G and M codes for turning and milling-meaning and applications of important codes.

**Text Books:**

1. Fundamentals of modern manufacturing: materials processing and systems by Mikell P. Grover, John Wiley and Sons.
2. Materials and processes in manufacturing by J.T. Black and R.A. Kohser, John Wiley and Sons.
3. Production Technology by R. K. Jain, Khanna Publishers.
4. Machine Tools by R. Kesavan & B. Vijaya Ramnath, Laxmi Publications.
5. Machining and Machine Tools by A. B. Chattopadhyay, WILEY INDIA.

**Reference Books:**

1. Principles of Machine Tools by G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg. & Tech by S. Kalpakjian and S.R. Schmid, Pearsons.
3. Modern Machining Processes by P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
4. Production Engineering: P.C. Sharma, S.Chand & Sons.
5. Introduction to Jig and Tool Design by Kempster M.H.A, Hodder & Stoughton, England

**Note: The paper setter will set the paper as per the question paper template provided.**

B. Tech. (5 <sup>th</sup> Semester) Mechanical Engineering							
MEC-305A	MECHANICAL VIBRATIONS AND TRIBOLOGY						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total Time	Time (Hrs)
3	0	0	3	75	25	100	3
<b>Purpose:</b>	To understand the vibration systems with different degrees of freedom in different modes and conditions and the basics of tribology.						
<b>Course Outcomes</b>							
<b>CO1</b>	Students will be capable of describing the fundamentals of vibration for a single degree of freedom (D.O.F.) system under free and damped vibrations.						
<b>CO2</b>	Students will be able to analyze different types of forced vibration system in single degree of freedom (D.O.F.) and damped, undamped, free and forced systems with two D.O.F.						
<b>CO3</b>	Students will be able to explain the principal modes of vibrations using different methods for various combinations of spring-mass, rotor-shaft systems; transverse, longitudinal and torsional vibration for beams, bars and shafts respectively.						
<b>CO4</b>	Students will be able to describe the fundamentals of tribology, lubrication, friction and wear.						

### UNIT-I

**Fundamentals:** Introduction, elements of a vibratory system, periodic and S.H.M., degrees of freedom (DOF), types of vibrations, work done by a harmonic force, beats, problems.

#### **Free vibration systems with single degree of freedom**

**Undamped systems:** Introduction, differential equations, torsional vibrations, spring and shaft combinations: series & parallel, linear and torsional systems, compound pendulum, bifilar and trifilar suspensions, problems.

**Damped systems:** Introduction, types of damping, differential equations of damped free vibrations, initial conditions, logarithmic decrement, vibrational energy, problems.

### UNIT-II

**Forced vibration systems with single degree of freedom:** Introduction, excitation and sources, equations of motion, rotating and reciprocating unbalanced system, support motion, vibration isolation, force and motion transmissibility, forced vibration system with different types of damping, vibration measuring instruments, resonance, bandwidth, quality factor and half power points, critical speed of shaft with and without damping with single and multiple discs, problems.

**Two degree of freedom system:** Introduction, torsional vibrations, principal modes of vibrations for two D.O.F., damped and undamped forced and free vibrations, semi-definite systems, co-ordinate coupling, spring and mass type vibration absorber, problems.

### UNIT-III

**Multi-degree of freedom systems:** Introduction, principal modes of vibrations for three or more DOF, influence coefficients, orthogonality principle, matrix method, matrix iteration method, Dunkerley's equation, Holzer's Method, Rayleigh Method, Rayleigh-Ritz method, Stodola method, problems.

**Continuous systems:** Introduction, lateral vibrations of strings, longitudinal vibrations of bars, transverse vibration of beams, torsional vibration of uniform shafts, problems.

#### UNIT-IV

**Tribology:** Introduction, tribology in design, tribology in industry, economic aspects.

**Lubrication:** Introduction, basic modes of lubrication, lubricants, properties of lubricants: physical and chemical, types of additives, extreme pressure lubricants, recycling of used oils and oil conservation, disposal of scrap oil, oil emulsion.

**Friction and wear:** Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theories of friction, effect of surface preparation. Introduction to wear, types of wear, various factors affecting wear, measurement of wear, wear between solids and liquids, theories of wear.

**Text Books:**

1. Mechanical Vibrations by G. K. Grover, Nem Chand and Bros., Roorkee
2. Elements of Mechanical Vibrations by Meirovitch, McGraw Hill
3. Introductory course on theory and practice of Mechanical Vibration by J.S. Rao and K.Gupta,  
New Age International.
4. Friction and wear of Materials by E. Robinowicz, Johan Wiley
5. Tribology an Introduction by Sushil Kumar Srivastava
6. Introduction to Tribology and Bearings by B. C. Majumdar, S. Chand and Company Ltd.  
New  
Delhi.

**Reference Books:**

1. Mechanical Vibrations by S. S. Rao, Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd. New Delhi.
2. Mechanical Vibrations by V.P. Singh, Dhanpat Rai & Co. Pvt. Ltd., Delhi
3. Engineering Tribology by Prashant Sahoo, PHI publications.
4. Principles of Tribology by J. Hailing, McMillan Press Ltd.

**Note: The paper setter will set the paper as per the question paper template provided.**



<b>B. Tech. (5<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-307LA</b>	<b>HEAT TRANSFER LAB</b>							
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total</b>	<b>Time (Hrs)</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Purpose</b>	To impart practical knowledge of different modes of heat transfer by conducting experiments.							
<b>Course Outcomes</b>								
<b>CO1</b>	Students will be able to design and conduct experiments, acquire data, analyze and interpret data.							
<b>CO2</b>	Students will be able to measure the thermal conductivity of metal rod, insulating material and liquids.							
<b>CO3</b>	Students will be able to explain the concept of composite wall and determine its thermal resistance.							
<b>CO4</b>	Students will be able to evaluate heat transfer coefficients in free and forced convection.							
<b>CO5</b>	Students will be able to measure the performance of a heat exchanger.							
<b>CO6</b>	Students will be able to determine the Stefan Boltzmann constant and emissivity.							

**List of Experiments:**

1. To determine the thermal conductivity of a metal rod.
2. To determine the thermal conductivity of an insulating slab.
3. To determine the thermal conductivity of a liquid using Guard plate method.
4. To determine the thermal conductivity of an insulating powder.
5. To determine the thermal resistance of a composite wall.
6. To plot the temperature distribution of a pin fin in free-convection.
7. To plot the temperature distribution of a pin fin in forced-convection.
8. To study the forced convection heat transfer from a cylindrical surface.
9. To determine the effectiveness of a concentric tube heat exchanger in a parallel flow arrangement.
10. To determine the effectiveness of a concentric tube heat exchanger in a counter flow arrangement.
11. To determine the Stefan-Boltzman constant.
12. To determine the emissivity of a given plate.
13. To determine the critical heat flux of a given wire.
14. To study the performance of an evacuated tube based solar water heater.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

B. Tech. (5 <sup>th</sup> Semester) Mechanical Engineering								
MEC-309LA	PRODUCTION TECHNOLOGY LAB							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	2	1	0	40	60	100	3
<b>Purpose</b>	To impart practical knowledge of various measuring instruments, machining and welding operations by performing experiments.							
<b>Course Outcomes</b>								
<b>CO 1</b>	Students will be able to measure the linear and angular dimensions using various equipment.							
<b>CO 2</b>	Students will be able to execute various machining operations for the preparation of jobs on different machine tools.							
<b>CO 3</b>	Students will be able to create various jobs using TIG/MIG welding.							
<b>CO 4</b>	Students will be able to develop jobs on CNC lathe and CNC milling.							

