

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
 (A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
 Department of Mechanical Engineering

For batches admitted in Academic Session 2020-21

Engineering Graphics

Category	Title	Code	Credit-3			Theory Slot
			L	T	P	
Engineering Science-ESC	Engineering Graphics	100014/100105/CEL/MEL/CSL/ EEL/ELL/ITL/CHL/ BTL105/1X25/BEEL/BELL/ BETL/BCHL/BAUL105/ BCEL/BMEL/BCSL/ BITL/BBTL204	1	2	-	Max.Marks-60 Min.Marks-19 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. Visualize the geometric details of engineering objects.	Skill Development
CO2. Translate the geometric information of engineering objects into engineering drawings.	Skill Development
CO3. Draw orthographic projections and sections.	Skill Development
CO4. Develop knowledge to read, understand and explain drawing.	Skill Development
CO5. Improve their skills so that they can apply these skills in developing new products	Skill Development
CO6. Prepare simple layout of factory, machine and buildings.	Skill Development

Course Objective:

- To inculcate the imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.
- To impart knowledge about principles/methods related to projections of one,two and three dimensional objects.

Syllabus:

Unit - 1

Introduction and scale: Basics of instruments, Lettering and dimensioning, Plane geometrical constructions. **Plain and diagonal scale** - Representative fraction, Unit conversion and Exercises based on linear, area, volume and speed. Scale of chord.

Engineering curves: Cycloidal curves - cycloid, epicycloid and hypocycloid curve, tangent and normal. Spiral curves - Archimedean and logarithmic spiral curves. Tangent & normal on the curves. Involute curve.

Unit - 2

Projection of points: Introduction, types of projections, quadrant system, positions of points and Exercise.

Projection of straight line: Introduction, Orientation of a straight line, Traces of a line and Exercise.

Unit - 3

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Projection of planes: Introduction, Types of planes, Traces of planes, Position of planes and Exercise.

Projection of solids: Introduction, Types of solids, Positions of solids and Exercise.

Unit - 4

Section of solids: introduction, Types of section planes and Anti-section and Exercise.

Development of surfaces of right solids: Introduction, Methods of development & anti-development and Exercise.

Intersection of cylinders: Introduction, methods of developments, intersection of cylinder by another cylinder and exercise.

Unit - 5

Isometric projections: Introduction, isometric scale, isometric axis, isometric view and isometric projections from orthographic views, orthographic views from pictorial view and exercise.

Computer Aided Drafting using Auto CAD: Introduction, software's basic commands, transformation and editing commands.

Text books:

1. Engineering Drawing by N. D. Bhatt, Charotar Publication Pvt. Ltd.
2. Engineering Drawing by P.S. Gill, S. K. kataria& sons, Delhi
3. Engineering Drawing by BasantAgrawal& C. M. Agrawal, Tata McGraw Hill Education Pvt. Ltd.
4. Engineering Graphics by K. Venugopal, New Age International Publication, India

NPTEL Link for Engineering Graphics:

<http://nptel.ac.in/courses/112103019/>

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Manufacturing Processes

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Manufacturing Processes	120311/190414/ 120403/190404	2	1	-	Max.Marks-50 Min.Marks-16 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1- Describe the different types of manufacturing processes and their applications.	Skill Development
CO2- Identify suitable manufacturing process to achieve the required product shape with the aim of avoid defects, material and time wastage.	Skill Development
CO3-Illustrate the advantage and limitations of various manufacturing processes with regard to shape formation and surface quality.	Skill Development
CO4-Analyse the manufacturing processes for given problem and able to select an appropriate process according to a specific requirement.	Skill Development
CO5-Evaluate the procedures and techniques involved for the manufacturing of components for its optimization.	Skill Development
CO6-Propose a simplified manufacturing processes with the aim of reduction of cost and manpower.	Skill Development

Course Objectives: To make students:

1. Able to learn the various methods and types of castings, welding processes, sheet metal forming, powder metallurgy
2. Able to examine the principles associated with basic operations involving the forming, machining and welding of engineering materials;
3. Aware of the necessity to manage manufacturing processes and systems for the best use of material and human resources.

Course Pre-Requisites: Manufacturing Practice

Syllabus

Unit-I Casting: Brief History, Basic principle & survey of casting processes. Sand casting, pattern materials, and allowances. Green and dry moulding, moulding methods, moulding sand properties and testing. Elements of mould and design considerations. Cores use, core materials and core making practice. Die, investment and centrifugal casting processes. **Melting practice and concepts in solidification. Inspection and defects analysis.**

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Unit-II Forming: Elastic and plastic deformation, Concept of strain hardening. Rolling, forging, extrusion, spinning, wire and tube drawing processes, machines and equipment's, parameters and force calculations.

Unit-III Sheet Metal Working: Role of sheet metal components. Cutting mechanism. Description of cutting processes like blanking. Piercing, lancing etc. Description of forming processes like bending cup drawing, coining, embossing etc. Basic elements of presses for sheet metal working. Punch and Die clearances and die elements.

Unit-IV Welding: Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables. MMAW, TIG & MIG processes and their parameter selection. Resistance Welding: principle and equipment. Spot, projection and Seam welding processes, Gas welding and cutting: Processes and equipment.

Unit-V Powder Metallurgy: Powder manufacturing, compaction and sintering processes. Advantages and applications of P/M. Manufacturing of Powder metallurgy components.

Text & Reference Books

1. Jain R.K., Production Technology, Khanna Publishers, 2001.
2. Hajra Choudhry, Elements of Workshop Technology, Vol – II Media Promoters & Publishers, 1994.
3. Production Technology by HMT, Tata McGraw-Hill.
4. Chapman, W.A.J., Workshop Technology, Vol - II, Oxford & IBH Publishing Co. Ltd.,
5. Manufacturing Processes by Amstead, B.H., P.F. Oswald and M.L. Begeman, John Wiley and Sons Inc., New York.
6. Manufacturing Technology Vol. 1 by P.N. Rao.
7. Modern Manufacturing Process Engineering by Neibel, B.W., Alan B. Draper and R.A. Wysk, McGraw-Hill Publishing Co., New York.
8. Manufacturing Engineering and Technology by Kalpakjian, S, Addison-Wesley Publishing Co., New York.
9. Materials and Processes in Manufacturing by E. Paul DeGarmo, J. Temple Black, and Ronald Kohser, Macmillan Publishing Co., New York.
10. Introduction to Manufacturing Processes John A. Schey, McGraw-Hill Book Co., New York.

NPTEL Link for Manufacturing Process

<http://nptel.ac.in/courses/112107145/>

List of Experiment

1. Performance on mold making of Simple component
2. Performance on pattern making of Simple component
3. Performance on Metal Casting of Simple component
4. Performance on Welding of simple workpiece (Example Arc Welding)
5. Performance on Sheet metal work of Simple component
6. Performance on hot forging of Simple component

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Mechanics of Materials

Category	Title	Code	Credit-3			Theory Paper
Departmental Core-DC	Mechanics of Materials	120312/190312/ 120302/190302/ BMEL-302/ MEL-305/3225	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	-	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1- Identify various structural elements and its application.	Skill Development
CO2- Illustrate different types of stress and strain on various types of structural elements like beam, shaft column etc.	Skill Development
CO3- Calculate principal stresses, maximum shearing stress, and the different stresses acting on a structural member.	Skill Development
CO4- Analyze stresses and deflection for beam, shaft, long columns, thin cylinder etc.	Skill Development
CO5- Select appropriate materials in design considering engineering properties, sustainability, cost and weight.	Skill Development
CO6- Design simple bars, beams, and circular shafts to meet desired needs in terms of strength and deformation.	Skill Development

Course Pre-Requisites:

Basic Civil Engineering and Mechanics

Course Objectives: To make the students:

1. Learn the basic concepts and principles of strength of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Apply the knowledge of strength of materials on engineering applications and design problems.

Syllabus

Unit- I Stress and strain: Stress-strain relationship and elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain, compound and combined stresses, thermal stresses.

Unit-II Stresses in beams: Shear Force & Bending Moment diagram, theory of simple bending, Section Modulus, bending Stresses and Shear stresses in beam.

Slope and deflection: Equation of Elastic Curve, Macaulay's Method, Area Moment Method, Strain Energy Methods etc.

Unit- III Shear stress distribution: Horizontal, Vertical, Transverse, Longitudinal Shear Stress, Graphical Methods for Different Sections.

Shafts: Torsion of circular shaft, stress concentration in shafts; series and parallel combination.

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Unit -IV Column and Struts: Euler's theory of column, Rankine's formula, slenderness ratio; strut with eccentric load.

Thin cylinder: Stress and Strain in thin cylinder, wire wound thin cylinder; thin spherical shells.

Unit- V Materials testing: Tensile, compressive, hardness, impact and torsion testing. Strain Gauges - types of strain gauges, electrical strain gauges, Gauge factor, strain rosette.

Strain Energy: Strain energy due to direct stress, simple shear, torsion, bending, shear force in beams.

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

Text & Reference Books

1. Strength of Materials (MoM) by R S Lehari and A S Lehari; S K Katariya and Sons Pub.
2. Strength of Materials by S S Rattan; McGraw Hill Pub.
3. Mechanics of Materials by F P Beer, E R Johnston, J T DeWolf; TATA McGraw Hill Pub.
4. Strength of Materials by S. Timoshenko; D Van Nostrand Compnay,
5. Mechanics of Solids by Mubeen; Pearson Education Pub
6. Strength of Materials by S Ramamrurtham, R Narayan; DhanpatRai sons Pub.
7. Strength of Materials by Sadhu Singh; Khanna Publisher Pub.
8. Mechanics of Materials by AdarashSwaroop, New Age international Pub.

NPTEL Link for Mechanics of Material

https://onlinecourses.nptel.ac.in/noc18_ce04/preview

LIST OF EXPERIMENTS

1. To Study Universal Testing Machine
2. To perform the Tensile test on metal specimen
3. To perform the Compression test on metal specimen
4. To perform Bending test on metal specimen
5. To perform single shear and double shear on UTM
6. To perform Hardness testing with Brinell hardness
7. To perform Hardness testing with Rockwell hardness
8. To study the impact testing machine and perform the IZOD impact test
9. To Perform Charpy impact test
10. To study and Perform Fatigue test
11. To study Bending Moment Diagram
12. To Study stiffness of spring and Modulus of rigidity of spring wire
13. Study of weight measurement using strain gauge

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Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-I	120313/ 120303/ 190411/190401	2	1	2	Max.Marks-50 Min.Marks-16 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1- Identify basic mechanisms in real life applications	Skill Development
CO2- Discuss about mechanics of various machines.	Skill Development
CO3- Apply fundamental principles of statics and dynamics to machinery.	Skill Development
CO4- Analyze various types of motions and mechanisms of machinery	Skill Development
CO5- Compare various components suitable for different applications.e.g. different types of governor, clutch, brakes, flywheel etc.	Skill Development
CO6- Create the mechanism or components to justify the demands of work.	Skill Development

Course Pre-Requisite:

Engineering Graphics
 Mechanics of Materials

Course objectives: To make the students:

1. Familiarize with different types of mechanisms.
2. Understand the basics of synthesis of simple mechanisms.
3. Apply fundamental of mechanics to machines which include engines, linkages etc.

Syllabus

Unit-I Mechanism: Machine, Mechanism, Kinematics Links, Pairs, Chains, Degree of freedom. Mechanisms and its Inversions; Slider, Double Slider and 4 bar mechanism. Lower pair mechanisms: pantograph, Straight line motions. Davis and Ackerman Steering Mechanisms.

Unit-II Kinematic Analysis: Displacement, velocity and acceleration analysis of plane mechanisms; relative velocity, instantaneous centre, Kennedy's Theorem, Klein's construction methods. Coriolis component.

Unit-III Dynamic Analysis: D'Alembert's principle. Equivalent dynamic system, Graphical and analytical methods of dynamic forces, analysis of mechanisms and machines including reciprocating engines.

Flywheel: Introduction, Turning-moment diagrams and Flywheel analysis.

Unit-IV Brakes: Analysis of simple brake assuming uniform pressures and uniform wear, band brake, block brakes, internal and external shoe brakes, braking of vehicles.

Clutches: Single plate and multi plate clutches, cone clutches, centrifugal clutches.

Dynamometers: Different types and their applications.

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Unit-V Governors: Introduction, Types of governors, Various gravity and spring-controlled governors, governor characteristics, Effort and power of a governor, Controlling force diagrams, Coefficient of insensitiveness.

Gyroscopes: Gyroscopic couple, Effect of Gyroscopic couple on the stability of four wheel and two-wheel vehicles, Aeroplanes and Naval ships, Gyrostabilisers.

Text & Reference Books:

1. Theory of Machines by Rattan, SS; TMH full detail of publicaiton
2. Theory of Machine by Norton, RL; TMH
3. Theory of Machine by Ballaney, PL; Kanna Pub.
4. Mechanism and Machine Theory by Ambekar, AG; PHI.
5. Theory of Mechanism and Machines by Sharma, CS and Purohit K; PHI.
6. Theory of Machines by Bevan, Thomos; Pearson/ CBS PUB Delhi.
7. Mechanism and Machine Theory by Rao, JS and Dukkipati; NewAge Delhi.
8. Theory of Machines by Lal, Jagdish; Metropolitan Book Co; Delhi –
9. Theory of Mechanisms & Machines by Ghosh, A., Mallik, AK; Affiliated East West Press, Delhi.

NPTEL Link for Theory of Machines-I

<http://nptel.ac.in/courses/112104121/1> and <http://nptel.ac.in/courses/112104114/>

List of experiments (expandable)

1. Study of Kinematics links pairs and chains.
2. To find degree of freedom of a given mechanism.
3. To study all inversions of four-bar mechanisms using models.
4. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
5. Study of inertia forces in reciprocating parts and analysis of flywheel.
6. Study of various types of governors.
7. Study of various types of clutch.
8. Study of various types of brakes.
9. Study of various types of dynamometer.
10. Use virtual lab for any two experiments.
11. Determine the gyroscopic effect of a rotating disc.
12. Determine the Corioli's component of acceleration.
13. Find the total slip, creep, velocity ratio and coefficient of friction between belt and pulley system.
14. Measure the percentage slip at fixed belt tension by varying load on brake drum

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Fluid Mechanics and Hydraulic Machines

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Fluid Mechanics and Hydraulic Machines	120314/190314				Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Define the fundamental properties of fluids.	Skill Development
CO2: Relate the concepts of mechanics with various laws of fluid mechanics.	Skill Development
CO3: Identify the laws of fluid mechanics applicable for the body in various fluids under different conditions.	Skill Development
CO4: Analyse various forces and their effects, related to fluids mechanics.	Skill Development
CO5: Measure and compare losses in different fluid flow conditions.	Skill Development
CO6: Compare different turbo machines depending on their behaviour and their merits and demerits	Skill Development

Course Objectives: To make the students understand:

1. Fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. And give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. And develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

Course Pre-Requisite:

Basic Mechanical Engineering.

Syllabus

Unit-I Properties of fluid: Pressure, density, specific weight, viscosity, dynamic and kinematic viscosity **Newton's law of viscosity** and its applications.

Fluid Static: Pressure variation with depth, pressure measurement, pressure on immersed surface centre pressure, **Buoyancy, flotation, stability of floating bodies.**

Unit-II Fluid Kinetics: One dimensional flow approximation, control volumes concept, continuity equation in 3-D, its differential and integral form, velocity and acceleration of fluid particle, stream line, path line. Rotation, vorticity and circulation. **Stream function and velocity potential function.** Flow net, Free and forced vortex flow.

Unit-III Fluid Dynamics: Momentum theorem, Impulse momentum equation and its application, **Euler's equation in 3-D, Bernoulli's equation for incompressible fluid flow**, engineering applications of energy equation, Pitot -Tube, Venturi meter, Orifice meter.

Unit-IV Flow through Pipes: **Critical Reynolds's number**, velocity distribution in pipes, friction factor. Moody's chart, Laminar flow through pipe, Hagen-Poiseuille's equation, Turbulent flow through

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pipe, Hydraulic gradient line and total energy line. Minor head losses in pipes, Pipe Networking and Transmission of power through pipes.

Unit-V Water Turbine and Pump: Impulse and Reaction principles, Pelton, Francis and Kaplan turbines, velocity diagrams, Work done by turbines, Draft Tube theory. Application of dimensional analysis, similarity to turbines and pumps, Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics of turbines and pumps.