### LIST OF EXPERIMENTS:

1. Study of linear, angular measuring devices and to measure the linear and angular dimensions using various equipment's.
2. Manufacture and assembly of a unit consisting of 2 to 3 components to have the concept of tolerances and fits (shaft and bush assembly or shaft, key and bush assembly or any suitable assembly).
3. To prepare a job on a lathe having various operations viz. drilling, boring, taper turning, thread cutting, knurling, etc.
4. Demonstration of formation of cutting parameters of single point cutting tool using bench grinder / tool & cutter grinder.
5. To make a spur gear of given part drawing involving operations namely drilling, boring, reaming, honing, key slotting, gear teeth machining, lapping and gear teeth finishing.
6. Introduction to various grinding wheels and demonstration on the cylindrical and surface grinder.
7. To demonstrate surface milling /slot milling.
8. To cut gear teeth on milling machine using dividing head.
9. To cut V Groove/ dovetail / Rectangular groove using a shaper.
10. To prepare a useful product containing different types of welded joints using simple arc/TIG/MIG welding set.
11. To cut external threads on a lathe and practice thread measurements.
12. To study CNC lathe trainer and its components (hardware and software) especially controllers (Fanuc and Siemens) and make a CNC programme using APT language of given part drawing for machining cylindrical job involving operations namely turning, step turning, taper turning, threading, radius contour cutting, chamfering etc.
13. To study CNC milling trainer and its components (hardware and software) especially controllers (Fanuc and Siemens) and make a CNC programme using APT language of given drawing for milling job operations namely end cutting, side cutting, contour cutting, face cutting, etc. and run the programme in simulation and actual mode in Cut Viewer or other software and run the program in actual mode using CNC controllers.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

<b>B. Tech. (5<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-311LA</b>	<b>MECHANICAL VIBRATIONS AND TRIBOLOGY LAB</b>							
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total Time</b>	<b>Time (Hrs.)</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Purpose:</b>	To provide practical knowledge of free and forced vibration system fundamentals and the mechanisms of friction, wear and lubrication.							
<b>Course Outcomes</b>								
<b>CO1</b>	Students will be able to evaluate free and forced vibrations of various elements in Universal Vibration Apparatus.							
<b>CO2</b>	Students will be able to measure the surface roughness of different materials and analyse the machinery faults, causes and sources using Machinery Fault Simulator (MFS).							
<b>CO3</b>	Students will be able to analyse the sliding wear and abrasive behavior of different materials using wear and friction monitoring apparatus and dry abrasion tester respectively.							
<b>CO4</b>	Students will be able to evaluate extreme pressure properties of different lubricants using four ball tester.							

**LIST OF EXPERIMENTS:**

1. To study undamped free vibrations and determine the natural frequency of:
  - 1.1 Spring mass system
  - 1.2 Simple Pendulum
  - 1.3 Torsional spring type double pendulum and compare them with theoretical values.
2. To study the torsional vibration of a single rotor shaft system and determine the natural frequency.
3. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency.
4. To verify the Dunkerley's rule.
5. To determine the radius of gyration for:
  - 5.1 Bifilar suspension.
  - 5.2 Compound pendulum.
  - 5.3 Trifilar suspension.
6. To study the forced vibration system with damping, Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.
7. To find out and locate machinery faults viz. vibrations and unbalancing using Machinery Fault Simulator (MFS) in:
  - 7.1 Direct Driven reciprocating pump;
  - 7.2 Direct Driven centrifugal pump;
  - 7.3 Defective straight tooth gearbox pinions.
8. To determine the wear rate, friction force and coefficient of friction of a metallic pin/ball by using wear and friction monitor apparatus.
9. To determine abrasion index of a material with the help of dry abrasion test rig.
10. To evaluate the wear and extreme pressure properties of a lubricating oil by using four ball tester.
11. To determine the roughness of a specimen using surface roughness tester.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

<b>B. Tech. (5<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-313 LA</b>	<b>PROJECT-I</b>							
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total Time</b>	<b>Time (Hrs.)</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>--</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>3</b>
<b>Purpose:</b>	To implement the engineering principles and theories into innovative practical projects for solving real world problems.							
<b>Course Outcomes</b>								
<b>CO1</b>	Students will be able to apply the theoretical knowledge into practical/software projects.							
<b>CO2</b>	Students will be able to design new products using latest technologies.							

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

**Note:** The maximum number of students in a group should not exceed four.

<b>B. Tech. (5<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-315A INDUSTRIAL TRAINING-II</b>								
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total</b>	<b>Time (Hrs.)</b>
<b>2</b>	<b>0</b>	<b>0</b>	<b>--</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>100</b>	<b>--</b>
<b>Purpose</b>	To provide an industrial exposure to the students and enhance their skills and creative capability for conversion of their innovative ideas into physical reality.							
<b>Course Outcomes</b>								
<b>CO 1</b>	Students will be able to self-improve through continuous professional development and life-long learning.							
<b>CO 2</b>	Students will be able to develop social, cultural, global and environmental responsibility as an engineer.							
<b>CO 3</b>	Students will be able to weigh all the latest changes in technological world.							

**Note:** MEC-315 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4<sup>th</sup> semester and students will be required to get passing marks to qualify.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

B. Tech. (5 <sup>th</sup> Semester) Mechanical Engineering								
MC-903A ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE								
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
3	0	0	--	100	--	--	100	3
<b>Purpose</b>	To impart basic principles of thought process, reasoning and inferencing.							
<b>Course Outcomes</b>								
<b>CO 1</b>	Students will be able to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.							

### Course Contents

- Basic structure of Indian Knowledge System: अष्टादशविद्या -ऋग्वेद,ऋजुवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ऋग्वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

### References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5<sup>th</sup> Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
- Fritzof Capra, *Tao of Physics*
- Fritzof Capra, *The Wave of life*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
- P B Sharma (English translation), *Shodashang Hridayan*

**Pedagogy:** Problem based learning, group discussions, collaborative mini projects.

**Note:** The paper setter will set the paper as per the question paper template provided.

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# **Sixth Semester**

B. Tech (6 <sup>th</sup> Semester) Mechanical Engineering							
HM-901A	ORGANIZATIONAL BEHAVIOUR						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	0	0	3	75	25	100	3
<b>Purpose:</b>	To make the students conversant with the basics concepts of organizational culture and behavior for nurturing their managerial skills.						
<b>Course Outcomes</b>							
<b>CO 1</b>	An overview about organizational behavior as a discipline and understanding the concept of individual behavior.						
<b>CO 2</b>	Understand the concept and importance of personality, emotions and its importance in decision making and effective leadership.						
<b>CO 3</b>	Enabling the students to know about the importance of effective motivation and its contribution in group dynamics and resolving conflicts.						
<b>CO 4</b>	Understand how to overcome organizational stress by maintaining proper organizational culture and effective communication						

### UNIT-I

**Introduction to organizational behavior:** Concept and importance of organizational behavior, role of Managers in OB, foundations or approaches to organizational behavior, challenges and opportunities for OB.

**Foundation of individual behavior:** Biographical characteristics, concept of abilities and learning, learning and learning cycle, components of learning, concept of values and attitude, types of attitude, attitude and workforce diversity.

### UNIT-II

**Introduction to personality and emotions:** Definition and Meaning of Personality, Determinants of Personality, Personality Traits Influencing OB, Nature and Meaning of Emotions, Emotions dimensions, concept of Emotional intelligence.

**Perception and individual decision making:** meaning of perception, factors influencing perception, rational decision making process, concept of bounded rationality. Leadership-trait approaches, behavioural approaches, situational approaches, and emerging approaches to leadership.

### UNIT-III

**Motivation:** Concept and theories of motivation, theories of motivation-Maslow, two factor theory, theory X and Y, ERG Theory, McClelland's theory of needs, goal setting theory, application of theories in organizational scenario, linkage between MBO and goal setting theory, employee recognition and involvement program.

**Foundations of group behavior and conflict management:** Defining and classifying of groups, stages of group development, Informal and formal groups- group dynamics, managing conflict and negotiation, a contemporary perspective of intergroup conflict, causes of group conflicts, managing intergroup conflict through resolution.

### UNIT-IV

**Introduction to Organizational Communication:** Meaning and importance of communication process, importance of organizational communication, effective communication, organizational



stress: definition and meaning sources and types of stress, impact of stress on organizations, stress management techniques.

**Introduction to Organization Culture:** Meaning and nature of organization culture, types of culture, managing cultural diversity, managing change and innovation-change at work, resistance to change, a model for managing organizational change.

**Text Books:**

1. Colquitt, Jason A., Jeffery A. LePine, and Michael Wesson. *Organizational Behavior: Improving Performance and Commitment in the Workplace*. 5th ed. New York: McGraw-Hill Education, 2017.
2. Hitt, Michael A., C. Chet Miller, and Adrienne Colella. *Organizational Behavior*. 4<sup>th</sup> ed. Hoboken, NJ: John Wiley, 2015.
3. Robbins, Stephen P., and Timothy Judge. *Organizational Behavior*. 17th ed. Harlow, UK: Pearson Education, 2017. Stephen P. Robins, *Organisational Behavior*, PHI Learning / Pearson Education, 11th edition, 2008.

**Reference Books:**

1. Schermerhorn, Hunt and Osborn, *Organisational behavior*, John Wiley.
2. Udai Pareek, *Understanding Organisational Behaviour*, Oxford Higher Education.
3. Mc Shane & Von Glinov, *Organisational Behaviour*, Tata Mc Graw Hill.
4. Aswathappa, K., *Organisational Behaviour– Text and Problem*, Himalaya Publication.

**Note: The paper setter will set the paper as per the question paper template provided.**

B. Tech. (6 <sup>th</sup> Semester) Mechanical Engineering							
MANUFACTURING TECHNOLOGY							
MEC-302A	Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Time (Hrs)
	3	0	0	3	75	25	100
<b>Purpose:</b>	To build a foundation in different manufacturing processes related to castings, metal forming, joining, powder metallurgy and plastic material shaping processes.						
<b>Course Outcomes</b>							
<b>CO 1</b>	Students will be able to explain the fundamentals of casting processes and evaluate design parameters.						
<b>CO 2</b>	Students will be able to describe different metal forming processes and analysis.						
<b>CO 3</b>	Students will be able to explain different welding processes with their applications.						
<b>CO 4</b>	Students will be able to evaluate design parameters of powder metallurgy processes and explain different powder metallurgy and plastic shaping processes.						

### UNIT-I

**Fundamentals of castings:** Introduction to casting: basic requirements of casting processes, casting terminology, solidification process: cooling curves, prediction of solidification time, the cast structure, molten metal problems, fluidity and pouring temperature, role of gating system, solidification shrinkage, riser and riser design, risering aids, Patterns, design considerations in castings.

**Expandable-mold casting processes:** Sand casting, cores and core making, other expendable-mold processes with multiple use patterns, expendable-mold processes with multiple use patterns, shakeout, cleaning and finishing. **Multiple-use-mold casting processes:** Permanent mold casting, die casting, squeeze casting and semisolid metal casting, centrifugal casting, cleaning treating and heat treating of castings, automation in foundry operations.

### UNIT-II

**Metal forming processes:** classifications of metal forming processes, bulk deformation processes, material behavior in metal forming, temperature in metal forming, rolling: flat rolling and its analysis, shape rolling, rolling mills, forging: open-die forging, impression-die forging, flashless forging, forging hammers, presses, and dies, extrusion: types of extrusion, analysis of extrusion, extrusion dies and presses, defects in extruded products, wire and bar drawing, analysis of drawing, drawing practice, tube drawing

**Sheet metal working:** Cutting operations: shearing, blanking, and punching, engineering analysis of sheet-metal cutting, other sheet-metal-cutting operations, bending operations: v-bending and edge bending, engineering analysis of bending, drawing: mechanics of drawing, engineering analysis of drawing, defects in drawing.

### UNIT-III

**Joining processes:** Principles of fusion welding processes, arc welding processes-consumable electrodes: shielded metal arc welding, gas metal arc welding, flux-cored arc welding, submerged arc welding, Arc welding processes-non-consumable electrodes: gas tungsten arc welding, plasma arc welding, resistance welding processes, other fusion-welding processes: electron-beam welding, laser-beam welding, electro-slag welding, thermit welding.

**Principles of solid state welding processes:** friction welding, explosive welding, ultrasonic welding processes. **Brazing, soldering, and adhesive bonding:** Principles of adhesive, brazing and soldering processes, origins of welding defects.

### UNIT-IV

**Powder metallurgy:** Characterization of engineering powders: geometric features, other features production of metallic powders: atomization: other production methods, conventional pressing and sintering: blending and mixing of the powders, compaction, sintering, heat treatment and finishing, design considerations in powder metallurgy.

**Shaping processes for plastics:** Properties of polymer melts, extrusion, production of sheet and film, fiber and filament production (spinning), coating processes, injection molding, compression and transfer molding, blow molding and rotational molding, thermoforming.

**Text Books:**

1. Fundamentals of modern manufacturing: materials processing and systems by Mikell P. Grover, John Wiley and Sons.
2. Materials and processes in manufacturing by J.T. Black and R.A. Kohser, John Wiley and Sons.
3. Principles of Manufacturing Materials & Processes by Campbell J. S., Publisher – Mc Graw Hill.
4. Production Technology by R. K. Jain, Khanna Publishers
5. Manufacturing Technology-Foundry, Forming and Welding by P.N. Rao, Tata McGraw Hill
6. Advanced Manufacturing Process by Hofy, H.E., B and H Publication.
7. Manufacturing Science by Ghosh, A. and Mullik, A, East –West private Limited.