Text & Reference Books:

1. Fluid Mechanics by Streeter & Wylis; McGraw-Hills Pub.
2. Fluid Mechanics by Modi & Seth; Standard publishing house.
3. Fluid Mechanics by D.S. Kumar ;Katson publisher.
4. Fluid Mechanics by R.K. Bansal; Laxmi Publishing House.
5. Fluid Mechanics by Yunus A Cengel & John M. Cimbala; Tata McGraw Hill Edition.

NPTEL Link for Fluid Mechanics and Hydraulic Machines

<http://nptel.ac.in/courses/112105171/1>

List of Experiments:

1. To find out coefficient of discharge of a given Venturimeter.
2. To determine the hydraulic coefficient C_v , C_c , and C_d of an Orifice
3. To study the flow over a Rectangular notch to find the coefficient of discharge for it.
4. To determine the coefficient of friction for pipes of different sizes.
5. Experimental determination of Metacentric height of a ship model
6. Study of Redwood viscometer.
7. To study of different types of flow (Reynold's experiment).
8. To verify Bernoulli's Equation Experimentally.
9. To study the performance characteristics of a centrifugal pump and to determine the characteristic with maximum efficiency.
10. To conduct load test on Pelton Wheel Turbine and to study the characteristics of Pelton wheel turbine.
11. To conduct load test on Francis turbine and to study the characteristics of Francis turbine.
12. To study the characteristics of a Kaplan turbine.

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Software Lab

Category	Title	Code	Credit-1			Practical End Sem
			L	T	P	
Departmental Lab Core-DLC	Software Lab	120315/ 190315	-	-	2	Max.Marks-60 Min.Marks-19
		120305	-	-	2	.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 Describe AutoCAD and CATIA toolbars	Skill Development/ Employability
CO2 Summarize 2D and 3D commands	Skill Development/ Employability
CO3 Solve real time problems using AutoCAD and CATIA software	Skill Development/ Employability
CO4 Analyse various mechanical engineering problems.	Skill Development/ Employability
CO5 Evaluate technical drawings of machine assemblies as a design engineer	Skill Development/ Employability
CO6 Generate 2D and 3D solid models with new features in machine elements	Skill Development/ Employability

Course Pre-Requisites:

Engineering Graphics

Course Objectives: To make the students:

1. Develop an ability to make familiar with 2D, 3D modelling and simulation software
2. Develop an ability to create and modify complex 2D and 3D entities using CATIA software
3. Develop creative skills in developing new ideas.

SYLLABUS:

Auto CAD: Auto CAD interface, work space setting, Basic commands, viewports and printing.

Snaps: snap to grid, show to grid. Orthographic polar snap, object snap, dynamic UCS.

2D and 3D commands: Trim, extend, Offset, move, mirror, scale, rotate, extrude, union, subtract etc. commands. Units: properties, measure and dimension.

CATIA concepts: Display-Tree appearance, Three button move, view tool bar, Normal standard and shading view, 2D toolbar, sketch tools, constraint, profile, operation.

Toolbar: Sketch based features toolbar, commands-Pad, Pocket, shaft, groove, holerib etc. Dress up feature, Transformation features, Boolean operation.

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Simulation: Assembly and simulation in CATIA, Linear and rotational motion, Nut-bolt mechanism simulation

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

CO1 Describe AutoCAD and CATIA toolbars

CO2 Summarize 2D and 3D commands

CO3 Solve real time problems using AutoCAD and CATIA software

CO4 Analyse various mechanical engineering problems.

CO5 Evaluate technical drawings of machine assemblies as a design engineer

CO6 Generate 2D and 3D solid models with new features in machine elements

Text Books and Reference books:

1. Franke & Roger: Modelling and simulation for chemical engineering, Willey Interscience
2. Luyben-Process modelling simulation and control for chemical engineers, IInd, McGraw Hill, 1989
3. Fundamentals of Engineering drawing Interactive graphics by Luzzader WJ, Duff JM; PHI
4. A general guide to computer aided design and drafting-CAD by Duggal, Vijay, cadd primer; CAD malimax publications.

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120411: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-II	120411/ 120401	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Identify the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.	Skill Development
CO2: Classify various components of machines like gear, gear train cam etc.	Skill Development
CO3: Solve numerical problems of various components of machines like gear, gear train cam etc.	Skill Development
CO4: Analyze the forces and motion of complex systems of linkages, gears and cams.	Skill Development
CO5: Evaluate the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications.	Skill Development
CO6: Design the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc.	Skill Development

Course Pre-Requisite:

Engineering Graphics
 Mechanics of Materials
 Theory of Machines

Course Objectives: To make the students:

1. Understand the basics of synthesis of simple mechanisms.
2. Apply fundamental of mechanics to machines elements which include gear, gear train, cams etc.,
3. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints.

Syllabus

Unit- I Gears: Classification, Terminology, Law of gearing, Forms of teeth, Tooth profile, Cycloidal and Involute tooth forms, path of contact, teeth in contact, Interference. Spur, Helical, Spiral, Worm and Bevel gears.

Unit- II Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains, Velocity Ratio. Various applications of gear trains - Motor car gear box, Differential mechanism, cyclometer mechanism etc.

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Unit-III Balancing: Introduction, Balancing of rotating and reciprocating masses, Locomotive balancing, Balancing of multi cylinder in line engines, Balancing of radial engines, Direct and reverse crank method of balancing.

Unit-IV Cams and Cam Dynamics: Introduction, Classification of cams and followers, Terminology, Displacement, Velocity and acceleration diagrams for different follower motions, Synthesis of cam profiles. Cams with specified contours, Cam dynamics.

Unit-V Synthesis of Linkages: Introduction, Types, Number and Dimensional synthesis, Function Generation, Chebychev's spacing of accuracy points, Synthesis with three accuracy points of 4-bar and slider-crank mechanisms, Synthesis of crank rocker mechanisms with optimum transmission angle, Path generation.

Text & References Books:

1. Design of Machinery by Robert L. Norton; TATA McGraw Hill.
2. Theory of Machines by S S Rattan; Tata McGraw Hill.
3. Theory of Machines by R S Khurmi; J K Gupta; S. Chand.
4. Mechanism & Machine Theory by Ashok G. Ambekar; PHI (Prentice-Hall India).
5. Theory of Machines by Sadhu Singh; Pearson Education.
6. Theory of Machines and Mechanisms by P L Ballaney; Khanna Publishers.
7. Theory of Machines by R K Bansal; Laxmi Publications.

NPTEL Link for Theory of Machines-II

<http://nptel.ac.in/courses/112104121/1> and <http://nptel.ac.in/courses/112104114/>

List of experiments

1. Study of various types of gears.
2. Study of various types of gear trains.
3. Balancing of rotating masses.
4. Balancing of reciprocating masses.
5. Study of kinematic synthesis of mechanisms.
6. Study of cams and followers.
7. To draw cam profile, velocity and acceleration diagrams of a given cam-follower mechanism.
8. Draw the profile of various cams with different types of followers.
9. Plot the follower displacement vs angle of cam rotation curves for changing compression spring, follower weights and cam speed.
10. Calculate the epicyclic gear ratio, input torque, holding torque and output torque.

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120412: Design of Machine Elements

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Design of Machine Elements	120412/ 120402				Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 Describe the basic design process and function of Permanent and temporary joints used in Machine Design	Skill Development
CO2 Summarize the design techniques, skills and tools used in design.	Skill Development
CO3 Solve the various design engineering problems by formulate and proper assumptions for practice.	Skill Development
CO4 Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts	Skill Development
CO5 Evaluate the cases of Temporary and permanent joints problems successfully	Skill Development
CO6 Create design techniques for a mechanical component under variety of environmental and service conditions.	Skill Development

Note: Use of PSG Design Data book is permitted in exam.

Course Pre-Requisites:

Mathematics-I(Subject Code – 100102)

Mechanics of Materials(Subject Code – 120302)

Course Objectives: To make the students:

1. Able to identify, formulate and solve design engineering problems.
2. Develop an ability to use the techniques, skills and modern design engineering tools necessary for engineering practice.
3. Demonstrate the ability to make proper assumptions, perform correct analysis while design upon various mechanical machine elements.

Syllabus

Unit-I Introduction: Design process, Factor of safety, design standards and units, Material selection in Mechanical Design, surface finish symbols, Surface Roughness, limit, fit, and tolerance, Gauge design, Tolerance analysis in manufacturing and assembly, Design for Manufacturability, Comparison between conventional design process and modern design process

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Unit-II Bolted, Riveted and Welded joints: Definition, Nomenclatures, Classifications, Applications, Methods of joining, Loadings & Failures, Design procedures, Eccentric loading problems.

Unit-III Cotter and Knuckle joints: Definitions, Nomenclature, Classifications, Comparison between keys and cotters, Design of Socket and spigot cotter joint, Sleeve type Cotter joint, Cotter with Gib, Knuckle Joint, Suspension link, Pin joint, Adjustable joint, Turn-buckle.

Unit-IV Shafts, Keys and Couplings: Definitions, Classifications and Applications. Design under various loads and cases.

Unit-V Theories of Failures: Maximum normal stress and shear stress theory, maximum normal strain and shear strain theory, maximum distortion energy theory. Applications of theories to different material. Introduction to 2D, 3D modules and tools, Fundamentals and applications of CAD/CAM. Concept of computer aided drafting and Machine drawing.

Text & Reference Books

1. Mechanical Engineering Design by Shigley JE et al; TMH
2. Machine Design by Mubeen
3. Design of Machine elements by Bhandari VB; TMH
4. Text Book of Machine Drawing by John KC; PHI Learning
5. Engineering design – George Dieter, MGH, New York.
6. Machine Drawing by Bhat, ND; Charotar.
7. Machine Drawing by Narayana and Reddy; New age, Delhi.
8. Design data book by PSG
9. Fundamental of Engg Drawing Interactive Graphics by Luzzader WJ, Duff JM; PHI.
10. Mechanical design data book by Mahadevan and Reddy's; CBS

NPTEL Link for Design of Machine Elements

<http://nptel.ac.in/courses/112105124/>

List of Experiments

1. Design and drawing of Single, double and triple riveted joint
2. Design and drawing of Single and double strap butt joint
3. Design and drawing of Welded joint
4. Design and drawing of Socket and Spigot cotter joint
5. Design and drawing of Gib and Cotter joint.
6. Design and drawing of Knuckle joint
7. Study of Theories of failure
8. Design and drawing of Solid and hollow shaft
9. Design and drawing of Rigid coupling
10. Design and drawing of Flexible coupling

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 Department of Mechanical Engineering

For batches admitted in Academic Session 2020-21

Metal Cutting and Machine Tools

Category	Title	Code	Credit: 3			Theory Paper
Departmental Core-DC	Metal Cutting and Machine Tools	120413/ 120502/ 190502	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 apply cutting mechanics to metal machining based on cutting force and power consumption.	Skill Development
CO2 operate lathe, milling machines, drill press, grinding machines, etc.	Skill Development
CO3 select cutting tool materials and tool geometries for different metals.	Skill Development
CO4 select cutting tool materials and tool geometries for different metals.	Skill Development
CO5 optimize parameters for material removal in unconventional machining processes.	Skill Development
CO6 identify the process parameters, their effect and applications of different processes	Skill Development

Course Objectives: To make the students understand:

1. The fundamental knowledge and principles in material removal processes.
2. The fundamentals and principles of metal cutting to practical applications through
3. The fundamentals of machining processes and machine tools.

Syllabus

Unit-I Mechanics of Metal Cutting: Introduction to manufacturing and machining, Classification of metal removal processes, Geometry of single point cutting tool and tool angles. Tool nomenclature. Conversion of tool angles from one system to another, **Mechanics of chip formation and types of chips**, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. **Thermal aspects of machining and measurement of chip tool interface temperature.** Friction in metal cutting. **Machinability & Cutting Fluids:** Concept and evaluation of machinability, tool life, mechanism of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Advanced Cutting Tool Materials, **Cutting Fluids**

Unit-II General Purpose Machine Tool: Constructional detail of milling, shaper and planer machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation. **Capston and turret Lathes**, single and multiple spindle automates, operations, planning and tool layout.

Unit-III Abrasive Processes & surface Finishing: Abrasive, natural and synthetic, manufacturing nomenclature. **Selection of grinding wheels, wheel mounting and dressing.** **Surface Finish:** Elements of surface roughness, evaluation and representation and measurement of surface roughness, relationship of surface roughness to production methods.

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Unit-IV Gear Manufacturing Processes: Introduction, materials, methods of gear manufacturing, Gear Milling, Gear Hobbing & Gear Shaping Machine Tools and processes. Modern gear manufacturing methods, gear inspection.

Unit-V Non Conventional machining: Benefits, general application and survey of Non-conventional machining processes. Mechanism of metal removal, tooling and equipment and specific applications of EDM, LBM, EBM, ECM, USM, AJM, WJM, AWJM, PAM processes

Text Books

1. Fundamentals of Metal Cutting and Machine Tool by Boothroyd Geofery; McGH, Kogakuha Ltd.
 2. Production Technology by Jain, R.K. and Gupta, S.C; Khanna Publishers.
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Reference Books:

1. Workshop Technology by Chapman, Volume I, II, & III, ELBS.
2. Production Technology by HMT; McGraw Hill, New Delhi.

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For batches admitted in Academic Session 2020-21

Engineering Thermodynamics

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Engineering Thermodynamics	120414/ 190413	2	1	2	Max.Marks-50 Min.Marks-16 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Define energy interactions between system and surroundings.	Skill Development
CO2: Correlate the law of thermodynamics to real life applications	Skill Development
CO3: Apply the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles	Skill Development
CO4: Analyze the thermal efficiency of air standard cycles	Skill Development
CO5: Analyze the entropy concept in thermodynamic systems.	Skill Development
CO6: Describe benefits of improvements to thermodynamic systems.	Skill Development

Course Objective: To make students able to:

1. Understand the nature and role of the various thermodynamic properties of matter.
2. Represent a thermodynamic system by a control mass or control volume and identify work and/or heat interactions between the system and surroundings.
3. Recognize the different forms of energy and restrictions imposed by the laws of thermodynamics on conversion from one form to another.

Course Prerequisites: Basic Mechanical Engineering

Syllabus

Unit-I Basic Concepts: Thermodynamics, Property, Equilibrium, State, Process, Cycle, **Zeroth law** of thermodynamics, Statement and significance, Concept of an Ideal gas, Gas Laws, Avogadro's Hypothesis, Heat and work transfer. **First law of thermodynamics** –Statement of first law of thermodynamics, first law applied to closed system undergoing a cycle, Process analysis of closed system flow process, Flow energy, Steady flow process analysis of closed system processes, Limitations of first law of thermodynamics.

Unit -II Properties of pure substances: - **P-V-T surfaces, h-s, T-S, P-V, P-h, T-V diagrams** of pure substance, saturated and sub-cooled liquid, superheated vapour, quality of steam, Mollier diagram, steam table, different processes, measurement of quality of steam

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Unit –III Second law of thermodynamics: Heat engine, Heat reservoir, Refrigerator, Heat pump, COP, Carnot's theorem, Carnot's cycle, Efficiency of Carnot's cycle, Statement of second law, Reversible and Irreversible processes, Consequences of Second law.

Unit –IV Availability and Irreversibility: Entropy, Entropy changes of Ideal gas, Available energy, T-S diagram, Availability and Irreversibility.

Thermodynamics Relations: Thermodynamics relations, e.g Maxwell relations and their applications.

Unit- V Air Standard Cycles: Carnot, Sterling, Ericsson, Otto, Diesel, Dual cycles and determination of their air standard efficiencies and their comparison. Brayton cycle, Atkinson cycle. PVT relationship, Mixture of ideal gases Properties of mixture of gases.

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

CO1: Define energy interactions between system and surroundings.

CO2: Correlate the law of thermodynamics to real life applications

CO3: Apply the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles

CO4: Analyze the thermal efficiency of air standard cycles

CO5: Analyze the entropy concept in thermodynamic systems.

CO6: Describe benefits of improvements to thermodynamic systems.

Text & Reference Books:

1. Engineering thermodynamics by P.K. Nag
2. Thermal engineering by R.K. Rajput
3. Thermal engineering by P.L. Ballaney
4. P L Dhar Thermal Engineering

NPTEL Link for Engineering Thermodynamics

https://onlinecourses.nptel.ac.in/noc18_ch03/preview

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For batches admitted in Session 2019-20

Industrial Engineering

Category	Title	Code	Credits: 3			Theory Paper
Departmental Core-DC	Industrial Engineering	120501/190501	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. analyze and measure productivity	Skill Development
CO2. acquire the knowledge and understanding regarding Production planning and Controlled required for industry to analyze the engineering problems.	Skill Development
CO3. utilize the operation research techniques as a problem solving techniques	Skill Development
CO4. gives practice through various Management and Operation Tools for Improving Quality and Quantity	Skill Development
CO5. solve various kinds of problems or issue faced by service and manufacturing industries like economic consideration, optimum utilization of resources, productivity	Skill Development
CO6. get the solutions for materials requirement planning.	Skill Development

Course Objectives: To make the students understand:

1. Professional, technical managerial, or leadership roles within industrial organizations.
2. The knowledge through discovery, synthesis, and integration for the betterment of their organization or society

Syllabus

UNIT-I

Production Systems and Productivity: Production Management: design of production systems (product, job shop and batch). Definition and types of productivity, **Measurement of productivity**, factors affecting the productivity and productivity improvement programs.