**Reference Books:**

1. Welding and Welding Technology by Richard L. Little Tata McGraw Hill Ltd.
2. Manufacturing Processes and Systems by Ostwald Phillip F., Munoz Jairo, John Wiley & Sons
3. Elements of Manufacturing Processes by B.S. Nagendra Parasher, RK Mittal, PHI N. Delhi

**Note: The paper setter will set the paper as per the question paper template provided.**

B. Tech. (6 <sup>th</sup> Semester) Mechanical Engineering							
MEC-304A	DESIGN OF MACHINE ELEMENTS						
Lecture	Tutorial	Practical	Credits	Major test	Minor Test	Total	Time (Hrs.)
2	4	0	6	75	25	100	4
<b>Purpose</b>	To understand the fundamentals for solving engineering problems relating to design of machine components.						
Course Outcomes							
<b>CO1</b>	Students will be able to explain the design procedures and methods, properties of engineering materials and their selection, design against static and fluctuating loads.						
<b>CO2</b>	Students will be able to solve the design problems of different types of joints i.e. bolted, riveted joint and welded joint and the problems related to the design of springs under different loading conditions.						
<b>CO3</b>	Students will be able to analyse the transmission shafts and keys.						
<b>CO4</b>	Students will be able to solve the design problems related to clutches and brakes and selection of bearings from manufacturer's catalogue.						

### UNIT-I

**Introduction:** Basic procedure of the design of machine elements, standards in machine design, selection of preferred sizes, engineering materials, properties and selection, BIS system of designation of steels.

**Design against static load:** Modes of failure, factor of safety, stress concentration: causes and mitigation.

**Design against fluctuating load:** Fluctuating stresses, endurance limit, low cycle and high cycle fatigue, notch sensitivity, endurance limit-approximate estimation, reversed stresses- design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman lines, Modified Goodman diagrams.

### UNIT-II

**Bolted, riveted and welded Joints:** Bolt of uniform strength, bolted joint- simple analysis, eccentrically loaded bolted joints, riveted joints for boiler shell according to I. B. R., riveted structural joint, eccentrically loaded riveted joint, types of welded joints, strength of welds under axial load, welds under eccentric loading.

**Springs:** Types of spring, helical spring terminology, design for helical springs, spring design-trial and error method, design against fluctuating load, surge in springs, design of leaf springs, rubber springs.

### UNIT-III

**Transmission shafts:** Shaft design on strength basis and torsional rigidity basis, ASME code for shaft design, design of hollow shaft on strength basis and torsional rigidity basis, **Keys:** types of keys, design of square and flat keys.

**Clutches:** Various types of clutches, design of friction clutches-single disc, multi-disc, cone and centrifugal clutches, torque transmitting capacity, friction materials, thermal considerations.

**Brakes:** Energy equations, block brake with short shoe, block brake with long shoe, internal expanding brake, band brakes, disc brakes, thermal considerations.

### UNIT-IV

**Rolling contact bearings:** Types of rolling contact bearing, selection of bearing-type, static and dynamic load carrying capacity, equivalent bearing load, load-life relationship, selection of bearings from manufacturer's catalogue, selection of taper roller bearing, design for cyclic loads and speeds, bearing failure-causes and analysis.

**Sliding contact bearings:** Basic modes of lubrication, Raimondi and Boyd method, bearing design-selection of parameters, bearing materials, bearings failure-causes and remedies.

**Text Books:**

1. Mechanical Engineering Design by Joseph E. Shigley and Charles R. Mischke, Tata McGraw Hill Book Co.
2. Design of Machine Element by V. B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.
3. Machine Design by R.S. Khurmi and J.K. Gupta, S. Chand.

**Reference Books:**

1. Machine Component Design by Robert C. Juvinall and Kurt M. Marshek, Wiley India Pvt. Ltd.
2. Mechanical Design of Machine Elements and Machines by Collins and Busby, Wiley India Pvt. Ltd.
3. Machine Design by U.C. Jindal, Pearsons publications.
4. Analysis and Design of Machine elements by V.K. Jadon and Suresh Verma, IK International Publishing House.

**Design Data Books:**

1. Design Data Book of Engineers, Compiled by Faculty of Mechanical Engineering, PSG College of Technology, Publisher Kalaikathir Achchagam, Coimbataore, 2009.
2. Design Data Handbook for Mechanical Engineers in SI and Metric Units by Mahadevan and Balaveera Reddy.

**Note: The paper setter will set the paper as per the question paper template provided.**

<b>B. Tech. (6<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-310 LA</b>	<b>PROJECT-II</b>							
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total Time</b>	<b>Time (Hrs.)</b>
<b>0</b>	<b>0</b>	<b>6</b>	<b>3</b>	<b>--</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>3</b>
<b>Purpose</b>	To implement the engineering principles and theories into innovative practical projects for solving real world problems.							
<b>Course Outcomes</b>								
<b>CO1</b>	Students will be able to apply the theoretical knowledge into practical/software projects.							
<b>CO2</b>	Students will be able to design new products using latest technologies.							

The project work could be done for the problem statement of an industry or practical project in the institute. The analysis based software projects undergone in the previous semester can be extended to its fabrication i.e. functional machine/product in this semester. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

**Note:** The maximum number of students in a group should not exceed four.

B. Tech. (6 <sup>th</sup> Semester) Mechanical Engineering							
MEP-302A	INTERNAL COMBUSTION ENGINES						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	1	0	4	75	25	100	3
<b>Purpose:</b>	To provide the detailed understanding of internal combustion engine, air compressors and gas turbines mainly based on its performance and emission parameters.						
<b>Course Outcomes</b>							
<b>CO1</b>	Student will be able to describe the basic concepts of Internal and External combustion engines and different air standard cycles.						
<b>CO2</b>	Students will be able to explain different types of injection systems, lubrication systems, carburetor; detonation, C.I. combustion chambers and their applications.						
<b>CO3</b>	Students will be able to determine the performance parameters of S.I. and C.I. engines.						
<b>CO4</b>	Students will be able to explain the basic concepts of reciprocating air compressors and gas turbine along with exhaust gas heat exchanger.						

#### UNIT-I

**Heat engines;** Internal and external combustion engines; Classification of I.C. Engines; Cycle of operations in four strokes and two-stroke IC engines; Wankle Engine.

**Air standard cycles:** Assumptions made in air standard cycles; Otto cycle; Diesel cycle; Dual combustion cycle; Comparison of Otto, diesel and dual combustion cycles; Sterling and Ericsson cycles; Air standard efficiency, Specific work output. Specific weight; Work ratio; Mean effective pressure; Deviation of actual engine cycle from ideal cycle.

#### UNIT-II

**Carburetor and Injection systems:** Mixture requirements for various operating conditions in S.I. Engines; Elementary carburetor, Calculation of fuel air ratio; The complete carburetor; Requirements of a diesel injection system; Type of injection system; Petrol injection; Requirements of ignition system; Types of ignition systems, ignition timing; Spark plugs.

**Engine parameters and knocking:** S.I. engines; Ignition limits; Stages of combustion in S. I. Engines; Ignition lag; Velocity of flame propagation; Detonation; Effects of engine variables on detonation; Theories of detonation; Octane rating of fuels; Pre-ignition; S.I. engine combustion chambers. Stages of combustion in C.I. Engines; Delay period; Variables affecting delay period; Knock in C.I. Engines; Cetane rating; C.I. Engine combustion chambers.

#### UNIT-III

**Lubrication and cooling systems:** Functions of a lubricating system, Types of lubrication system; Mist, Wet sump and dry sump systems; Properties of lubricating oil; SAE rating of lubricants; Engine performance and lubrication; Necessity of engine cooling; Disadvantages of overcooling; Cooling systems; Air-cooling, Water-cooling; Radiators.

**Heat balance and emission control:** Performance parameters; BHP, IHP, Mechanical efficiency; Brake mean effective pressure and indicative mean effective pressure, Torque, Volumetric efficiency; Specific fuel consumption (BSFC, ISFC); Thermal efficiency; Heat balance; Basic engine measurements; Fuel and air consumption, Brake power, Indicated power and friction power, Heat lost to coolant and exhaust gases; Performance curves; Pollutants from S.I. and C.I. Engines; Methods of emission control, Alternative fuels for I.C. Engines; The current scenario on the pollution front.

#### UNIT-IV

**Air compressor:** Working of a single stage reciprocating air compressor; Calculation of work input; Volumetric efficiency; Isothermal efficiency; Advantages of multi stage compression; Two stage compressor with inter-cooling; Perfect inter cooling; Optimum intercooler pressure; Rotary air compressors and their applications; Isentropic efficiency.

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**Gas turbine:** Brayton cycle; Components of a gas turbine plant; Open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; Multi stage compression with inter-cooling; Multi stage expansion with reheating between stages; Exhaust gas heat exchanger; Application of gas turbines.

**Text books:**

1. Internal Combustion Engine by V. Ganeshan Tata Mc-Graw Hill Publications.
2. Internal Combustion Engine by Mathur & Sharma, Dhanpat Rai Publications.
3. Internal Combustion Engine by Ramalingam Sci-tech publications.
4. Internal Combustion Engine Fundamentals by John B. Heywood, Tata Mc-Graw Hill Publications.

**Reference Books**

1. Heat Power Engineering by Dr. V.P. Vasandhani & Dr. D.S. Kumar
2. Fundamentals of Internal Combustion Engine by H. N. Gupta, PHI publications.

**Note: The paper setter will set the paper as per the question paper template provided.**



B. Tech (6 <sup>th</sup> Semester) Mechanical Engineering							
MEP-304A	GAS DYNAMICS AND JET PROPULSION						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	1	0	4	75	25	100	3
<b>Purpose:</b> To familiarize the students with the concept of compressible and incompressible flows and to understand the aircraft and rocket propulsion.							
<b>Course Outcomes</b>							
<b>CO 1</b>	Students will be able to explain the fundamentals of compressible flow, Mach number, types of waves and effect of Mach number on compressibility.						
<b>CO 2</b>	Students will be able to describe compressible flow with friction and its effect in flow through nozzles.						
<b>CO 3</b>	Students will be able to explain the concepts of normal shock, oblique shock, Rayleigh line and Rayleigh flow equation in compressible flows.						
<b>CO 4</b>	Students will be able to describe the aircraft propulsion systems and rocket propulsion with their applications, solid and liquid propellants.						

#### UNIT-I

**Compressible flow – fundamentals:** Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility

#### UNIT-II

**Flow through variable area ducts:** Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

#### UNIT-III

**Flow through constant area ducts:** Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.

**Normal and oblique shock:** Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock. Flow with Oblique Shock – Fundamental relations, Prandtl's equation, Variation of flow parameters.

#### UNIT-IV

**Propulsion:** Aircraft propulsion – types of jet engines – study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines. Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants.

#### **Text Books:**

1. Fundamental of compressible flow with Aircraft and Rocket propulsion by S.M., Yahya, New Age International (p) Ltd., New Delhi.
2. Compressible fluid flow by Patrich.H. Oosthvizen, William E.Carscallen, McGraw-Hill.
3. Gas turbine theory by Cohen.H., Rogers R.E.C and Sravanamutoo, Addison Wesley Ltd.

#### **Reference Books:**

1. Gas Turbines by V. Ganesan, Tata McGraw-Hill, New Delhi.
2. Gas Dynamics by E. Rathakrishnan, Prentice Hall of India, New Delhi.

<b>B. Tech (6<sup>th</sup> Semester) Mechanical Engineering</b>							
<b>MEP-306A</b>	<b>Design of Transmission Systems</b>						
<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Total</b>	<b>Time (Hrs.)</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>75</b>	<b>25</b>	<b>100</b>	<b>3</b>
<b>Purpose</b>	To understand the components of transmission systems and make the students capable of design the transmission system and its various elements.						
<b>Course Outcomes</b>							
<b>CO 1</b>	Students will be able to design and select belt drives, pulleys and the chain drives from manufacturer's catalogue.						
<b>CO2</b>	Students will be able to explain the mechanism of manual transmission, clutch synchronization and gear drives.						
<b>CO4</b>	Students will be able to apply the Lewi's and Buckingham's equations for the design of spur, helical and bevel gears.						
<b>CO5</b>	Students will be able to design worm gear based on strength rating, wear rating and thermal rating and to select belts and chain drives from manufacturer's catalogue.						
<b>CO6</b>	Students will be able to describe torque converters, perform torque formulation and evaluate torque capacity.						
<b>CO7</b>	Students will be able to design gear boxes, couplings and discuss their applications.						

### UNIT-I

**Flat belt drives and pulleys:** Introduction, Selection of flat belts from manufacturer's catalogue, Pulleys for flat belts. **V-Belts and pulley:** Selection of V-Belts and V-grooved pulley. **Chain Drives:** Roller chains, geometric relationships, polygonal effect, power rating, sprocket wheels, design of chain drives, chain lubrication.

**Manual transmissions:** Powertrain layout and manual transmission structure, power flows and gear ratios.

### UNIT-II

**Manual transmission clutches:** Clutch structure, clutch torque capacity, synchronizer and synchronization: shift without synchronizer, shift with synchronizer, equivalent mass moment of inertia, equation of motion during synchronization, condition for synchronization, shifting mechanisms.

**Gear drives:** Classification of gears, selection of type of gears, law of gearing, standard systems of gear tooth, interference and undercutting, backlash.

**Design of spur gears:** geometry and nomenclature, force analysis, material selection, beam strength of gear tooth, effective load on gear tooth, module estimation based on beam strength, wear strength of gear tooth, module estimation based on wear strength, spur gear design procedure.

**Design of helical gears:** geometry and nomenclature, force analysis, beam strength of helical gears, effective load on gear tooth, wear strength of helical gears, design procedure.

### UNIT-III

**Design of bevel gears:** Geometry and nomenclature, force analysis, beam strength of bevel gears, effective load on gear tooth, wear strength of bevel gears, design procedure. **Design of worm gears:** Terminology, force analysis, friction in worm gears, material selection, strength rating and wear rating, thermal considerations and design procedure.

**Torque converters:** Torque converter structure and functions: torque multiplication and fluid coupling, torque converter locking up, automatic transmission fluid (ATF) circulation and torque formulation, torque capacity and input–output characteristics.

#### UNIT-IV

**Design of speed reducers (gear boxes):** Geometric progression, standard step ratio, ray diagram, kinematics layout, design of sliding mesh gear box, design of multi speed gear box for machine tool applications, constant mesh gear box, speed reducer unit, variable speed gear box.

**Design of couplings:** Design of muff coupling, clamp coupling, rigid flange couplings and bushed-pin flexible couplings.