Production Planning and Control: Objective, importance, need and function of production planning and control, planning, routing, scheduling, dispatching, follow up & progress report, production planning and production control.

UNIT-II

Forecasting techniques: Need and type of forecasting, **factors affecting forecasting**, forecasting in decision making, time series analysis, demand patterns, qualitative methods- measures of forecast accuracy and error analysis in quantitative forecasting.

Capacity and aggregate planning: **Capacity planning:** capacity measurement, long-term and short-term strategies, aggregate production planning, and graphical method to choose aggregate plan.

UNIT-III

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Inventory Control – Objectives and functions, need and classifications- codification and standardization ABC analysis, deterministic inventory models, quantity discount; perpetual and periodic inventory control systems. Probabilistic inventory management, economic ordering quantity procurement cost, carrying charges, lead-time, re-order point.

Project management – PERT and CPM.

UNIT-IV

Product Design and Development: Principles of good product design, tolerance, quality and cost considerations, product life cycle, standardization, simplification, diversification, value engineering and analysis, methodology, applications, concurrent engineering; comparison of production alternatives. **Facility Locations and Plant Layout:** Facility location factors and evaluation of alternate locations; qualitative aspects, quantitative models for layout decisions, types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing, materials handling systems.

UNIT-V

Master Production Scheduling and MRP: Functions, planning horizon and planning periods for master production schedule, types of master production schedule, Bill of Material, Independent Demand versus dependent demand, Functions of material requirements planning and manufacturing resource planning (MRP I and MRP II), inputs for MRP system, performance characteristics of MRP system, materials requirement planning explosion.

Text Books:

1. Industrial Engineering and Management by O. P. Khanna, Latest Edition.
2. Manufacturing planning and control for SCM by Vollmann; TMH, Latest Edition.
3. Purchasing & Materials Management by Dobler & Lee, PHI, Latest Edition

Reference Books:

1. Operations Management by Krajewski, L. J., Ritzman, L. P. and Malhotra, M. K., Prentice Hall, New Delhi; Latest Edition.
2. Production/Operations Management by Ebert, J and Adams, D.J., Prentice Hall of India, New Delhi; Latest Edition.
3. Production and Operations Management: manufacturing and services by Chase, R. B., Aquilano, N. J. and Jacob, F. R., TMH, New Delhi; Latest Edition .
4. Modern Production/Operations Management by Buffa and Sarin, Wiley India; Latest Edition.

List of Open Source Software/learning website:

- I. <http://nptel.ac.in/courses/110106045/>
- II. <http://www.newagepublishers.com/samplechapter/001233.pdf>
- III. <http://onlinelibrary.wiley.com/doi/10.1111/poms.12315/pdf>

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Metal Cutting and Machine Tools

Category	Title	Code	Credit: 4			Theory Paper
Departmental Core-DC	Metal Cutting and Machine Tools	120502/ 190502	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 apply cutting mechanics to metal machining based on cutting force and power consumption.	Skill Development
CO2 operate lathe, milling machines, drill press, grinding machines, etc.	Skill Development
CO3 select cutting tool materials and tool geometries for different metals.	Skill Development
CO4 select cutting tool materials and tool geometries for different metals.	Skill Development
CO5 optimize parameters for material removal in unconventional machining processes.	Skill Development
CO6 identify the process parameters, their effect and applications of different processes	Skill Development

Course Objectives: To make the students understand:

1. The fundamental knowledge and principles in material removal processes.
2. The fundamentals and principles of metal cutting to practical applications through
3. The fundamentals of machining processes and machine tools.

Syllabus

Unit-I Mechanics of Metal Cutting: Introduction to manufacturing and machining, Classification of metal removal processes, Geometry of single point cutting tool and tool angles. Tool nomenclature. Conversion of tool angles from one system to another, **Mechanics of chip formation and types of chips**, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. **Thermal aspects of machining and measurement of chip tool interface temperature**. Friction in metal cutting. **Machinability & Cutting Fluids:** Concept and evaluation of machinability, tool life, mechanism of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Advanced Cutting Tool Materials, Cutting Fluids

Unit-II General Purpose Machine Tool: Constructional detail of milling, shaper and planer machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation. **Capston and turret Lathes**, single and multiple spindle automates, operations, planning and tool layout.

Unit-III Abrasive Processes & surface Finishing: Abrasive, natural and synthetic, manufacturing nomenclature. Selection of grinding wheels, wheel mounting and dressing. **Surface Finish:** Elements of surface roughness, evaluation and representation and measurement of surface roughness, relationship of surface roughness to production methods.

Unit-IV Gear Manufacturing Processes: Introduction, materials, methods of gear manufacturing, Gear Milling, Gear Hobbing& Gear Shaping Machine Tools and processes. **Modern gear manufacturing methods, gear inspection.**

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Department of Mechanical Engineering

Unit-V Non Conventional machining: Benefits, general application and survey of Non-conventional machining processes. Mechanism of metal removal, tooling and equipment and specific applications of EDM, LBM, EBM, ECM, USM, AJM, WJM, AWJM, PAM processes

Text Books

1. Fundamentals of Metal Cutting and Machine Tool by Boothroyd Geofery; McGH, Kogakuha Ltd.
2. Production Technology by Jain, R.K. and Gupta, S.C; Khanna Publishers.

Reference Books:

1. Workshop Technology by Chapman, Volume I, II, & III, ELBS.
2. Production Technology by HMT; McGraw Hill, New Delhi.

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Department of Mechanical Engineering

For batches admitted in Session 2019-20

Heat and Mass Transfer

Category	Title	Code	Credits: 4			Theory Paper
			L	T	P	
Departmental Core-DC	Heat and Mass Transfer	120503/190503	2	1	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 state principles of heat and mass transfer to basic engineering systems	Skill Development
CO2 develop basic concepts of heat transfer, differentiate between heat transfer and thermodynamics, modes of heat transfer (rates) i.e. Conduction, Radiation and convection.	Skill Development
CO3 analyze and solve heat transfer problem of conduction, convection and radiation	Skill Development
CO4 apply physics of heat transfer in the processes like Condensation and 'Boiling' and in applications like 'Fins' and 'Heat-Exchangers'. Analyze and design heat exchangers	Skill Development
CO5 formulate and solve one dimensional conduction with and without heat generation, convection and radiation heat transfer problems.	Skill Development
CO6 create solution techniques which include both closed form and numerical methods of heat conduction and Convection.	Skill Development

Course Objectives: To make the students understand:

1. the comprehensive of physical science and its fundamentals applicable to the engineering discipline of heat and mass transfer.
2. the fundamentals of heat transfer mechanisms in fluids and solids.

Syllabus

UNIT-I Fundamental of Heat Transfer: Modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's law, thermal conductivity and its variation with temperature, film coefficient of heat transfer, general heat conduction equations, Steady state heat transfer: **Thermal resistances and conductance**, overall Heat transfer Coefficient, Heat transfer through plane and composite wall, hollow and composite hollow cylinder and sphere, thermal diffusivity, one dimensional steady state conduction with heat generation, critical thickness of insulation. Unsteady **State Heat Transfer:** Transient and periodic conduction, Lumped System Analysis, heating and cooling of bodies with known temperature distribution, response of thermocouple.

UNIT-II Convection Heat Transfer: Introduction to Free and Forced Convection, laminar and turbulent flow, **forced convection through hydrodynamic and thermal boundary layers**, analysis of hydrodynamic and thermal boundary layer. Empirical equations of convection heat transfer. Heat Transfer in a circular pipe (forced convection). Applications of dimensional analysis to free and forced convection. Reynolds Number, Prandtl Number, Grashoff Number, **Nusselt numbers, and Boit Number**.

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Department of Mechanical Engineering

UNIT-III Heat Exchangers: Basic types of heat exchanger. Logarithmic Mean Temperature Difference (LMTD), fouling factor, heat exchanger effectiveness, NTU Methods. Extended surfaces: Pin-Fin and rectangular fin of uniform cross section. Effectiveness and efficiency of Fin. Use of fin analysis for measuring, thermometric error, triangular and parabolic profile.

UNIT-IV Thermal radiation: Basic concept. Monochromatic and total emissive power, absorptivity, reflectivity and transmissivity, Kirchhoff's law, Concept of Black & Grey bodies. Planck's distribution law. Wien's displacement law. Steffen – Boltzmann law, Concept of Shape factor. Condensation heat transfer: Introduction, process, Theory of laminar film condensation. Nusselt's theory. Drop wise condensation. Influence of the presence of non-condensable gases. Boiling heat transfer: Nature, Boiling regimes, Bubble size consideration, bubble growth and Collapse. Critical diameter, Rosen how Correlation.

UNIT V Diffusion Mass Transfer: Fick's law. Steady state diffusion of gases and liquids through solids, Equi-molar diffusion, isothermal diffusion, isothermal evaporation of water into air. Mass transfer coefficient. **Convective Mass Transfer:** Mass transfer through boundary layer. Analogy between momentum heat & mass transfer. Dimensional analysis, application to convective mass transfer. Forced convection mass transfer in laminar and turbulent flow through tubes. Simultaneous heat and mass transfer.

Text Book:

1. Kumar D. S, Heat & Mass Transfer, Latest Edition, Katson Publication.
2. Rajput R. K., Heat & Mass Transfer, Latest Edition, S. Chand Publication.

References Books:

1. Arora & Domkundwar, A course in Heat & Mass Transfer, Latest edition, Dhanpat Rai & Co. Publication.
2. Nag P K, Heat Transfer, Latest Edition, McGrawhill
3. Holman J. P., Heat Transfer, Latest Edition, TMH.
4. Kreith & Bohn, Principles of Heat Transfer, Latest Edition, CL Engineering Publication.
5. Cengel Yunus A., Heat and Mass Transfer, Latest Edition, TMH.
6. Thirumaleshwer M., Heat and Mass Transfer by, Latest Edition, Pearson.

List of Experiments: -

1. Determination of Thermal Conductivity of Metal Rod.
2. Determination of Thermal Conductivity of Insulating Powder.
3. Measurement of Emissivity.
4. Determination of Stefan-Boltzman constant.
5. Determination of Heat Transfer coefficient by Pin-Fin Apparatus.
6. Determination of Effectiveness of Shell and Tube heat exchanger.
7. Determination of effectiveness of Parallel and Counter Flow Heat Exchanger.
8. Determination of heat transfer coefficient by Forced Convection.
9. Determination of Heat Transfer coefficient by drop and film wise condensation method.

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Department of Mechanical Engineering

10. To study the drying characteristics of different wet granular materials using natural and forced circulation in a tray dryer.
11. To determine the diffusion coefficient of liquid vapor in air by Stefan's tube.

For batches admitted in Session 2019-20

120504: Thermal Engineering

Category	Title	Code	Credit -4			Theory Paper
Departmental Core-DC	Thermal Engineering	120504	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: selection of various types of fuels based on required applications.	Skill Development
CO2: outlining the basics of Refrigeration and Air conditioning	Skill Development
CO3: solve analytical problems of thermal engineering.	Skill Development
CO4: compare different turbo machines depending on their behavior and their merits and demerits.	Skill Development
CO5: select proper fluid machines for appropriate operation.	Skill Development
CO6: design of various types of combustion chambers for Internal Combustion Engines.	Skill Development

Syllabus

UNIT I -Air Standard Cycles And Vapor Power Cycles: Carnot, Sterling, Ericsson, Otto, Diesel, Dual cycles and determination of their air standard efficiencies and their comparison. Brayton cycle, Atkinson cycle. PVT relationship, Mixture of ideal gases Properties of mixture of gases. Vapor Carnot cycle and its limitations, Rankine cycle and modified Rankine cycle, actual vapor power cycle, Reheat cycle, ideal regenerative cycle, actual regenerative cycle, Reheat – regenerative cycle, feed water heaters, working fluids in vapor power cycle, binary vapor cycles, efficiency of coupled cycles, process heat, efficiencies in power cycles. Basics of condensers.

UNIT II - Engine Construction, Operation And Performance:

Basics of CI and SI Engines, Valve timing diagram, Firing order and its significance - relative merits and demerits of SI and CI engines. Two stroke engine construction and operation. Comparison of four-stroke and two-stroke engines. Performance parameters, **Heat balance. Testing of engine.**

UNIT III - Combustion In SI And CI Engines:

Combustion process in IC engines. Stages of combustion, Flame propagation, velocity and area of flame front. Rate of pressure rise - Cycle to cycle variation – Abnormal combustion - Theories of detonation - Effect of engine operating variables on combustion. **Combustion chambers for SI and CI engines,** Importance of air motion - Swirl, squish and turbulence - Swirl ratio. Fuel air mixing - Stages of combustion - Delay period - Factors affecting delay period, Knock in CI engines - **methods of controlling diesel knock.**

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Department of Mechanical Engineering

UNIT IV – Turbines and Pumps

Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work done Draft Tubes, governing or water turbines, Impulse staging, velocity and pressure compounding utilization factor, analysis for optimum U.F. Curtis stage, and Rateau stage, including qualitative analysis. Effect of blade and nozzle losses on Vane efficiency, Stage efficiency. Analysis for optimum efficiency vortex types of flow, flow with constant reaction. Application of dimensional analysis, similarity to turbines and pumps, Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics of turbines and pumps.

Unit V Refrigeration and Air Conditioning

Reversed Brayton Cycle, Bell-Coleman Cycle. Air Cycles for Aircraft Refrigeration, Properties Requirement, & Applications of Refrigerants. CFC & HFC Refrigerants. Simple vapour Absorption Systems-Electrolux Refrigerator, Refrigerants, Ozone depleting refrigerants.

Vapour Compression System: Simple Systems, Multi pressure systems. Compound Compression, Multi Evaporator Systems. Cascade Systems. Vapour absorption system,

Air Conditioning: Introduction to Psychometry and Air Conditioning.

Text Books:

1. Ganesan V, "Internal combustion engines", Latest edition, Tata McGraw Hill Education,
2. Arora C. P. "Refrigeration & Air-Conditioning" Latest edition, Tata McGraw Hill Education,
3. Rajput R. K, "A textbook of Thermal Engineering", Latest edition, Laxmi Publications.

References Books:

1. John. B, Heywood, "Internal Combustion Engine Fundamentals", Latest edition, McGraw Hill Publishing Co., New York,
2. Ramalingam K. K, "Internal Combustion Engines", Latest edition, Scitech Publications.
3. Sharma S. P, Chandramohan, "Fuels and Combustion", Latest edition, Tata McGraw Hill Publishing Co.
4. Mathur and Sharma, "A course on Internal combustion Engines", Latest edition, Dhanpat Rai & Co.
5. Edward & Obert, "Internal Combustion Engines and Air Pollution", Latest edition, Intext Education Publishers.

List of Experiments:

1. Performance test of two stroke petrol engine and four stroke petrol engine.
2. Performance test of two stroke diesel engine and four stroke diesel engine.
3. Demonstration of C.O.P. and Performance of Air-Conditioner.
4. Determination of C.O.P. in Vapour compression Refrigeration system
5. Demonstration of C.O.P. and other performance parameters for Mech. Heat Pump.
6. Study of Governing of Pelton, Francis, Kaplan Turbine
7. Determination of Specific quantities in Pelton, Francis, Kaplan Turbine
8. Study of Axial Compressor

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Department of Mechanical Engineering

For batches admitted in Session 2019-20

120505: Machine Design

Category	Title	Code	Credit -4			Theory Paper
Departmental Core-DC	Machine Design	120505	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Describe the design procedure used in automotive industry to design the engine parts	Skill Development
CO2: Classify the different types of spring, bearing and Gears	Skill Development
CO3: Choose the right strategy for designing the machine components based on material and methods	Skill Development
CO4: Apply the design procedure for solving and drafting the different design of machine elements	Skill Development
CO5: Compare the various curves and design procedure used	Skill Development
CO6: Selection of machine elements under various loading and environmental conditions.	Skill Development

Note: Use of PSG Design Data book is permitted in exam.