**Text Books:**

1. Mechanical Engineering Design, Joseph E. Shigley and Charles R. Mischke, Tata McGraw Hill Book Co.
2. Automotive Power Transmission Systems, Yi Zhang and Chris Mi, Wiley Publications.
3. Design of Machine Element, V. B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.
4. Machine Design, R.S. Khurmi and J.K. Gupta, S. Chand.

**Reference Books:**

1. Machine Component Design, Robert C. Juvinall and Kurt M. Marshek, Wiley India Pvt. Ltd.
2. Mechanical Design of Machine Elements and Machines, Collins and Busby, Wiley India Pvt. Ltd.
3. Machine Design, U.C. Jindal, Pearsons publications.
4. Design of Transmission Systems, E.V.V. Ramamurthy and S. Ramachandaran, Air Walk Publications.
5. Handbook of Gear Design and Manufacture, S. P. Radzevich, CRC Press, T&F.

**Design Data Books:**

1. Design Data Book of Engineers, Compiled by Faculty of Mechanical Engineering, PSG College of Technology, Publisher Kalaikathir Achchagam, Coimbatore, 2009.
2. Design Data Handbook for Mechanical Engineers in SI and Metric Units, 4<sup>th</sup> Ed, Mahadevan and Balaveera Reddy.
3. Machine design data book, V.B. Bhandari, Mc Graw Hill Edu. Pvt. Ltd.

**Note: The paper setter will set the paper as per the question paper template provided.**

B. Tech (6th Semester) Mechanical Engineering							
MEP-308A	Composite Materials						
L	T	P	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	1	0	4	75	25	100	3
<b>Purpose</b>	To acquaint the student with the knowledge of different composite materials manufacturing techniques and familiarization with the basic expressions and methods used in the mechanics of composite structures, characterization techniques and understanding of practical implementation.						
Course Outcomes							
<b>CO 1</b>	Students will be able to explain different reinforcement and matrix materials with their practical applications.						
<b>CO 2</b>	Students will be able to differentiate between various composite fabrication techniques and analyse the behaviour of unidirectional composites at micro and macro level.						
<b>CO 3</b>	Students will be able to determine the stresses and strains in the short fiber reinforced composites and laminated composites.						
<b>CO 4</b>	Students will be able to describe different experimental techniques for physical and mechanical characterization and different non-destructive techniques.						

### Unit- I

**Introduction:** Definitions, characteristics, classification, particulate composites, fiber-reinforced composites, applications of fiber composites, Advance fibers: glass fibers, carbon and graphite fibers, aramid fibers, boron fibers, other fibers, matrix materials.

**Emerging composite materials:** Nanocomposites, carbon-carbon composites, bio-composites, composites in “smart” structures.

### Unit- II

**Fabrication of composites:** Fabrication of thermosetting resin Matrix composites: Hand lay-up technique, bag molding processes, resin transfer molding, filament winding, pultrusion; Fabrication of thermoplastic-resin matrix composites (Short-fiber composites), Fabrication of Metal matrix and ceramic matrix composites.

**Behavior of unidirectional composites:** Nomenclature, volume and void fraction, longitudinal behavior of unidirectional composites, transverse stiffness and strength, failure modes, expansion co-efficient and transport properties.

### Unit-III

**Short-fiber composites:** Introduction, theories of stress transfer: approximate analysis of stress transfer, stress distribution from finite-element analysis, average fiber stress. Modulus and strength of short-fiber composites: prediction of modulus, prediction of strength, effect of matrix ductility.

**Analysis of laminated composites:** Introduction, laminate strains, variation of stresses in laminates, resultant forces and moments, laminate description system, determination of laminate stresses and strains, analysis of laminates after initial failure, performance of fiber composites: fatigue and impact effects.

### Unit-IV

**Experimental characterization of composites:** Introduction, measurement of physical properties: density, constituent weight and volume fractions, void volume fraction, thermal expansion coefficient, moisture absorption and diffusivity and moisture expansion co-efficient, measurement of mechanical properties: properties in tension, compression, in-place shear properties.

**Damage identification using non-destructive evaluation techniques:-** Ultrasonic, X-Radiography, Laser Shearography, Thermography.

**Text Books:**

1. Analysis and performance of Fiber Composites by Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, Wiley India Pvt. Ltd., India.
2. Fiber Reinforced Composites: Materials Manufacturing and Design by P.K. Mallick, 3<sup>rd</sup> Edition, CRC Press.
3. Mechanics of Composite Materials by Autar K. Kaw, 2nd Edition, CRC Taylor and Francis Group.
4. Composite Materials, Design and Applications by Daniel Gay, Suong V. Hoa, 2<sup>nd</sup> Edition, CRC Taylor and Francis Group.

**Reference Books:**

1. Mechanics of Composite Materials by R. M. Jones, CRC Press.
2. Fibrous Materials by K. K. Chawla, Cambridge University Press.

**Note: The paper setter will set the paper as per the question paper template provided.**



B. Tech. (6 <sup>th</sup> Semester) Mechanical Engineering							
MEP-310A REFRIGERATION AND AIR CONDITIONING							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	1	0	4	75	25	100	3
<b>Purpose</b>	The objective of this course is to make the students aware of refrigeration, Air-conditioning, various methods of refrigeration. The course will help the students to build the fundamental concepts in order to solve engineering problems and to design HVAC applications.						
<b>Course Outcomes</b>							
<b>CO 1</b>	Students will be able to explain different refrigeration processes like ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, steam jet refrigeration systems etc.						
<b>CO 2</b>	Students will be able to identify, formulate and solve air refrigeration, vapour refrigeration and vapour absorption refrigeration problems.						
<b>CO 3</b>	Students will be able to identify different refrigerants and discuss their uses.						
<b>CO 4</b>	Students will be able to describe psychrometric properties, psychrometric chart and its use for different cooling and heating processes along with humidification and dehumidification.						
<b>CO 5</b>	Students will be able to design various air-conditioning systems by including the internal and external heat gain.						

## REFRIGERATION

### UNIT-I

**Introduction:** Basics of heat pump & refrigerator, Carnot refrigeration and heat pump, units of refrigeration, COP of refrigerator and heat pump, Carnot COP, Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, vapour refrigeration system, steam jet refrigeration, thermo- electric cooling, adiabatic demagnetization.

**Air refrigeration:** Basic principle of operation of air refrigeration system, Bell Coleman air refrigerator, advantages of using air refrigeration in air craft, disadvantage of air refrigeration in comparison to other cold producing methods, simple air refrigeration in air craft, simple evaporative type, air refrigeration in air craft, necessity of cooling the aircraft.

### UNIT-II

**Simple vapour compression refrigeration system:** Simple vapour compression refrigeration system, different compression processes (wet, dry and saturated Compression, superheated compression), Limitations of vapour compression refrigeration system if used on reverse Carnot cycle, representation of theoretical and actual cycle on T-S and P-H charts, effects of operating conditions on the performance of the system, advantages of vapour compression system over air refrigeration system.

**Advanced vapour compression refrigeration system:** Methods of improving COP, flash chamber, flash inter cooler, optimum inter stage pressure for two stage refrigeration system, single expansion and multi expansion cases, basic introduction of single load and multi load systems, cascade systems.

**Vapour absorption refrigeration system and special topics:** Basic absorption system, COP and maximum COP of the absorption system. Actual NH<sub>3</sub> absorption system, function of various components, Li-Br absorption system, Selection of refrigerant and absorbent pair in vapour absorption system, Electro-Lux refrigerator, comparison of compression and absorption refrigeration system, Nomenclature of refrigerants, desirable properties of refrigerants, cold storage and Ice Plants.

## AIR-CONDITIONING

### UNIT-III

**Introduction:** Difference between refrigeration and Air-conditioning, Psychrometric properties of moist air (wet bulb, dry bulb, dew point temperature, relative and specific humidity, temperature of adiabatic saturation), empirical relation to calculate  $P_v$  of moist air.

**Psychrometry:** Psychrometric chart, construction and use, mixing of two air streams, sensible heating and cooling, latent heating and cooling, humidification and dehumidification, cooling with dehumidification, cooling with adiabatic humidification, heating and humidification, By- pass factor of coil, sensible heat factor, ADP of cooling coil, Air washer.

### UNIT-IV

**Air-conditioning Systems:** Classification, factors affecting air-conditioning systems, comfort air-conditioning system, winter air-conditioning system, summer air-conditioning system, year round air-conditioning system, unitary air-conditioning system, central air-conditioning system, Room sensible heat factor, Grand sensible heat factor, effective room sensible heat factor.

**Cooling Load calculation:** Inside design conditions, comfort conditions, components of cooling load, internal heat gains (occupancy, lighting, appliances, product and processes), system heat gain (supply air duct, A.C. fan, return air duct), External heat gain (heat gain through building, solar heat gain through outside walls and roofs), sol-air temperature, solar heat gain through glass windows, heat gain due to ventilation and infiltration.

**Industrial and Commercial Application:** Transport air conditioning, evaporative condensers, cooling towers, heat pumps.

#### Text Books:

1. Refrigeration and Air-conditioning by C.P. Arora, Tata McGraw-Hill
2. Basic Refrigeration and Air-conditioning by Ananthana and Rayanan, McGraw-Hill

#### Reference Books:

1. Refrigeration and Air Conditioning by Arora and Domkundwar, Dhanpat Rai.
2. Refrigeration and air-conditioning by R.C.Arora, PHI

**Note:** The paper setter will set the paper as per the question paper template provided.

<b>B. Tech (6th Semester) Mechanical Engineering</b>							
<b>MEP-312A</b>	<b>PRODUCT ENGINEERING</b>						
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credit</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Total</b>	<b>Time</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>75</b>	<b>25</b>	<b>100</b>	<b>3</b>
<b>Purpose</b>	To acquaint the students with the knowledge of engineering techniques used to produce an engineering product.						
<b>Course Outcomes</b>							
<b>CO1</b>	Students will be able to explain different work, method and time study techniques.						
<b>CO2</b>	Students will be able to appraise the inventory control and solve the problems related to queuing theory.						
<b>CO3</b>	Students will be able to describe sales forecasting methods and explain the network analysis representations.						
<b>CO4</b>	Students will be able to explain the concept of value engineering and different modern approaches of product design.						

### **Unit-I**

**Introduction to Work Study:** Work study, human considerations in work study, relationship of work-study person with management, relationship of work-study person and supervisor, Method Study: procedure of method study, Therbligs, Motion study, cycle graph and chronocycle graph: equipment used, procedure and uses, principles of motion economy, Work measurement: definitions and objectives, time-study procedures, work-measurement techniques, job selection for work measurement, equipment's and forms used for time study, performance rating, determination of normal time and standard time allowances, pre-determined motion time systems.

**Ergonomics:** Human being as applicator of forces, Anthropometry, the design of controls, the design of displays, Man/Machine information exchange, Workplace layout from ergonomic considerations.

### **Unit-II**

**Inventory Control:** Functions of inventory; Types of inventory; Control importance functions, Inventory costs, factors affecting inventory control, various inventory controls models; A.B.C. analysis, lead-time calculations.

**Queuing Theory:** Introduction, applications of Queuing theory, waiting time and idle time cost, Single channel queuing theory and multi-channel queuing theory with Poisson arrivals and exponential services, numerical on single channel and multi channels theory.

### **Unit-III**

**Sales Forecasting:** Introduction, objectives and importance of sales forecasting, Types of forecasting, Methods of sales forecasting, Collective opinion method, Delphi technique, economic indicator method; Regression analysis.

**Network Analysis:** Phases of project management, network representation, techniques for drawing network, numbering of events (Fulkersen rule), PERT calculations, Critical path method (CPM): Forward pass computation, backward pass computation, computation of float and slack time, critical path, time cost optimization algorithm, updating a project, resource allocation and scheduling, Management operation system technique (MOST).



### **Unit-IV**

**Value Engineering:** Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation check list, Cost reduction through value engineering-case study, materials and process selection in value engineering.

**Modern Approaches:** Concurrent engineering, Quality function deployment (QFD), Reverse engineering, 3D printing.

**Text Books:**

1. Work study and Ergonomics by Prof. P.C. Tewari, Ane Books Pvt. Ltd., New Delhi-110002.
2. Operations Research by A. M., Natarajan and P. Balasubramanie, Pearson Education India.
3. Industrial Engineering and Production Management by TelSang Martand, S. Chand and company Ltd.

**Reference Books:**

1. Operation Research by Prem Kumar Gupta and D.S. Heera, S. Chand Publications.
2. Motion and time study: Improving Productivity by Marvin E, Mundel and David L, Pearson Education.
3. Work study and Ergonomics by S. K. Sharma and Savita Sharma, S. K. Kataria and Sons, Delhi.
4. Product design and engineering by A. K. Chitale and Gupta, PHI

**Note: The paper setter will set the paper as per the question paper template provided.**

<b>B. Tech. (6<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-306 LA</b>	<b>MECHANICAL ENGINEERING LAB-I</b>							
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total Time</b>	<b>Time (Hrs.)</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Purpose:</b>	To provide practical knowledge in the concerned subject that a student opt from the program electives offered in the curriculum.							

**INTERNAL COMBUSTION ENGINES PRACTICALS:****COURSE OUTCOMES:**

- CO 1:** Students will be able to explain the principles, construction and working of S.I. and C.I. engines.
- CO 2:** Students will be experiment on fuel injection systems, lubrication and cooling systems.
- CO 3:** Students will also be able to evaluate the performance parameters of reciprocating air compressor, petrol and diesel engines.

**LIST OF EXPERIMENTS**

- To make a trial on single cylinder 4-stroke Diesel Engine to calculate B. H. P., S.F.C. and to draw its characteristics curves.
- To make a trial on 4-stroke high-speed diesel engine and to draw its Heat Balance Sheet.
- To make a trial on Wiley's jeep Engine at constant speed to calculate B. H. P., S. F. C. Thermal efficiency and to draw its characteristic Curves.
- To make Morse Test to calculate IHP of the multi cylinder petrol engine and to determine its mechanical efficiency.
- To calculate the isothermal efficiency and volumetric efficiency of a 2 stage reciprocating air compressor.
- To find out the efficiency of an air Blower.
- To make a trial on the Boiler to calculate equivalent evaporation and efficiency of the boiler.
- To study the following models;  
(a) Gas Turbine (b) Wankle Engine.
- To study  
(a) Lubrication and cooling systems employed in various I. C. Engines in the Lab  
(b) Braking system of automobile in the lab
- To study a Carburetor.
- To study (I) the Fuel Injection System of a C. I. Engine. (II) Battery Ignition system of a S.I. Engine
- To study Cooling Tower.
- To make a trial with multi-cylinder four stroke vertical Diesel Engine test Rig with Hydraulic Dynamometer.