Course Pre-Requisites:

1. Mechanics of Materials
2. Design of Machine Elements

Course Objectives: To make students:

1. Develop an ability to identify, formulate and solve design engineering problems.
2. Develop an ability to use the techniques, skills and modern design engineering tools necessary for engineering practice.
3. Demonstrate the ability to make proper assumptions, perform correct analysis while design upon various mechanical machine elements.

Syllabus

UNIT-I

Stress concentration & fatigue:

Stress Concentration-causes, effect in tension, bending and torsion, mitigation, **Fatigue**- cyclic loading, endurance limit, S-N curve, concentration factor, notch sensitivity, design consideration, Goodman and modified Goodman's diagram, Soderberg's equation, Gerber's parabola, design for finite life, cumulative fatigue damage factor.

UNIT-II

Spring: Function, classification, Rate, curvature of coil, scale, resilience, material, Stresses and deflection equations of helical springs, design of compression and tension springs, torsion springs,

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Department of Mechanical Engineering

fatigue loading on springs, surge in spring, critical load, spiral springs, design of leaf spring.

UNIT-III

Gears: Design of Spur, Helical, worm and Bevel Gears: Force analysis, Selection of material, Beam and wear strength, Form or Lewis factor, Dynamic load-Barth equation and Buckingham equation, consideration for maximum power transmitting capacity, Gear lubrication.

UNIT-IV

Sliding contact bearings:

Classification, Selection, Viscosity of Lubricants, Materials, Types, Petroff's relation, loads on bearing, Design, Advantages, Disadvantages, Limitations, Heat Dissipation.

UNIT-V

Rolling contact bearings:

Designation, Types, Friction effect, loads, Fatigue, Deflection & deformation, Selection, bearing life.

Text Books

1. Shigley, J.E., and Charles Mechanical Engineering Design; TMH
2. Bhandari VB, Design of Machine elements; Tata McGraw Hill Book Co.

Reference Books

1. John KC, Text Book of Machine Drawing; PHI Learning.
2. Machine Design by Mubeen, Pearson.
3. Engineering design by George Dieter; McGraw Hill.
4. Bhatt, ND, Machine Drawing; Charotar.
5. Kulkarni, S.G., Machine Design, McGraw Hill.
6. Narayana and Reddy, Machine Drawing; New age publication.
7. Design data book, PSG College of Technology, Coimbatore
8. Luzzader, WJ, Duff, JM, Fundamental of Engineering Drawing Interactive Graphics; PHI.
9. Mahadevan, Reddy's, Mechanical design data book; CBS Publisher.

NPTEL Link for Design of Machine Elements

<https://nptel.ac.in/syllabus/112106137/>

<https://nptel.ac.in/downloads/112105125/>

List of Experiments

1. Design and drawing of helical spring.
2. Design and drawing of Spur gear.
3. Design and drawing of Helical gear.
4. Design and drawing of Worm gear.
5. Design and drawing of bevel gear.
6. Modelling and simulation of Gear box.

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Head
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7. Study of Sliding Contact Bearings and Ball bearing and its selection
8. Design and drawing of Antifriction Bearing.
9. Design and drawing of Journal Bearing.
10. Assembly drawing of the Foot step bearing.

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Department of Mechanical Engineering

For batch admitted in Academic Session 2018-19

900203: INDUSTRIAL AUTOMATION

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Industrial Automation	900203	2	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. Identify potential areas for automation and justify need for automation	Skill Development
CO2. Select suitable major control components required to automate a process or an activity	Skill Development
CO3. Translate and simulate a real time activity using modern tools and discuss the benefits of automation.	Skill Development
CO4. Decide suitable automation hardware for the given application.	Skill Development
CO5. Design appropriate modeling and simulation tool for the given manufacturing application.	Skill Development
CO6. Create layout for different machines.	Skill Development

Course Objective: To make the students to understand:

1. The basic principles and elements of automation.
2. The material handling and Identification Technologies.
3. The function of Industrial Robots and their applications for transformational and handling activities.

Pre-requisite: Nil

Syllabus

Unit I Introduction to Automation: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

Unit II Material handling and Identification Technologies: Overview of Material Handling Systems, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Unit III Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, Inspection Principles and Practices, Inspection Technologies.

Unit IV Industrial Robotics: Industrial Robots and their applications for transformational and handling activities, Configuration and motions, robot classification and their performance capabilities, hardware of robots, Actuators, sensors and end effectors.

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Unit V Overview of Industrial automation using robots: Selection and use of robots in manufacture and assembly, welding robot, machining inspection and painting.

Text & References Books:

1. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI publication.
2. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication
3. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
4. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.
5. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

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Department of Mechanical Engineering

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900204: SOLAR ENERGY

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Solar Energy	900204	2	1	-	Max. Marks – 70 Min. Marks – 22 Duration – 3 hrs

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. Define the basic terms used in solar systems and various sun-earth angles.	Skill Development
CO2. Establish the energy balance and develop the thermal model of different solar systems.	Skill Development
CO3. Investigate the effectiveness of utilizing the solar energy by different so systems.	Skill Development
CO4. Analyze the life cycle cost and other economic aspects of solar systems	Skill Development
CO5. Describe the application of solar systems and find out the areas of improvement.	Skill Development

Course Objective: To make the students to understand:

1. The basic concepts of solar energy and various sun-earth angles.
2. How to develop thermal models and how to carry out economic analysis of solar systems and establish energy balance in different solar energy systems.
3. The different types of collectors, PV systems and their application.

Course Prerequisites: Basic Physics

Syllabus

UNIT – I Solar radiation, basic concepts, various Sun – Earth angles and modeling

UNIT – II Solar collectors and types: flat plate, concentrating solar collectors, Selective coatings, thermal modeling of flat plate collectors, applications of solar collectors.

UNIT – III Active and passive heating and cooling of buildings, Home lighting systems.

UNIT - IV Solar energy storage options, Solar Economics and life cycle cost analysis.

UNIT –V Solar photo voltaic System: Basic concepts of solar cell and PV Panel in series and parallel combination, characteristics curves of PV cell and panels, Photovoltaic materials, Need for different cell design, Applications of photovoltaic for power generation.

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Recommended Books:

1. Solar Energy by G.N. Tiwari
2. Solar Energy: Problems, Solution and Experiments by G.N. Tiwari, P. Barnwal, S.C. Solanki and M.K. Gaur
3. Solar Energy by John A. Duffie, William A. Beckman
4. Solar Energy by S.P. Sukhatme and J.K. Nayak

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900214: ENGINEERING MATERIALS FOR INDUSTRIAL APPLICATIONS

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC3	Engineering Materials for Industrial Applications	900214				Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. State the properties of engineering materials.	Skill Development
CO2. Understand the material composition and their effects	Skill Development
CO3. Classify different engineering material.	Skill Development
CO4. Discuss the production and fabrication techniques of Engineering Materials.	Skill Development
CO5. Select different types of materials as per requirement.	Skill Development

Course Objectives: To make the students to understand:

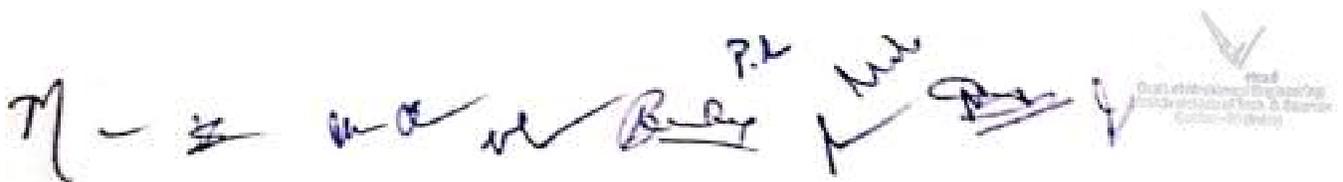
1. The basic fundamentals of materials science and engineering.
2. The different classes of materials, their properties, structures and imperfections present in them.
3. The functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Course Prerequisites: Basic Chemistry

Syllabus

Unit- I Properties of Engineering Materials: Materials for space applications, Materials for Solar applications, Shape Memory Alloys, **Materials for High Temperature Applications**, Materials of Electronic and Electrical Applications: Semiconductors, Organic Semiconductors, Liquid Crystals, Electroluminescent Materials, Magnetic Materials. Materials for Development of Energy Efficient Building, Materials of Chemical Applications: Plastics, Rubber, Ceramics, Magneto-Rheological Materials

Unit-II Production of Engineering Materials: Production of Electronic Materials- Semiconductors, Magnetic Materials. Production of Civil Materials- Cements, Concrete, Steel and its types. **Synthesis of Chemical Engineering Materials- Polymerisation, production of ceramics.**



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900215: Maintenance Engineering

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC3	Maintenance Engineering	900215	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. Describe the fundamental concepts of maintenance engineering noise and vibration, measurement techniques of Condition Monitoring.	Skill Development
CO2. Show skills of fault diagnosis.	Skill Development
CO3. Demonstrate the need of instrumentation and signal processing for condition monitoring	Skill Development
CO4. Examine the condition of machine parts through Failure analysis of plant machineries	Skill Development
CO5. Apply correct usage of a method or procedure of maintenance	Skill Development

Course Objective: To make the students to understand:

1. The fault Identification, Computerized Maintenance Systems.
2. The Maintenance strategies and overall configuration and Maintenance of Machines , structure and System.
3. The Condition Monitoring & Non-Destructive Testing.

Course Prerequisites: Basic Mathematics

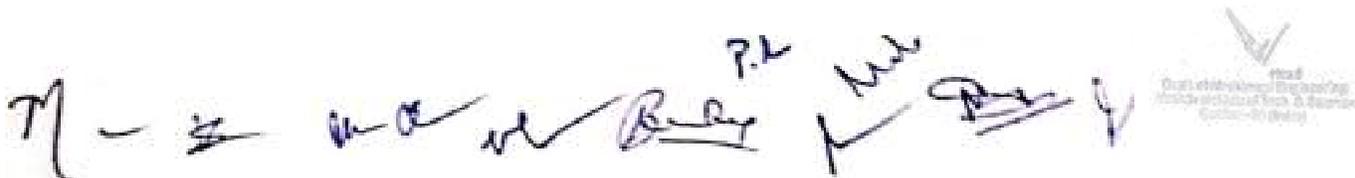
Syllabus

Unit- I: Introduction, Maintenance Principles, FMECA, Fault Diagnostics and Prognostics, Machine Learning in CBM, Basics of Vibration, Free and Forced Response, Vibration and Shock Isolation, Practical Examples of Vibration.

Unit- II: Time Domain Analysis, Frequency Domain Analysis, Non Stationary Signal Analysis, Modulation and Beats, Orbit and Order Analysis, Computer aided data acquisition, Orbit and Order Analysis, Data Recording, Cepstrum Analysis, Hilbert Transform in Condition Monitoring.

Unit- III: Introduction to MATLAB, Signal Processing using MATLAB, Numericals in Signal Processing and Data Acquisition, Signal Hetrodyning, Practical Signals, Basics Of Instrumentation, Signal Conditioning and Filtering, Errors In Measurements, Dynamic Range And Frequency Response, Overview of Transducers For CBM.

Unit- IV: Accelerometers, Vibration Monitoring, Rotational Speed Measurements, Basics of Noise, Noise Monitoring, Introduction to Faults in Rotating Machines, Unbalance Detection, Field Balancing, Misalignment, Crack and Looseness, Journal and Anti-Friction Bearings, Gears, Pumps



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Material Science

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Material Science	190211/120211	3	-	-	Max.Marks-50 Min.Marks-16 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. State fundamental relationship between structure and properties of materials.	Skill Development
CO2. Discuss mechanical properties of materials	Skill Development
CO3. Compare the different processes to alter the material properties.	Skill Development
CO4. Determine the effect of different phases, impurities on the behavior of materials.	Skill Development
CO5. Analyze crystal structure and composition of different materials.	Skill Development
CO6. Create the different engineering materials and alloys.	Skill Development

Course Objectives: To make the students to understand:

1. The basic fundamentals of materials science and engineering.
2. The different classes of materials, their properties, structures and imperfections present in them.
3. The functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Syllabus

Unit-I Structure of materials

Fundamentals of crystal structures and crystal system, crystallographic planes and directions, linear and planar density, single crystal, polycrystalline material and non-crystalline materials, Homogeneous and heterogeneous solidifications, **Crystal imperfections:** point, line, surface and volume defects.

Unit-II Material testing and mechanical properties

Mechanical properties in static tensile, compression and bending tests, Hardness: Rockwell, Brinell, Vicker's, Impact toughness and fracture toughness.

Role of dislocations in plastic deformation, **slip and twinning processes.** **Mechanism of ductile and brittle fracture.** Fatigue: Cyclic stresses, S-N curve, crack initiation and propagation, factors affecting fatigue life; Creep: Generalized creep behavior, stress and temperature effects.

Unit-III Engineering Materials

Ferrous (Steels and Cast irons with role of different alloying elements) and non-ferrous metals and alloys (Aluminum, Magnesium, Titanium, Copper, Nickel alloys), **Nano-materials, Ceramic material, Composite material** with their properties and applications, Smart materials, Bio-materials

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Unit-IV Phase diagrams and phase transformation of metal alloys

Concept of phases, Gibb's phase rule, Lever-rule, binary isomorphous and eutectic phase diagrams, Eutectoid, Peritectic and Peritectoid systems, allotropy in iron, Fe-Fe₃C phase diagram; Isothermal transformation of austenite, continuous cooling transformation of austenite, Objectives of heat treatments, Annealing, Normalizing, Hardening (bulk and surface)

Unit-V Environmental consideration and some case studies

Corrosion: Introduction, types & its prevention; generalized material selection process, material selection for torsionally-stressed cylindrical shaft, Automotive valve spring, orthopedic implants, Integrated circuit and etc.

Text & Reference Books

1. Material Science and Engineering: An Introduction, William D. Callister, John Willey & Sons Inc., 7th edition
2. Elements of Material Science and Engineering by Lawrence, H. Vanvlackdison; Wesley. Mention the Year or the Edition and Publisher and Place of Publication
3. Material Science and Engineering by Raghvan, V; Prentice Hall of India.
4. Introduction to Engineering Materials by Agrawal, B.K; Tata McGraw Hill, N. Delhi.

NPTEL Link for Material Science

https://onlinecourses.nptel.ac.in/noc18_mm05/preview

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Basic Mechanical Engineering

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
Engineering Science-ESC	Basic Mechanical Engineering	100021/100204/CEL/ MEL/CSL/EEL/ ELL/ITL/CHL/ BTL114/2X24	2	1	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. Define the essential concepts of thermal, design and production used in Mechanical Engineering.	Skill Development
CO2. Summarize fundamental techniques and process used in power generating machines	Skill Development
CO3. Solve the various problems based on basic concepts of Mechanical Engineering.	Skill Development
CO4. Analyze the various gas, steam and air cycles.	Skill Development
CO5. Evaluate the problems of Steam Generator, Thermodynamics, Steam and I.C. engines	Skill Development
CO6. Generate the skills to demonstrate steam Generator and reciprocating machine in depth	Skill Development

Course Objectives: To make the students:

1. Develop the fundamentals of Engineering materials, measurement and reciprocating machines.
2. Develop an ability to understand the Thermodynamic laws, steam generator and reciprocating machines for solving engineering problems.
3. Demonstrate Engines and Boiler fundamentals using models.

Syllabus

UNIT-I:

Materials: Classification of engineering material, composition of cast iron and carbon steels on iron-carbon diagram and their mechanical properties; Alloy steel and their applications; Stress-Strain diagram, Hooks law and modulus of elasticity. Tensile, shear, hardness and fatigue testing of materials.

UNIT-II:

Measurement: Temperature, pressure, velocity, flow, strain, force and torque measurement, concept of measurement error & uncertainty analysis, measurement by Vernier caliper, micrometer, dial gauges, slip gauges, sine-bar and combination set; introduction to lathe drilling, milling and shaping machines.

UNIT-III

Fluids: Fluid properties, pressure, density and viscosity; pressure variation with depth, static and kinetic energy; Bernoulli's equation for incompressible fluids, viscous and turbulent flow, working principle of fluid coupling, pumps, compressors, turbines, positive displacement machines and pneumatic machines. Hydraulic power & pumped storage plants for peak load management as compared to base load plants.

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UNIT-IV

Thermodynamics: Zeroth, First, second and third law of thermodynamics; steam properties, steam processes at constant pressure, volume, enthalpy & entropy, classification and working of boilers, efficiency & performance analysis, natural and induced draught, calculation of chimney height. Refrigeration, vapour absorption and compression cycles, coefficient of performance (COP).