## **DESIGN OF TRANSMISSION SYSTEMS PRACTICALS:**

### **COURSE OUTCOMES:**

- CO 1:** Students will be able to analyse and simulate transmission elements using different modules of SOLIDWORKS/ANSYS.
- CO 2:** Students will be able to apply the design principles and concepts in designing and simulation of various transmission elements of an automobile under different operating conditions.
- CO 3:** The students will be able to construct and work with different transmission components used in automobiles.

### **LIST OF EXPERIMENTS**

1. To model and simulate the V-belt drive/belt conveyor.
2. To simulate and analyze the rack and pinion arrangement under different loading conditions.
3. Static structural analysis of different gears.
4. Transient and explicit analysis on transmission system gears.
5. To simulate and analyze rigid flange coupling and bushed-pin flexible coupling.
6. To simulate and analyze the camshaft.
7. Static structure and fatigue analysis of crank shaft.
8. To study the construction details, working principles and operations of different types of automotive clutches.
9. To study the direct-shift continuous variable transmission (CVT) system.
10. To study the constructional details, working principles and operations of different types of automotive brakes.

## **GAS DYNAMICS AND JET PROPULSION PRACTICALS**

### **COURSE OUTCOMES:**

- CO 1:** Students will be able to simulate and analyse the flow through the nozzle and an airfoil.
- CO 2:** Students will be able to simulate the vortex shedding phenomenon.
- CO 3:** Students will be able to develop and validate the computer program for Couette flow.
- CO 4:** Students will be able to develop the computer based program of fully developed laminar flow in a pipe.

### **LIST OF EXPERIMENTS**

1. To simulate and analyze the compressible flow through a nozzle.
2. To simulate and analyze the transonic flow over an airfoil.
3. To simulate vortex shedding phenomenon over a cylinder in laminar flow.
4. To make and validate a computer program for the Couette flow.
5. To make and validate a computer program for the fully developed laminar flow in circular pipe.
6. To simulate and analyze the laminar flow pipe.

**Note:** At least six experiments are required to be performed by students from the above list and remaining four may be performed from the experiments developed by the institute.

<b>B. Tech. (6<sup>th</sup> Semester) Mechanical Engineering</b>								
<b>MEC-308 LA</b>	<b>MECHANICAL ENGINEERING LAB-II</b>							
<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	<b>Credits</b>	<b>Major Test</b>	<b>Minor Test</b>	<b>Practical</b>	<b>Total Time</b>	<b>Time (Hrs.)</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>40</b>	<b>60</b>	<b>100</b>	<b>3</b>
<b>Purpose:</b>	To provide practical knowledge in the concerned subject that a student opt from the program electives offered in the curriculum.							

### **COMPOSITE MATERIALS PRACTICALS**

#### **COURSE OUTCOMES:**

**CO 1:** Students will be able to develop composites such as polymer matrix composites, MMC etc. using different types of composites development techniques.

**CO 2:** Students will be capable of analysing the physical, mechanical and tribological behavior of the developed composites.

#### **LIST OF EXPERIMENTS**

1. To study the hot compression molding technique for the preparation of thermosetting-resin matrix composites.
2. To develop the advanced fiber reinforced polymer composites and characterize for their physical properties (density, constituent weight and volume fractions, void volume fraction, thermal expansion coefficients, moisture absorption and diffusivity, moisture expansion coefficients).
3. To find the hardness and tensile and flexural properties of the advanced fiber reinforced polymer composites.
4. To develop the particle reinforced polymer composites and characterize for their physical properties (density, constituent weight and volume fractions, void volume fraction, thermal expansion coefficients, moisture absorption and diffusivity, moisture expansion coefficients).
5. To develop the Al metal-matrix composites using friction stir casting and characterize for various mechanical properties.
6. To find the friction and wear properties of Al metal matrix composites using pin-on-disc apparatus.
7. To find the hardness and tensile and flexural properties of the particle reinforced polymer composites.
8. To find the friction and wear properties of fiber reinforced/particle reinforced polymer composites using pin-on-disc apparatus.

### **REFRIGERATION AND AIR CONDITIONING PRACTICALS**

#### **COURSE OUTCOMES:**

**CO 1:** Students will be able to evaluate the performance of water cooler, Ice plant, cooling towers and Cascade refrigeration system.

**CO 2:** Students will be able to analyse different cycles of operation in air-conditioning.

**CO 3:** Students will be able to measure humidity in air-conditioning systems.

**CO 4:** Students will be able to operate various control devices in refrigeration and air-conditioning systems.

### **LIST OF EXPERIMENTS**

1. To study and perform experiment on basic vapour compression Refrigeration Cycle.
2. To study and perform experiment on Solar Air-conditioner based on vapour absorption cycle.
3. To find C.O.P. of water cooler.
4. To study and perform experiments on compound compression and multi-load systems.
5. To study and perform experiment on vapour absorption apparatus.
6. Perform the experiment & calculate various performance parameters on a blower apparatus.
7. To find the performance parameter of cooling tower.
8. To study various components in room air conditioner.
9. To find RH of atmospheric air by using Sling Psychrometer.
10. To find performance of a refrigeration test rig system by using different expansion devices.
11. To study different control devices of a refrigeration system.
12. To find the performance parameters of Ice Plant.
13. To study and perform experiment on Cascade system.

### **PRODUCT ENGINEERING PRACTICALS**

#### **COURSE OUTCOMES:**

**CO 1:** Students will be able to analyze P-Chart and C-Chart.

**CO 2:** Students will be able to analyze normal distribution and universal distribution.

**CO 3:** Students will be able to interpret the two handed process chart and Multi activity chart (Man- Machine Chart).

**CO 4:** Students will be able to interpret the concept of R Charts and Process capability.

### **LIST OF EXPERIMENTS**

1. To draw left and right hand process charts and to conduct time study for the bolt, washer & nut assembly of present and improved methods.
2. To show that sample means for a normal universe follow a normal distribution.
3. To learn performance rating through observation of the activity of dealing pack of 52 playing cards.
4. To study the changes in heart beat rate for different subjects using Treadmill.
5. To plot the operating charters tic curve for a single sampling attributes plan of a given lot of plastic balls and to compare the actual O.C curve with theoretical O.C curve.
6. To study the changes in heart beat rate for different subjects using Ergocycle.
7. To draw P-Chart for fraction defective and to check the control of the process for a given set of plastic balls.
8. To draw a C- chart for a given set of metal discs and to check the control of the process by taking each disk with 10 holes of each 6 mm size as one unit.
9. To show that the sample means from a rectangular universe follow a normal distribution.
10. To draw multiple activity chart or man-machine chart for the subject of toasting 3 slices of bread in one electric double compartment toaster.
11. To draw and R charts and to determine the process capability from the measurement of large diameter of a given set of stepped pins.
12. Measure the skill and dexterity in the moment of wrist and fingers using pin board.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.