UNIT-V

Reciprocating Machines: Steam engines, hypothetical and actual indicator diagram; Carnot cycle and ideal efficiency; Otto and diesel cycles; working of two stroke & four stroke petrol and diesel IC engines.

Reference Books:

1. Narula; Material Science; TMH
2. Agrawal B & CM; Basic Mechanical Engineering; TMH
3. Nag PK, Tripathi et al; Basic Mechanical Engineering; TMH
4. Rajput; Basic Mechanical Engineering;
5. Sawhney GS; Fundamentals of Mechanical Engineering; PHI
6. Nakra and Chaudhary; Instrumentation and Measurement; TMH
7. Nag PK; Engineering Thermodynamics; TMH
8. Ganesan; Combustion Engines; TMH

Lists of Experiments:

1. Study of simple vertical boilers.
2. Study of Locomotive boilers.
3. Study of Babcock and Wilcox boilers.
4. Study of Lancashire, Cornish and Cochran boilers.
5. Study of boiler mounting and accessories.
6. Study of 2 stroke diesel and petrol engines.
7. Study of 4 stroke diesel and petrol engines.
8. Study of simple steam engines.
9. Study of Lathe machine.
10. Study of Vernier and Micrometer.
11. Study of Internal Combustion Engine Parts.

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Manufacturing Practices

Category	Title	Code	Credit-1			Practical End Sem
			L	T	P	
Engineering Science-ESC	Manufacturing Practices	100024/100106	L	T	P	Max.Marks-60 Min.Marks-19
			-	-	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1. Discuss the hand tools, machine tools and power tools.	Skill Development
CO2. Utilize appropriate tools required for specific operation.	Skill Development
CO3. Apply safety measures required to be taken while using the tools in floor shops, Machine shops and carpentry shop.	Skill Development
CO4. Use the techniques, skills, and modern engineering tools necessary for manufacturing and production engineering.	Skill Development
CO5. Conduct experiments in the field of Production engineering.	Skill Development
CO6. Design a system, components, or process to meet desired needs, ethical, health and safety, manufacturability and sustainability.	Skill Development

Course Objectives:

- To familiarize with the basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy.
- To with the production of simple models in the above trades.
- To develop general machining skills in the students.

Syllabus

UNIT-I

Introduction: Manufacturing Processes and its Classification, Casting, Machining, Plastic deformation and Metal forming, Joining Processes, Heat treatment process, Assembly process.

Black Smithy Shop

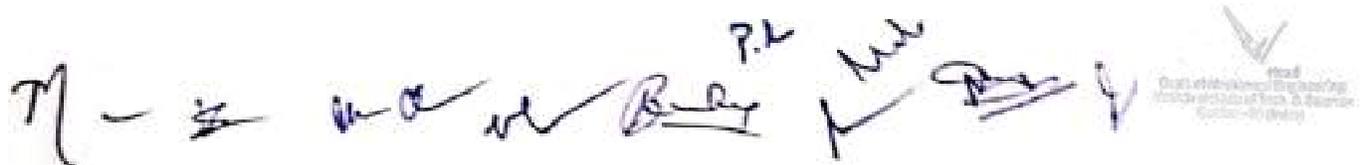
Use of various smithy tools. Forging operations; Upsetting, Drawing down, Fullering, swaging, Cutting down, Forge welding, Punching and drafting.

Suggested Jobs: Forging of chisel, forging of Screw Driver.

UNIT-II Carpentry Shop

Timber: Type, Qualities of timber disease, Timber grains, Structure of timber, Timber seasoning, Timber preservation. Wood Working Tools: Wood Working Machinery, joints and joinery, various operations of planning using various carpentry planes sawing & marking of various carpentry joints.

Suggested Jobs: Name Plate, Any of the carpentry joint like mortise or tennon Joint.



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UNIT-III Fitting Shop:

Study and use of measuring instruments, Engineer steel rule, Surface gauges caliper, Height gauges, feeler gauges, Micrometer. Different types of files, File cuts, File grades, Use of surface plate, Surface gauges drilling tapping Fitting Operations: Chipping filing, Drilling and Tapping.

Suggested Jobs: Preparation of job piece by making use of filing, sawing and chipping, drilling and tapping operation.

UNIT-IV Foundry:

Pattern Making: Study of pattern materials, pattern allowances and types of patterns. Core box and core print, Use and care of tool used for making wooden patterns.

Moulding: Properties of good mould& Core sand, Composition of Green, Dry and Loam sand. Methods used to prepare simple green and bench and pit mould dry sand bench mould using single piece and split patterns.

UNIT-V Welding: Study and use of tools used for Brazing, Soldering, Gas& Arc welding. Preparing Lap & Butt joints using Gas and Arc welding methods, study of TIG and MIG welding processes. Safety precautions.

Text & References Books:

1. Bawa HS; Workshop Practice, TMH
2. Rao PN; Manufacturing Technology-Vol.1 & 2, TMH
3. John KC; Mechanical Workshop Practice; PHI
4. HazraChoudhry; workshop Practice-Vol.1 & 2.
5. Jain R. K.; Production Technology

NPTEL Link for Manufacturing Practices

<http://nptel.ac.in/courses/112107145/>

Laboratory Work:

Relevant shop floor exercises involving practice in forging, Carpentry, fitting, pattern making, Sand casting, Moulding, Welding, Sheet metal fabrication techniques.

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Basic Mechanical Engineering Lab

Category	Title	Code	Credit-1			Practical End Sem
			L	T	P	
Engineering Science-ESC	Basic Mechanical Engineering Lab	100026	L	T	P	Max.Marks-60 Min.Marks-19
			-	-	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

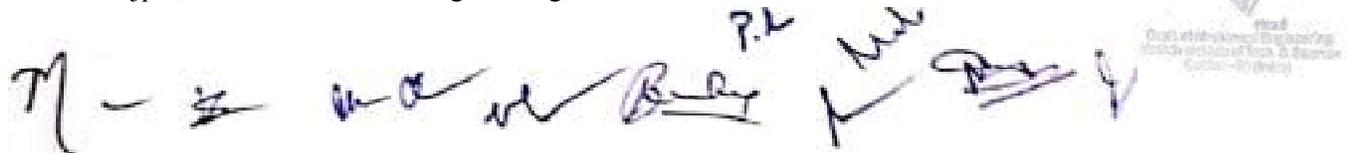
Course Outcomes (COs)	Mapping
CO1. Define the essential concepts of thermal, design and production used in Mechanical Engineering.	Skill Development
CO2. Summarize fundamental techniques and process used in power generating machines	Skill Development
CO3. Solve the various problems based on basic concepts of Mechanical Engineering	Skill Development
CO4. Analyze the various gas, steam and air cycles.	Skill Development
CO5. Evaluate the problems of Steam Generator, Thermodynamics, Steam and I.C. engines	Skill Development
CO6. Generate the skills to demonstrate steam Generator and reciprocating machine in depth.	Skill Development

Lists of Experiments:

1. Study of simple vertical boilers.
2. Study of Locomotive boilers.
3. Study of Babcock and Wilcox boilers.
4. Study of Lancashire, Cornish and Cochran boilers.
5. Study of boiler mounting and accessories.
6. Study of 2 stroke diesel and petrol engines.
7. Study of 4 stroke diesel and petrol engines.
8. Study of simple steam engines.
9. Study of Lathe machine.
10. Study of Vernier and Micrometer.
11. Study of Internal Combustion Engine Parts.

Reference Books:

1. Narula; Material Science; TMH
2. Agrawal B & CM; Basic Mechanical Engineering; TMH
3. Nag PK, Tripathi et al; Basic Mechanical Engineering; TMH
4. Rajput; Basic Mechanical Engineering;



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5. Sawhney GS; Fundamentals of Mechanical Engineering; PHI
6. Nakra and Chaudhary; Instrumentation and Measurement; TMH
7. Nag PK; Engineering Thermodynamics; TMH
8. Ganesan; Combustion Engines; TMH

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For batches admitted in Academic Session 2020-21

120411: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-II	120411/ 120401	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Identify the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.	Skill Development
CO2: Classify various components of machines like gear, gear train cam etc	Skill Development
CO3: Solve numerical problems of various components of machines like gear, gear train cam etc.	Skill Development
CO4: Analyze the forces and motion of complex systems of linkages, gears and cams.	Skill Development
CO5: Evaluate the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications.	Skill Development
CO6: Design the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc.	Skill Development/ employability

Course Pre-Requisite: Engineering Graphics, Mechanics of Materials, Theory of Machines

Course Objectives: To make the students:

1. Understand the basics of synthesis of simple mechanisms.
2. Apply fundamental of mechanics to machines elements which include gear, gear train, cams etc.,
3. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints.

Syllabus

Unit- I Gears: Classification, Terminology, Law of gearing, Forms of teeth, Tooth profile, Cycloidal and Involute tooth forms, path of contact, teeth in contact, Interference. Spur, Helical, Spiral, Worm and Bevel gears.

For batches admitted in Academic Session 2020-21

120412: Design of Machine Elements

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Design of Machine Elements	120412/ 120402	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 Describe the basic design process and function of Permanent and temporary joints used in Machine Design	Skill Development
CO2 Summarize the design techniques, skills and tools used in design	Skill Development
CO3 Solve the various design engineering problems by formulate and proper assumptions for practice.	Skill Development
CO4 Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts	Skill Development
CO5 Evaluate the cases of Temporary and permanent joints problems successfully	Skill Development
CO6 Create design techniques for a mechanical component under variety of environmental and service conditions.	Skill Development/ employability

Note: Use of PSG Design Data book is permitted in exam.

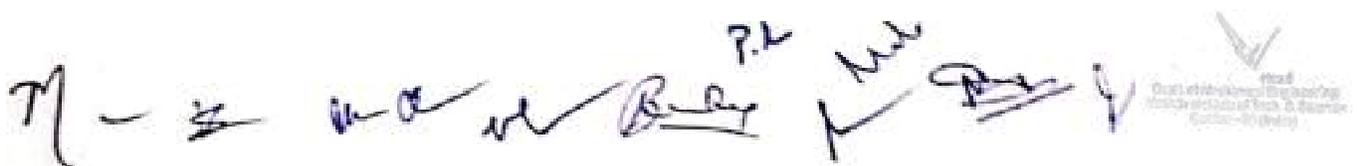
Course Pre-Requisites: Mathematics-I(Subject Code – 100102), Mechanics of Materials(Subject Code – 120302)

Course Objectives: To make the students:

1. Able to identify, formulate and solve design engineering problems.
2. Develop an ability to use the techniques, skills and modern design engineering tools necessary for engineering practice.
3. Demonstrate the ability to make proper assumptions, perform correct analysis while design upon various mechanical machine elements.

Syllabus

Unit-I Introduction: Design process, Factor of safety, design standards and units, Material selection in Mechanical Design, surface finish symbols, Surface Roughness, limit, fit, and tolerance, Gauge design, Tolerance analysis in manufacturing and assembly, Design for Manufacturability, Comparison between conventional design process and modern design process



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 Department of Mech. & Engrg.
 Gwalior-505009

Unit-II Bolted, Riveted and Welded joints: Definition, Nomenclatures, Classifications, Applications, Methods of joining, Loadings & Failures, Design procedures, Eccentric loading problems.

Unit-III Cotter and Knuckle joints: Definitions, Nomenclature, Classifications, Comparison between keys and cotters, Design of Socket and spigot cotter joint, Sleeve type Cotter joint, Cotter with Gib, Knuckle Joint, Suspension link, Pin joint, Adjustable joint, Turn-buckle.

Unit-IV Shafts, Keys and Couplings: Definitions, Classifications and Applications. Design under various loads and cases.

Unit-V Theories of Failures: Maximum normal stress and shear stress theory, maximum normal strain and shear strain theory, maximum distortion energy theory. Applications of theories to different material. Introduction to 2D, 3D modules and tools, Fundamentals and applications of CAD/CAM. Concept of computer aided drafting and Machine drawing.

Text & Reference Books

1. Mechanical Engineering Design by Shigley JE et al; TMH
2. Machine Design by Mubeen
3. Design of Machine elements by Bhandari VB; TMH
4. Text Book of Machine Drawing by John KC; PHI Learning
5. Engineering design – George Dieter, MGH, New York.

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For batches admitted in Academic Session 2020-21

Metal Cutting and Machine Tools

Category	Title	Code	Credit: 3			Theory Paper
Departmental Core-DC	Metal Cutting and Machine Tools	120413/ 120502/ 190502	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 apply cutting mechanics to metal machining based on cutting force and power consumption.	Skill Development
CO2 operate lathe, milling machines, drill press, grinding machines, etc.	Skill Development
CO3 select cutting tool materials and tool geometries for different metals.	Skill Development
CO4 select cutting tool materials and tool geometries for different metals.	Skill Development
CO5 optimize parameters for material removal in unconventional machining processes.	Skill Development
CO6 identify the process parameters, their effect and applications of different processes	Skill Development

Course Objectives: To make the students understand:

1. The fundamental knowledge and principles in material removal processes.
2. The fundamentals and principles of metal cutting to practical applications through
3. The fundamentals of machining processes and machine tools.

Syllabus

Unit-I Mechanics of Metal Cutting: Introduction to manufacturing and machining, Classification of metal removal processes, Geometry of single point cutting tool and tool angles. Tool nomenclature. Conversion of tool angles from one system to another, **Mechanics of chip formation and types of chips**, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting. **Machinability & Cutting Fluids:** Concept and evaluation of machinability, tool life, mechanism of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Advanced Cutting Tool Materials, **Cutting Fluids**

Unit-II General Purpose Machine Tool: Constructional detail of milling, shaper and planer machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation. **Capston and turret Lathes**, single and multiple spindle automates, operations, planning and tool layout.

Unit-III Abrasive Processes & surface Finishing: Abrasive, natural and synthetic, manufacturing nomenclature. Selection of grinding wheels, wheel mounting and dressing. **Surface Finish:** Elements of surface roughness, evaluation and representation and measurement of surface roughness, relationship of surface roughness to production methods.

Unit-IV Gear Manufacturing Processes: Introduction, materials, methods of gear manufacturing, Gear Milling, Gear Hobbing & Gear Shaping Machine Tools and processes. **Modern gear manufacturing methods, gear inspection.**

Unit-V Non Conventional machining: Benefits, general application and survey of Non-conventional machining processes. Mechanism of metal removal, tooling and equipment and specific applications of **EDM, LBM, EBM, ECM, USM, AJM, WJM, AWJM, PAM processes**

Text Books

1. Fundamentals of Metal Cutting and Machine Tool **by** Boothroyd Geofery; McGH, Kogakuha Ltd.
2. Production Technology **by** Jain, R.K. and Gupta, S.C; Khanna Publishers.

Reference Books:

1. Workshop Technology **by** Chapman, Volume I, II, & III, ELBS.
2. Production Technology **by** HMT; McGraw Hill, New Delhi.

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For batches admitted in Academic Session 2020-21

Engineering Thermodynamics

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Engineering Thermodynamics	120414/ 190413	1	1	1	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Define energy interactions between system and surroundings.	Skill Development
CO2: Correlate the law of thermodynamics to real life applications	Skill Development
CO3: Apply the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles	Skill Development
CO4: Analyze the thermal efficiency of air standard cycles	Skill Development
CO5: Analyze the entropy concept in thermodynamic systems.	Skill Development
CO6: Describe benefits of improvements to thermodynamic systems.	Skill Development

Course Objective: To make students able to:

1. Understand the nature and role of the various thermodynamic properties of matter.
2. Represent a thermodynamic system by a control mass or control volume and identify work and/or heat interactions between the system and surroundings.
3. Recognize the different forms of energy and restrictions imposed by the laws of thermodynamics on conversion from one form to another.

Course Prerequisites: Basic Mechanical Engineering

Syllabus

Unit-I Basic Concepts: Thermodynamics, Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, Statement and significance, Concept of an Ideal gas, Gas Laws, Avogadro's Hypothesis, Heat and work transfer. First law of thermodynamics –Statement of first law of thermodynamics, first law applied to closed system undergoing a cycle, Process analysis of closed system flow process, Flow energy, Steady flow process analysis of closed system processes, Limitations of first law of thermodynamics.



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Unit –II Properties of pure substances: - P-V-T surfaces, h-s, T-S, P-V, P-h, T-V diagrams of pure substance, saturated and sub-cooled liquid, superheated vapour, quality of steam, Mollier diagram, steam table, different processes, measurement of quality of steam

Unit –III Second law of thermodynamics: Heat engine, Heat reservoir, Refrigerator, Heat pump, COP, Carnot's theorem, Carnot's cycle, Efficiency of Carnot's cycle, Statement of second law, Reversible and Irreversible processes, Consequences of Second law.

Unit –IV Availability and Irreversibility: Entropy, Entropy changes of Ideal gas, Available energy, T-S diagram, Availability and Irreversibility.

Unit- V Thermodynamics Relations: Thermodynamics relations, e.g Maxwell relations and their applications.

Air Standard Cycles: Carnot, Sterling, Ericsson, Otto, Diesel, Dual cycles and determination of their air standard efficiencies and their comparison. Brayton cycle, Atkinson cycle. PVT relationship, Mixture of ideal gases Properties of mixture of gases.

Text &Reference Books:

1. Engineering thermodynamics by P.K. Nag
2. Thermal engineering by R.K. Rajput
3. Thermal engineering by P.L. Ballaney
4. P L Dhar Thermal Engineering

NPTEL Link for Engineering Thermodynamics

https://onlinecourses.nptel.ac.in/noc18_ch03/preview

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For batches admitted in Academic Session 2020-21

120415: Production Lab

Category	Title	Code	Credit-2			Practical Slot
			L	T	P	
Departmental Lab Core-DLC	Production Lab	190415/120415/ 120405/190405	L	T	P	Max.Marks-60 Min.Marks-19
			-	-	4	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1 Apply the theory of metal cutting in experiments.	Skill Development/ Employability
CO2 Perform step, taper turning, knurling and threading.	Skill Development/ Employability
CO3 Produce stepped surface using shaper and keyway using milling machine	Skill Development/ Employability
CO4 Demonstrate knowledge of different machine tools used in machine shop.	Skill Development/ Employability
CO5 Evaluate the chip thickness ratio, shear angle and material removal rate.	Skill Development/ Employability

Course Objective:

1. To demonstrate the fundamentals of machining processes and machine tools.
2. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
3. To apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, etc.

List of Experiments:

1. Step Turning and Taper Turning on Lathe.
2. Threads Cutting and Knurling on Lathe.
3. Machining Flat Surface using Shaper Machine.
4. Manufacturing of Spur Gear using Milling Machine.
5. Making Internal Splines using Slotting Machine.
6. Hole on work piece through Drilling.



7. Grinding of Single Point Cutting Tool
8. Slot / Groove cutting using shaping machine.
9. Performance on mold making of Simple component.
10. Performance on pattern making of Simple component.
11. Performance on Metal Casting of Simple component.
12. Performance on Welding of simple work piece (Example Arc Welding)
13. Performance on Sheet Metal work of Simple component.
14. Performance on hot forging of Simple component

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For batches admitted in Academic Session 2020-21

Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Theory of Machines-I	190411/190401/ 120313/ 120303/	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Identify basic mechanisms in real life applications.	Skill Development
CO2: Discuss about mechanics of various machines.	Skill Development
CO3: Apply fundamental principles of statics and dynamics to machinery.	Skill Development
CO4: Analyze various types of motions and mechanisms of machinery.	Skill Development
CO5: Evaluate the applications of concepts of components e.g. governor, clutch, brakes, flywheel etc.	Skill Development
CO6: Create the mechanism or components to justify the demands of work such as flywheel, mechanism etc.	Skill Development

Pre-Requisite:

Engineering Graphics, Mechanics of Material

Course Objectives:

To make the students:

1. Familiarize with different types of mechanisms.
2. Understand the basics of synthesis of simple mechanisms.
3. Apply fundamental of mechanics to machines which include engines, linkages etc.,

Syllabus:

Unit-I Mechanism: Machine, Mechanism, Kinematics Links, Pairs, Chains, Degree of freedom. Mechanisms and its Inversions; Slider, Double Slider and 4 bar mechanism. Lower pair mechanisms: pantograph, Straight line motions. Davis and Ackerman Steering Mechanisms.

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Unit-II Kinematic Analysis: Displacement, velocity and acceleration analysis of plane mechanisms; relative velocity, instantaneous Centre, Kennedy's Theorem, Klein's construction methods. Coriolis component.

Unit-III Dynamic Analysis: D'Alembert's principle. Equivalent dynamic system, Graphical and analytical methods of dynamic forces, analysis of mechanisms and machines including reciprocating engines.

Flywheel: Introduction, Turning-moment diagrams and Flywheel analysis.

Unit-IV Brakes: Analysis of simple brake assuming uniform pressures and uniform wear, band brake, block brakes, internal and external shoe brakes, braking of vehicles.

Clutches: Single plate and multi plate clutches, cone clutches, centrifugal clutches.

Dynamometers: Different types and their applications.

Unit-V Governors: Introduction, Types of governors, Various gravity and spring-controlled governors, governor characteristics, Effort and power of a governor, Controlling force diagrams, Coefficient of insensitiveness.

Gyroscopes: Gyroscopic couple, Effect of Gyroscopic couple on the stability of four wheel and two-wheel vehicles, Aeroplanes and Naval ships, Gyrostabilisers.

Text Books:

1. Theory of Machines by Rattan, SS; TMH
2. Theory of Machine by Norton, RL; TMH
3. Theory of Machine by Ballaney, PL; Kanna Pub.
4. Mechanism and Machine Theory by Ambekar, AG; PHI.
5. Theory of Mechanism and Machines by Sharma, CS and Purohit K; PHI.
6. Theory of Machines by Bevan, Thomas; Pearson/ CBS PUB Delhi.
7. Mechanism and Machine Theory by Rao, JS and Dukkupati; NewAge Delhi.
8. Theory of Machines by Lal, Jagdish; Metropolitan Book Co; Delhi –
9. Theory of Mechanisms & Machines by Ghosh, A., Mallik, AK; Affiliated East West Press, Delhi.

NPTEL Link for Theory of Machines-I

<http://nptel.ac.in/courses/112104121/1> and <http://nptel.ac.in/courses/112104114/>

List of experiments

1. Study of Kinematics links pairs and chains.
2. To find degree of freedom of a given mechanism.

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3. To study all inversions of four-bar mechanisms using models.
4. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
5. Study of inertia forces in reciprocating parts and analysis of flywheel.
6. Study of various types of governors.
7. Study of various types of clutch.
8. Study of various types of brakes.
9. Study of various types of dynamometer.
10. Use virtual lab for any two experiments.
11. Determine the gyroscopic effect of a rotating disc.
12. Determine the Coriolis's component of acceleration.

$\eta = \frac{m a}{m a + m b} \times \frac{P.L}{m a}$

For batches admitted in Academic Session 2020-21

Automotive Electrical & Electronics System

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Automotive Electrical & Electronics System	190412/190402	L	T	P	Max.Marks-50 Min.Marks-16 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: State various laws of Basic Electrical & Electronics.	Skill Development
CO2: Identify the different types of electrical and Electronics components of Automotive Vehicles.	Skill Development
CO3: Explain the working principle of different electrical & Electronic components.	Skill Development
CO4: Apply the knowledge of electrical & Electronics to calculate different performance parameter	Skill Development
CO5: Analyse the performance of various components used in different Conditions.	Skill Development
CO6: Create vehicle electrical and electronic circuits as per various segments of vehicles.	Skill Development

Pre-requisite:

Basic Electrical and Electronics Engineering

Course Objectives:

To make the students:

1. Provide knowledge about application of electrical and electronics in automobile engineering
2. Develop skill of finding faults and rectification of ignition circuits and wiring.
3. Study different types of sensors, working and their applications.

Syllabus:

UNIT I ELECTRIC POWER SOURCE:

Storage Batteries: Requirements, Basic Principle, construction, charging and discharging of battery, battery characteristics, **battery Capacity**, Efficiency, Rating and performance of lead acid battery, Battery

types: Maintenance free battery, AGM battery, Deep cycle resistant battery, Battery maintenance, Electrolyte, Battery tests, Battery charging equipment and methods. Battery malfunctions.

UNIT II STARTER AND CHARGING SYSTEMS:

Starter and charging system: Requirements of starter, design factors, classification, operation of starter, triggering the starter, characteristics of starter motor, type of starting, motor drive mechanisms, starter switch, starter system fault Diagnosis.

Charging systems and Accessories: D.C. generator & A.C. alternators, Magneto, Armature reaction, Cut out relay, Voltage and Current regulatory system for generator and alternators. Electrodynamics and electromagnetic principle.

UNIT III AUXILLIARY SYSTEMS:

Symbols used in circuit diagrams, Lighting equipment's: low beam and high beam head lamp (Reflection headlamps, facet-type reflector, PES headlamps, Xenon headlamps, Bi-Litronic), tail lamps, fog lamps, brake light, side indicator, parking and other indicating lights. Principle of automotive illumination, dash board lights, indicators and meters, speedometers, electric horn, windshield wiper, heaters & defrosters, electric horn and relay devices.

Different types of gauges and indicators. Electrical fuel pump. Ignition system: Contact less electronic ignition system, electronic spark timing and its control. EG Rcontrol.

Electronic ignition systems – Spark advance correction schemes: Vacuum Advance Mechanism, Centrifugal Advance Mechanism, fuel injection timing control.

UNIT IV ELECTRONIC VEHICLE MANAGEMENT SYSTEM: Cruise control system, Electronic suspension system, Low tire pressure warning system. Microprocessor and microcomputer-controlled devices in automobiles such as voice warning system, travel information system, keyless entry system, Automatic transmission system, Electronic steering system

Sensors: Basic sensor arrangements. Types of sensors – oxygen sensor, hot wire anemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, Crank position sensor.

UNIT V SAFETY SYSTEMS:

Antilock braking system, air bag restraint system, voice warning system, seat belt system, road navigation system, antitheft system.

Text Books:

1. Modern Electrical Equipment of Automobiles by Judge. A.W; Chapman & Hall, London, 1992

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2. Automobile Electrical Equipment by Young A. P., & Griffiths L.; English Language Book Society & New Press, 1990
3. Automotive electrical equipment's, P.L. Kohli, TMH
4. Electrical Ignition Equipment, Constable & Co Ltd. by Spreadbury. F.G; London, 1962
5. Automotive computers and Digital Instrumentation by Robert N Brady; A Reston Book, Prentice Hill, Eagle Wood Cliffs, New Jersey, 1988..

List of Experiments (Expandable):

1. Experiment on testing and study of different types of Batteries and constructions.
2. Testing, Assembling and dismantling of starter motor used in automobile.
3. Testing, Assembling and dismantling of alternator used in automobile.
4. Study of different color code system used in automotive wiring system.
5. Demonstration and study of Battery Ignition System and their parts used in Automobile Vehicles.
6. Study of different Electrical Equipment's & Accessories (Speedometer, Warning lights, Electric Horn, Wind shield wipers system)
7. Study of different sensor used in modern automotive system.
8. Study of various electronics system (Electronic fuel injection system, Electronic ignition system, Air bag, ABS, Electronic fuel injector cleaner).
9. Demonstration and experiment on lighting system, head light
10. Demonstration, experiment and diagnosis on ignition system.

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For batches admitted in Academic Session 2020-21

Manufacturing Processes

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Manufacturing Processes	190414/120311/ 120403/190404	2	1	-	Max.Marks-50 Min.Marks-16 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1- Describe the different types of manufacturing processes and their applications.	Skill Development
CO2- Identify suitable manufacturing process to achieve the required product shape with the aim of avoid . defects, material and time wastage.	Skill Development
CO3- Illustrate the advantage and limitations of various manufacturing processes with regard to shape formation and surface quality.	Skill Development
CO4-Analyse the manufacturing processes for given problem and able to select an appropriate process according to a specific requirement	Skill Development
CO5-Evaluate the procedures and techniques involved for the manufacturing of components for its optimization.	Skill Development
CO6-Propose a simplified manufacturing processes with the aim of reduction of cost and manpower.	Skill Development

Course Objectives: To make students:

1. Able to learn the various methods and types of castings, welding processes, sheet metal forming, powder metallurgy
2. Able to examine the principles associated with basic operations involving the forming, machining and welding of engineering materials;
3. Aware of the necessity to manage manufacturing processes and systems for the best use of material and human resources.

Course Pre-Requisites: Manufacturing Practice

Syllabus

Unit-I Casting: Brief History, Basic principle & survey of casting processes. Sand casting, pattern materials, and allowances. Green and dry moulding, moulding methods, moulding sand properties and testing. Elements of mould and design considerations. Cores use, core materials and core making practice. Die, investment and centrifugal casting processes. **Melting practice and concepts in solidification. Inspection and defects analysis.**

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Unit-II Forming: Elastic and plastic deformation, Concept of strain hardening. Rolling, forging, extrusion, spinning, wire and tube drawing processes, machines and equipment's, parameters and force calculations.

Unit-III Sheet Metal Working: Role of sheet metal components. Cutting mechanism. Description of cutting processes like blanking. Piercing, lancing etc. Description of forming processes like bending cup drawing, coining, embossing etc. Basic elements of presses for sheet metal working. Punch and Die clearances and die elements.

Unit-IV Welding: Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables. MMAW, TIG& MIG processes and their parameter selection. Resistance Welding: principle and equipment. Spot, projection and Seam welding processes, Gas welding and cutting: Processes and equipment.

Unit-V Powder Metallurgy: Powder manufacturing, compaction and sintering processes. Advantages and applications of P/M. Manufacturing of Powder metallurgy components.

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

CO1- Describe the different types of manufacturing processes and their applications.

CO2- Identify suitable manufacturing process to achieve the required product shape with the aim of avoid . defects, material and time wastage.

CO3- Illustrate the advantage and limitations of various manufacturing processes with regard to shape formation and surface quality.

CO4-Analyse the manufacturing processes for given problem and able to select an appropriate process according to a specific requirement.

CO5-Evaluate the procedures and techniques involved for the manufacturing of components for its optimization.

CO6-Propose a simplified manufacturing processes with the aim of reduction of cost and manpower.

Text Books:

1. Jain R.K., Production Technology, Khanna Publishers, 2001.
2. Hajra Choudhry, Elements of Workshop Technology, Vol – II Media Promoters & Publishers, 1994.
3. Production Technology by HMT, Tata McGraw-Hill.
4. Chapman, W.A.J., Workshop Technology, Vol - II, Oxford & IBH Publishing Co. Ltd.,

5. Manufacturing Processes by Amstead, B.H., P.F. Oswald and M.L. Begeman, John Wiley and Sons Inc., New York.
6. Manufacturing Technology Vol. 1 by P.N. Rao.
7. Modern Manufacturing Process Engineering by Neibel, B.W., Alan B. Draper and R.A. Wysk, McGraw-Hill Publishing Co., New York.
8. Manufacturing Engineering and Technology by Kalpakjian, S, Addison-Wesley Publishing Co., New York.
9. Materials and Processes in Manufacturing by E. Paul DeGarmo, J. Temple Black, and Ronald Kohser, Macmillan Publishing Co., New York.
10. Introduction to Manufacturing Processes John A. Schey, McGraw-Hill Book Co., New York

NPTEL Link for Manufacturing Process

<http://nptel.ac.in/courses/112107145/>

120601: Advanced Production Technology

(for batch admitted 2019-20)

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Department Core-DC	Advanced Production Technology	120601	L	T	P	Max.Marks-70
			2	1	2	Min.Marks-22 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Illustrate the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion.	Skill Development
CO2: Demonstrate the machining operations, programming languages and its control system used for solving practical problems of automation based.	Skill Development
CO3: Compare the components of computer integrated manufacturing and integrate them in a coordinated manner.	Skill Development
CO4: Decide between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements.	Skill Development
CO5: Designing Flexible manufacturing cell after carrying out Group technology study, Automated Material Handling Systems, Automated Inspection Systems and finally creating FMS.	Skill Development
CO6: Knowledge in the broad spectrum of Production Engineering.	Skill Development

Course Objectives: To make the student understand:

1. the application of computers in various aspects manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity and reduces the unnecessary costs.
2. the fundamental of automation and brief history of robot configurations, sensors, end effectors, vision systems and to impart knowledge of various additive manufacturing Technologies for application to various industrial needs.

Pre-requisite: Manufacturing Processes, Metal cutting

Syllabus

UNIT-I FUNDAMENTALS OF NC, CNC & DNC MACHINES: Principles of numerical control, types of CNC machines, features of CNC systems, integration of CNC machines in CIM environment, Direct numerical control (DNC), Open loop system, Closed loop system.

UNIT-II CONSTRUCTIONAL FEATURES OF CNC MACHINES and PART PROGRAMMING:
 Features of CNC Machines such as Structure, Drive Mechanism, Main drive, feed drive, Spindle Motors, Axes motors, Tool magazines, ATC, Control systems, Feedback devices, Input media and coding formats.
 Manual part programming for Lathe, Drilling and Milling machines, Cutter diameters and Length

compensation. Computer assisted part programming Languages APT, EXPAT, ADAPT, COMPACT. Computer numerical control, direct and distributed numerical control, adaptive control.

UNIT-III GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: - GT Part Families, Classification & coding, M/C Cell Design, Benefits of GT, FMS Workstations, Material Handling & Storage Systems, Computer Control System, Planning of FMS Analysis Methods. Basic Elements of an Automated system, Levels of Automation.

UNIT-IV INDUSTRIAL ROBOTICS: Industrial Robots and their applications for transformational and handling activities. Configuration and motions, robot classification and their performance capabilities, hardware of robots, Actuators, sensors and end effectors, selecting assembly machines Feeding and transfer of arts, applications of robots in manufacture and assembly.

UNIT-V ADDITIVE MANUFACTURING: Introduction and Basic Principles of Additive Manufacturing, Development of Additive Manufacturing Technology, Generalized Additive Manufacturing Processes, Photopolymerization Processes / Powder based system Processes / Extrusion-Based Systems, Material Jetting / Binder Jetting / Sheet Lamination/sintering Processes, Prototyping, Rapid Tooling, Applications of Additive Manufacturing, Comparison of Additive Manufacturing Methods.

Text & References Books:

1. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI publication.
2. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication
3. Computer control of machine tools by Koren Yoram, Tata McGraw Hill publication
4. Manufacturing Engineering And Technology by Serope Kalpakjian, PHI publication.
5. CAD/CAM/CIM by Bhupendra Gupta, Dhanpat Rai publication
6. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009.
7. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.

List of Experiments:

1. CNC Programming and Simulation.
2. Setting up of workpiece zero position and machining in Modular Vertical 3 Axis CNC Milling machine.
3. Machining in Semi production Vertical 3 Axis CNC machine
4. Setting up of workpiece zero position and machining in Modular CNC Turning machine.
5. Write a manual part program for the linear interpolation for the given part and execute.
6. Write a manual part program for the taper turning for the given part and execute.
7. Write a manual part program for chamfering and step turning for the given part and execute.

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Dr. P. K. [Signature]
Head of Department of Mechanical Engineering
M.T.S. Institute of Technology & Science
Gwalior (M.P.)

8. Write a manual part program for slotting operation for the given part and execute.
9. Write a manual part program for drilling operation for the given part and execute.

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Madhav Institute of Technology & Science
Gwalior

190601 Automotive Transmission

(for batch admitted 2019-20)

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Automotive Transmission	190601	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: State the need of transmission System in an Automobile.	Skill Development
CO2: Describe the working of different component of transmission system.	Skill Development
CO3: Identify the working principle used in various transmissions.	Skill Development
CO4: Compare the various transmission systems according to their applications.	Skill Development
CO5: Analyze the merits and demerits of different components of transmission.	Skill Development
CO6: Design the transmission system for different types of vehicles.	Skill Development

Course Objectives

To make the students:

1. develop the basic knowledge of the students in mechanics, torque conversion areas.
2. understand various transmission system.
3. develop the skills to work in the areas of alternative drives.

Syllabus

UNIT -I TRANSMISSION REQUIREMENTS:

Requirements of transmission system, general arrangement of power transmission, general arrangement of rear-engine vehicle with live axles, general arrangement of dead- axle and axles transmission; four-wheel-drive transmission.

UNIT -II CLUTCHES:

Clutches Requirements of clutches, principle of friction clutches, types of clutches and materials used- cone, single-plate, diaphragm-spring, multi-plate, centrifugal, over-running and electromagnetic clutch.

UNIT -III GEAR BOX:

Need of gear boxes, types- sliding mesh, constant mesh and epicyclic, gear boxes;

Synchronizers: principle, early and later Warner synchronizer, Vauxhall synchronizer- gear materials lubrication and design of gear box; **Hydrodynamic drive:** Advantages and limitations, principle of fluid coupling, constructional details, torque-capacity performance characteristics, drag torque, methods of minimizing drag torque; **Torque converter:** performance characteristics; single, multistage and poly phase

torque converters, converter-coupling-performance characteristics, coupling-blade angle and fluid flow, converter fluid.

UNIT-IV TRANSMISSION SYSTEMS-DRIVE LINE:

Definition, forces & torques acting; types of drives-Hotchkiss, torque tube & radius rod drives; components- propeller shaft, slip joint, universal joints & constant velocity universal joints; front wheel drive; Final drive: definition; types- worm-wheel, straight-bevel gear, spiral-bevel gear & hypoid-gear drives; double-reduction & twin-speed final drives; Differential: Function, principle, construction and working; non-slip differential; differential lock; rear axle- loads acting & types; multi-axled vehicles.

UNIT -V AUTOMATIC TRANSMISSION:

Chevrolet "turbo glide" transmission, power glide transmission, hydraulic control system of automatic transmission; Electric drive: advantages and limitations, principle of early and modified Ward-Leonard system, modern electric drive for buses; performance characteristics.

Text & References Books:

- 1 Heldt P.M.; Torque converters; Chilton Book Co.
- 2 Giri NK; Automobile Engineering; Khanna Publisher
- 3 .Newton, Steeds & Garret; Motor Vehicles; B.H. Publication.
4. Judge, A.W., Modern Transmission Systems, Chapman & Hall Ltd.
5. Check Chart; Automatic Transmission; Harper & Row Publication.

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120611: Vibration and Noise Engineering

Category	Title	Code	Credit - 4			Theory Paper
Departmental Elective-DE1	Vibration and Noise Engineering	120611	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: understand basics of vibration and noise.	Skill Development
CO2: define the physical systems in to spring-mass-damper systems.	Skill Development
CO3: use different methods and principles applicable to dynamic systems.	Skill Development
CO4: determine responses of vibrating systems.	Skill Development
CO5: analyse the behaviours of physical systems.	Skill Development
CO6: design the mechanical systems by considering vibration and noise.	Skill Development/ employability

Prerequisite: Engineering Mathematics, Basics of Electrical and Electronics, Theory of Machines, Mechanics of Materials

Course Objectives:

1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. To be able to resolve industrial problems related to vibration and noise.

Syllabus

Unit-I: Basics of Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition, beats phenomena, undamped and damped vibrations, free and forced vibration, Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations using Newton's second law, **D' Alembert's principle and Principle of conservation of energy.**

Unit-II: Multi Degree Freedom System: Free Vibration equation of motion. Langranges Equations Matrix Method, Eigenvalues and Eigenvector problems. **Modal Analysis. Forced Vibrations of undamped system and modal analysis.**

Numerical Methods: **Rayleigh's Method**, Rayleigh-Ritz Method, Holzer's Method, Methods of Matrix iterations, Transfer Matrix Method, Impulse response and frequency response functions.

UNIT III Continuous System:

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Vibrations of String, Bars, Shafts and beams, free and forced vibration of continuous systems.

Transient vibrations: Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response functions.

Vibration Control:

Balancing of rotating machine, In-situ balancing of rotors, control of natural frequency, introduction of damping, transmissibility, vibration isolation & vibration absorbers.

UNIT IV Vibration Measurement: Transducers, FFT analyzer, vibration exciters, signal analysis. Time domain & Frequency domain analysis of signals. Experimental modal analysis, Machine Conditioning and Monitoring, fault diagnosis.

UNIT V Noise and Its Measurement:

Sound waves, governing equation its propagation, Fundamentals of Noise, Decibel, Sound Pressure level, Sound Intensity, Sound fields, reflection, absorption and transmission. Noise measurement, Sound meter, Allowed exposure levels and time limit by B.I.S., Octave Band analysis of sound, Fundamentals of Noise control, source control, path control, enclosures, noise absorbers, noise control at receiver.

Text Books:

1. Mechanical Vibrations: G K Groover.

References Books:

1. Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi
2. Mechanical Vibrations: S SRao Addison-Wesley Publishing Co.
3. Fundamentals of Vibration: Leonard Meirovitch , McGraw Hill International Edison.
4. Principles of Vibration Control: Asok Kumar Mallik, Affiliated East-West Press.
5. Mechanical Vibrations A H Church ,John Wiley & Sons Inc
6. Mechanical Vibrations J P Den Hartog ,McGraw Hill.
7. Mechanical Vibration Analysis: Srinivasan ,McGraw Hill.
8. Vibration and Noise for Engineers: KewalPujara ,DhanpatRai& CO.

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120612: Statistical Quality Control

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective-DE1	Statistical Quality Control	120612	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Draw the histogram, bar charts.	Skill Development
CO2:State various techniques including various variable and attribute control charts	Skill Development
CO3: Relate mathematical standard plots for defect analysis.	Skill Development
CO4: Justify the life cycle of component on the basis of Reliability and Quality.	Skill Development
CO5: Compare various statistical quality control tools.	Skill Development
CO6: Solve quality-related problems using these SQC tools and methods.	Skill Development

Course Objective: To make the students to understand:

1. The concepts of inspection techniques.
2. About reliability, life testing and costing of product.

Syllabus

Unit-I: Statistical Concepts:

Inspection types, Organization, Advantages & Limitations. Comparison with quality control. Development. Statistical Concept-Frequency, Tally Sheet, Histogram, Bar Chart, Mean, Median, Mode, Standard Deviation. Variance. Concept of Probability, Hyper, Geometrical, Binomial, Poison & Normal Distribution, Area Under Normal Curve, Estimation of Parameters.

Unit-II: Control Chart Techniques:

Control Charts for Average, range & Standard Deviation, Fraction Defective & Percent Defectives, Control Chart for No. of Defects Per Unit.

Unit-III: Acceptance Sampling:

Fundamentals, OC Curves, Single Sampling Plan, Double Sampling plan, Sequential Sampling Plan. AQL & AOQL. Dodge – Roming Plan for Lot by Lot Acceptance Sampling for Attributes.

Unit-IV: Reliability, Cost & Design Aspects of S.Q.C.:

Life Testing & Reliability, Cost due to Poor Quality, Quality Cost With- 100% inspection, Sampling Inspection & NO. Inspection. Statistical Aspect of Tolerance Setting Design.

120613: Work Study and Ergonomics

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective-DE1	Work Study and Ergonomics	120613/190612	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Identify potential and current OH&S hazards in the workplace relating to ergonomics issue.	Skill Development
CO2: Describe relation between human motion and industry.	Skill Development
CO3: Calculate the production capacity of man power of an organization.	Skill Development
CO4: Analyze the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.	Skill Development
CO5: Devise appropriate wage and incentive plan for the employees of an organization.	Skill Development
CO6: Design physical and psychosocial work system and work places.	Skill Development/ Employability

Course Objective: To make the students to understand:

1. Concept and significance of work study and ergonomics.
2. Various techniques of work-study for improving the productivity of an organization.

Syllabus

Unit -I Human being in Man Made World, Gross Human Anatomy, Anthropometrics, Static and Dynamic, Muscles and Work Physiology, **Static and Dynamic Work including Maximum Capacity.**

Unit-II Biomechanics, Environmental Condition including Thermal, Illumination Noise and Vibration, Biological Transducer and Nervous system including their Limitations. Control and Displays Psycho Physiological aspects of Design. Research Techniques in Ergonomics. Generation. Interpretation and application as statistical Methods. Case Analysis

Unit-III Method Study: - Selection of Problem, Application of critical examination techniques. Preparation of work Study Reports, **Development of improved methods**, preparation for and presentation of improved methods, implementation of improved methods, follow-up techniques and report.

Unit-IV Work Measurement: - **Work Sampling.** Fundamental statistical concepts sample size, procedure for making a work sampling study, determining time standards by work sampling, practical applications, advantages and disadvantages.

Unit-V Micro Motion Study:- **PMTS. MTM Systems** work factor system and Production Incentives

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Text & References Books:

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Lakhwinder Pal Singh, "Work Study and Ergonomics" CAMBRIDGE , 2010.
3. S.K. Sharma Savita Sharma , "Work Study and Ergonomics" S K Kataria and Sons 2006.
4. P.C.Tiwari, "Work Study and Ergonomics" CRC Press , 2004.
5. Suresh Dalela and Saurabh Dalela, "Work Study and Ergonomics" CRC Press , 2001.
6. Marvin E, Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education,2000.

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120614: Turbo Machinery

Category	Title	Code	Credit - 4			Theory Paper
			L	T	P	
Departmental Elective –DE1	Turbo Machinery	120614	4	-	-	Max.Marks-70 Min.Marks-22 Duration-3hrs

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Understand the working principles of rotating machines.	Skill Development
CO2: Describe the velocity triangles, thermodynamic plots and losses in turbo-machinery.	Skill Development
CO3: Demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo machinery.	Skill Development
CO4: Analyze the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.	Skill Development
CO5: Analyze energy transfer through graphical and analytical methods in turbo machines.	Skill Development
CO6: Design different type of rotating machine	Skill Development/ Employability

Course Objectives: To make the students to understand:

1. To enable the students, know the operation of turbo machines for compressible and incompressible fluids.
2. To provide students thorough understanding of velocity triangles, thermodynamic plots and losses in turbo machinery.

Syllabus:

UNIT-I Fundamentals of Turbo Machinery:

Energy Transfer in Turbo Machines Application of first and second Laws thermodynamics to turbo machines. Moment of momentum equation and Euler turbine equation. Principles of Impulse and reaction machines, **degree of reaction**, Energy equation for relative velocities, one dimensional analysis only.

UNIT-II Steam Turbine:

Impulse staging, velocity and pressure compounding utilization factor, analysis for optimum U.F. curtis stage, and Rateau stage, including qualitative analysis. Effect of blade and nozzle losses on Vane efficiency, Stage efficiency. Analysis for optimum efficiency vortex types of flow, flow with constant reaction. **Governing and Performance characteristics of steam turbines.**

UNIT-III Water Turbines:

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Classification, Pelton, Francis and Kaplan turbines, vector diagrams and workdone, Draft Tubes, governing or water turbines, cavitation problem, methods to avoid cavitation, performance characteristics of water turbine.

UNIT-IV Centrifugal Pumps:

Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics: Application of dimensional analysis and similarity to water turbine and centrifugal pumps, unit and specific quantities, selection of machines, Hydraulic, volumetric mechanical and overall efficiencies, Main and operating characteristics of the machine cavitation.

UNIT-V Rotary Fans, Blowers and Compressors:

Classification based on pressure rise, Centrifugal and axial flow machines.

Centrifugal Blowers: Vane shapes, Velocity triangle degree of reactions, slip cost event speed of machine. Vane shape and stresses, efficiency characteristics. Fan laws and characteristics.

Centrifugal Compressor: Vector diagrams, work done, temp, and pressure ratio, slip factor, was input factor, pressure coefficient, Dimensions of inlet eye, impeller and diffuser.

Axial flow compressors: Vector diagrams, work done factor, temp. and pressure ratio, degree reaction. Dimensional Analysis, Characteristics, surging, Polytropic and isentropic efficiencies.

Text Books:

1. Fluid mechanics and fluid power engineering – by Dr. D. S. Kumar, Kat Son, Latest edition
2. Thermal Engineering – by P L Ballaney, Khanna Publisher Latest edition.

Reference Books:

1. Thermal Engineering-by R.K. Rajput, Latest edition
2. Turbines, Fans & Compressors – by S.M. Yahya, TMH Latest edition
3. Fluid Mechanics, Thermodynamics of Turbomachinery, S. L. Dixon, Butterworth-Heinemann, Latest edition
4. Power plant engineering, P K Nag TMH, Reprint Latest edition

190611: Automotive Materials

Category	Title	Code	Credit - 4			Theory Paper
			L	T	P	
Departmental Elective-DE 1	Automotive Materials	190611	L	T	P	Max.Marks-70
			4	-	-	Min.Marks-22 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Define various properties of the materials used in the automotive manufacturing.	Skill Development
CO2: Describe different types of materials used in the Automobile industry and their application.	Skill Development
CO3: Classify different materials according to their properties and usage.	Skill Development
CO4: Demonstrate the use of advance and non-conventional materials and how they are beneficial for the automobiles.	Skill Development
CO5: Compare different types of materials based on their properties and cost.	Skill Development
CO6: Select the best possible materials for a particular automobile applications and for specific requirements.	Skill Development

Pre-requisite:

Nil

Course Objectives:

- To develop the knowledge of Automotive engineering materials and Selection
- To develop the knowledge of materials and their applications in automotive applications
- To introduce the concepts of heat treatment and surface modification techniques

Syllabus

UNIT 1: AUTOMOTIVE COMPONENTS & MATERIAL SELECTION

Organized process of Selection of Materials for different components. Materials for Power train components like cylinder block ,head& liner, piston &piston rings, gudgeon pin, connecting rod, bearings, crankshaft, flywheel, camshaft, valves, valves seats, springs, gear train, chain &belt drives. Materials for Automobile components like body –in –white, crash worthiness, suspension systems, cabin interiors. Functional requirements, manufacturing processes & failure modes for each.

UNIT 2: ENGINEERING ALLOYS

Cast iron, steels, alloy steels - significance of iron – iron carbide equilibrium diagram in design steels and cast irons, stainless steels –, types, specific applications, heat treatment, effect of alloying

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elements Aluminium, Magnesium and Ti wrought and cast alloys used in automotive applications – Types, specifications, heat treatment.

UNIT 3: SURFACE MODIFICATION OF MATERIALS

Mechanical surface treatment and coating - Case hardening and hard facing - thermal spraying – vapour deposition-iron implantation - Diffusion coating - Electroplating and Electro-less - Conversion coating -Ceramic and organic coatings – laser based surface modification Diamond coating.

UNIT 4: NON METALLIC MATERIALS

Elastomers and Engineering Plastics, FRP Composite materials, ceramics, laminated & heat treated glass, adhesive bonding, An over view of Manufacturing processing, their characteristics features, types and applications.

UNIT 5: MODERN MATERIALS AND ALLOYS

Lightweight materials & implications on vehicle design,, Micro alloyed, high strength low alloy steel – High strength Steels (HSS), Advanced High Strength Steels (AHSS), Ultra high strength Steels (UHSS), developments in Aluminium and Magnesium alloys; Carbon fiber composites, Natural fibers, refractory metals, SMART Materials - shape memory alloys (SMA), Piezo-electric materials, MEMS, Metallic glass-Quasi crystal and Nano crystalline materials, metal foams.

Text & References Books:

1. Callister W.D. (2006) "Material Science and Engineering- An introduction", Wiley –Eastern can be indicated as a text book.
2. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 9th Edition 2009, can be included as a text book
3. Hiroshi Yamagata “The Science and Technology of Materials in Automotive Engines”
4. Thomas H. Courtney, (2000) “Mechanical Behavior of Materials”, McGraw Hill.
5. Flinn R. A. and Trojan P. K., (1999)”Engineering Materials and their Applications”, Jaico.

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190612: Work Study and Ergonomics

Category	Title	Code	Credit-4			Theory Paper
Departmental Elective-DE 1	Work Study and Ergonomics	190612/120613	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Identify potential and current OH&S hazards in the workplace relating to ergonomics issue.	Skill Development
CO2: Describe relation between human motion and industry.	Skill Development
CO3: Calculate the production capacity of man power of an organization.	Skill Development
CO4: Analyze the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.	Skill Development
CO5: Devise appropriate wage and incentive plan for the employees of an organization.	Skill Development
CO6: Design physical and psychosocial work system and work places.	Skill Development

Course Objective: To make the students to understand:

1. Concept and significance of work study and ergonomics.
2. Various techniques of work-study for improving the productivity of an organization.

Syllabus

Unit –I Human being in Man Made World, Gross Human Anatomy, Anthropometrics, Static and Dynamic, Muscles and Work Physiology, Static and Dynamic Work including Maximum Capacity.

Unit-II **Biomechanics**, Environmental Condition including Thermal, Illumination Noise and Vibration, Biological Transducer and Nervous system including their Limitations. Control and Displays Psycho Physiological aspects of Design. **Research Techniques in Ergonomics** .**Generation**. Interpretation and application as statistical Methods. **Case Analysis**

Unit-III Method Study: - Selection of Problem, Application of critical examination techniques. Preparation of work Study Reports, **Development of improved methods**, preparation for and presentation of improved methods, implementation of improved methods, follow-up techniques and report.

Unit-IV Work Measurement: - **Work Sampling**. Fundamental statistical concepts sample size, procedure for making a work sampling study, determining time standards by work sampling, practical applications, advantages and disadvantages.

Unit-V Micro Motion Study. **PMTS**. **MTM Systems** work factor system and Production Incentives

Text & References Books:

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1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Lakhwinder Pal Singh, "Work Study and Ergonomics" CAMBRIDGE , 2010.
3. S.K. Sharma Savita Sharma , "Work Study and Ergonomics" S K Kataria and Sons 2006.
4. P.C.Tiwari, "Work Study and Ergonomics" CRC Press , 2004.

190613: Automotive Pollution and Control

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Category	Title	Code	Credit-4			Theory Paper
Departmental Elective-DE1	Automotive Pollution And Control	190613	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: State the demand of the world, nation and available resources to full fill the demand.	Skill Development
CO2: Describe about the exploration of known conventional energy resources and their effective tapping technologies.	Skill Development
CO3: Demonstrate the different emission measurement test.	Skill Development
CO4: Compare the different modern energy conversion technologies.	Skill Development
CO5: Select appropriate technology for the effective utilization of available renewable energy resources.	Skill Development
CO6: Design various pollution control devices.	Skill Development/ Employability

Course Objectives: To make the students to understand:

1. The present and future energy demand of world and nation and techniques to exploit the available renewable energy resources such as, solar, bio-fuels, & electric vehicles.
2. The emissions standard.

Syllabus

UNIT I - EMISSIONS FROM SI ENGINES AND THEIR CONTROL:

Various pollutants from SI and CI engines. Effects of pollutants on environment and human beings. Estimation of petroleum reserves. Need for alternative fuels. Potential alternative fuels (alcohols, oxygenates, hydrogen, LPG, NG, biogas, and vegetable oils), Merits and demerits of various alternative fuels.

Emission formation in SI engines (CO, HC and NO_x). Effect of design and operating variables on emission formation. Control techniques -Thermal reactor, exhaust gas recirculation, three way catalytic convertor and Charcoal canister control for evaporative emission- positive crank case ventilation for blow by gas control.

UNIT II - EMISSIONS FROM CI ENGINES AND THEIR CONTROL:

Emission formation in CI engines (HC, CO, NO_x, aldehydes, smoke and particulates), effect of design and operating variables on emission formation, control techniques, exhaust gas recirculation, NO_x selective catalytic reduction, diesel oxidation catalytic convertor, diesel particulate filter, NO_x versus particulates –trade off.

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UNIT III - EMISSION MEASURING INSTRUMENTS AND TEST PROCEDURES:

Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO₂ and CO by NDIR, hydrocarbon emission by FID, Chemiluminescent analyser for NO_x, Liquid and Gas chromatograph, spot sampling and continuous indication type smoke meters (Bosch, AVL and Hartridge smoke meters) emission test procedures – FTP, Euro and Bharat norms

UNIT IV - ALCOHOL FUELS AND GASEOUS FUELS:

Properties of alcohols, engine modifications required to use alcohols in SI engines, performance, combustion and emission characteristics in SI engines, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, use of alcohols in CI engines-emulsions, dual fuel system, spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in CI engines.

Properties of hydrogen, production and storage methods, safety precautions, use in SI and CI engines, biogas production and its properties, use in SI and CI engines, properties of LPG and CNG, use in SI and CI engines. Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines.

UNIT V - VEGETABLE OILS:

Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines, methods to improve the engine performance using vegetable oils-preheating, Etherification (biodiesel, blending with good secondary fuels, semi-adiabatic engine, surface ignition engine, ignition accelerators dual fuelling with gaseous and liquid fuels, performance, combustion and emission characteristics of vegetable oil fuelled diesel engines.

Text book

1. Ganesan V, "Internal combustion engines", 4th edition, Tata McGraw Hill Education, 2012.

References

1. Michael F. Hordeski, "Alternative Fuels: The Future of Hydrogen", The Fairmont Press, Inc., 2008.
2. Rajput R. K, "A textbook of Internal Combustion Engines", 2nd edition, Laxmi Publications (P) Ltd, 2007.
3. "Society of Automotive Engineers", Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000.
4. Thipse S. S, "Alternative Fuels: Concepts, Technologies and Developments", Jaico Publishing House, 2010.

List of Experiments

1. Study of secondary fuels in IC engine.
2. Study of emission control device and methods in IC engine.
3. Study of various vegetable oils for diesel engine.
4. Emission test /smoke test of SI and CI engine.
5. Octane number and cetane number test of petrol and diesel.
6. AmitavaMitra, Fundamentals of Quality Control and Improvement, John Wiley & Sons

190614: Automotive Component Design

Category	Title	Code	Credit-4	Theory Paper
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Departmental Elective-DE1	Automotive Component Design	190614	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			4	-	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Apply the fundamental concept of Mechanics and strength of material to develop a mathematical model for various automotive components.	Skill Development
CO2: Ability to do cam mechanism classification and cam motion profiles, and familiarity with introductory cam design considerations.	Skill Development
CO3: Recognize and select the different type of frictional drives for automotive power transmission.	Skill Development
CO4: Awareness of the ways that heat transfer applies to thermal design of clutch and brakes.	Skill Development
CO5: Describe the representation of materials and machine elements used in machine drawing	Skill Development
CO6: Construct an assembly drawing using part drawings of machine components.	Skill Development

Pre-requisite:

Basic concept of strength of material and material science.

Course Objectives:

To make the students understand:

1. How to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used Automotive components.
2. The variety of Automotive components available and emphasize the need to continue learning.
3. How to apply Automobile engineering design theory to identify and quantify machine elements in the design of commonly used Automotive systems.
4. How to apply computer based techniques in the analysis, design and/or selection of Automotive components.

Syllabus

UNIT-I: Design of friction clutches: common friction materials, single plate, multi plate and centrifugal clutches and their characteristics and design of friction clutches.

Design of Brakes: Common friction materials, shoe, band, cone and disc brakes their characteristics and design of brakes.

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UNIT II: Cam Design: Introduction, cam terminology, types of cam ,follower and follower motions. Motion constraints, svaj diagrams, single-dwell and double-dwell cam design. Critical path motion, pressure angle and radius of curvature of cam motion; introduction of SOHC and DOHC.

UNIT-III Design of Engine Parts: Piston, Engine Valves, Cylinder, Connecting Rod, Crank Shaft and flywheel for CI and SI engines.

UNIT-IV Design of suspension spring and front axles:

Types of Suspension springs. Design of coil spring, leaf spring. Design of front axle beam.

UNIT-V Assembly Drawing

- a. Piston Assembly
- b. Connecting rod assembly
- c. Shackle Assembly
- d. Wheel Cylinder Assembly
- e. Master Cylinder Assembly

Text /Reference Books:

1. Bhat, ND; Machine Drawing; Charotar
2. Machine Drawing by K R Gopal Krishna, Subhash Publication, Bangalore
3. Automotive Engineering by Drawing by R B Gupta
4. Narayana and Reddy; Machine Drawing; New age, Delhi.
5. Agarwal and agrawal; Engineering Drawing; TMH
6. Shigley JE et al; Mechanical Engineering Design, TMH
7. Kulkarni SG; Machine Design; TMH
8. Mubeen and Mubeen; Machine Design.
9. Maleeve Hartman and O.P. Grover, "Machine Design", CBS Publication & Publishers, ISBN-978-8123906379.

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900101 (OC-1): Robotics

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Open Course-OC	Robotics	900101	2	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Understand importance of robotics and its impact on human safety, quality of life, economy, environment, etc.; basics of open-ended type of Robotic manipulators.	Skill Development
CO2: Discuss Kinematics and dynamics of open ended robotic mechanisms; Fixing frames	Skill Development
CO3: Ability to formulate , derive, analyse, design and synthesize kinematics and dynamics of open ended robotic mechanisms.	Skill Development
CO4: Apply detailed concepts relating to various actuators, sensors, and their integration with drives and signal conditioning for robotics	Skill Development
CO5: Apply detailed concepts relating to various actuators, sensors, and their integration with drives and signal conditioning for robotics	Skill Development
CO6: Impart knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems. control theory and applying them to design and development of robots	Skill Development

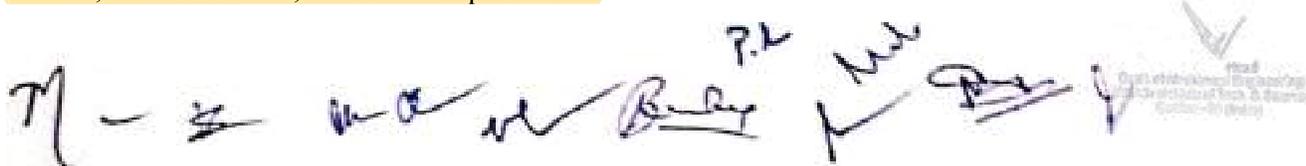
Course Objectives: To make the students to understand:

1. Study and understand the concepts of robotics and mechatronics.
2. Impart basic knowledge about the different sensors and their applications in robotics.
3. Learn the basic fundamentals of actuation Systems.
4. To impart knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems.
5. To work professionally in the area of robot programming.

Syllabus

UNIT - I Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system, Chain type: Serial manipulator and Parallel Manipulator. Components of Industrial robotics-recession of movement-resolution, accuracy and repeatability

Kinematic and Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors, Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, Force or Torque sensors.



UNIT - II Grippers - Mechanical Gripper-Grasping force, Magnetic gripper, vacume cup gripper-considerations in gripper selection and design, **Industrial robots** specifications. Selection based on the Application.

UNIT – III Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots. **Dynamics**: Equations of motion, State-Space equation,

UNIT - IV Trajectory planning: Joint space scheme- Cubic polynomial fit, Obstacle avoidance in operation space-cubic polynomial fit with via point, Introduction Cartesian space scheme. Control-Interaction control, Rigid Body mechanics, **Control architecture**- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

UNIT – V Basics of data acquisition systems, Programming of Robots - programming methods (Arduino MATLAB, Bond Graph, etc.), Vision System, Bioinspired robots and applications, Teach pendent- overview of various textual programming languages, Application of knowledge.

Text & References Books:

1. Introduction to Robotics: Mechanics and Control, **by** John J. Craig, Addison-Wesley.
2. Introduction to Robotics **by** S. K. Saha, Tata McGraw-Hill Publishing Company Ltd.
3. Introduction to Robotics Analysis Systems, Applications **by** S. B. Niku of Pearson Education.
4. Industrial Robotics-Technology Programming and Applications **by** M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey of McGraw-Hill Book and Company
5. Robotics: Fundamental Concepts and Analysis **by** A. Ghosal of Oxford University Press.
6. Robot Dynamics and Control, **by** Spong M. W., and Vidyasagar M., John Wiley & Sons.
7. Mechatronic Systems: Fundamentals **by** R. Iserman of Springer.
8. Fundamentals of Mechatronics **by** Musa Jouaneh of Cengage Learning.
9. Mechatronics **by** W. Bolton, Pearson education.
10. Micromechatronics, Modeling, Analysis, and Design with MATLAB **by** V. Giurgiutiu and S. E. Lyshevski, CRC Press.
11. Bond Graph in Modeling, Amalendu **by** Mukherjee, Ranjit Karmakar and Arun Kumar Samantaray, Simulation and Fault Identification, I. K. International Publishing House Pvt.

900102 (OC-1): Product Design

Category	Title	Code	Credit - 3			Theory Paper
Open Course-OC	Product Design	900102	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	-	

Course outcomes focus on employability/ entrepreneurship/ skill development

Course Outcomes (COs)	Mapping
CO1: Analyze the demands and needs of customers to conceptualize product.	Skill Development
CO2: Describe the different steps involved in the product design.	Skill Development
CO3: Analyze the shortcoming in the product development.	Skill Development
CO4: Identify the opportunities to develop the product.	Skill Development
CO5: Utilize the recourses available in efficient manner for maximum productivity.	Skill Development
CO6: Forecast the impact of product on the surrounding environment.	Skill Development

Course Objectives: To make the students to understand:

1. The multidisciplinary aspects of product development and innovation.
2. The basic methodology and tools that can be used in product development projects.

SYLLABUS

Unit 1: Basic: Significance of product design, product characteristics, product design and development process, the challenges of product development, design morphology, sequential engineering design method.

Product Planning: Identifying opportunities evaluate and prioritize projects, allocation of resources.

Unit 2: Identifying Customer Needs: Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, Translating customer needs

Product Specifications: Establish target specifications, setting final specifications, product costing.

Unit 3: Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output.

Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, design for manufacturing, design for assembly, and design for maintenance, design for environment.

Unit 4: Concept Selection: Overview, concept screening and concept scoring, methods of selection, Creativity techniques.

Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, general theory of innovation and TRIZ, Value engineering applications in product development and design, Model-based technology for generating innovative ideas.

Unit 5: Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customer's response.

Intellectual Property: Elements and outline, patenting procedures, claim procedure.

Text books and References:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill.
2. Otto K, and Wood K, Product Design, Pearson.
3. George Dieter, Engineering Design, MGH New York.
4. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
5. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
6. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, AllaZusman, CRC Press.

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