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 Session 2019-20

120401: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Theory of Machines-II	120401	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course Pre-Requisite:
Engineering Graphics (Subject Code – 100105)
Mechanics of Materials (Subject Code – 120302)
Theory of Machines (Subject Code – 120303)

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.

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.

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

CO 1.Identify the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO 2.Classify various components of machines like gear, gear train cam etc
CO 3.Solve numerical problems of various components of machines like gear, gear train cam etc.
CO 4.Analyze the forces and motion of complex systems of linkages, gears and cams.

CO 5. **Evaluate** the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications.

CO 6. **Design** the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc.

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.

Laboratory Course Outcomes: After the completion of the course Lab student will be able to

CO1 **Identify** the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism.
CO2 **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
CO3 **Determine** the degrees-of-freedom (mobility) of a mechanism
CO4 **Apply** the fundamental principles of statics and dynamics to machinery.
CO5 **Evaluate** the dynamic forces for various machines.
CO6 **Analyze** the fundamentals of machines for desired kinematic or dynamic performance.

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120402: Design of Machine Elements

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Design of Machine Elements	120402	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

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

Course Pre-Requisites:
Mathematics-I
Mechanics of Materials

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

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.

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

CO1 Describe the basic design process and function of Permanent and temporary joints used in Machine Design

CO2 Summarize the design techniques, skills and tools used in design
CO3 Solve the various design engineering problems by formulate and proper assumptions for practice.
CO4 Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts
CO5 Evaluate the cases of Temporary and permanent joints problems successfully
CO6 Create design techniques for a mechanical component under variety of environmental and service conditions.

Text &Reference Books

1. Mechanical Engineering Design byShigley JE et al; TMH
2. Machine Design byMubeen
3. Design of Machine elementsbyBhandari VB; TMH
4. Text Book of Machine Drawing byJohn KC; PHI Learning
5. Engineering design – George Dieter, MGH, New York.
6. Machine Drawing byBhat, ND; Charotar.
7. Machine Drawing byNarayana 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

Laboratory Course Outcomes: After the completion of the course Lab students will be able **to**
CO1 **Design** and analysis the different part of an I.C Engine like Piston, cylinder, connecting rod , crank shafts , flywheel.
CO2 **Compare** the materials used in designing the automobile engine parts.
CO3 **Use** the software like AUTO CAD , CATIA , PRO/E, SOLID WORKS.
CO4 **Select** the spring for a proper application also can select the proper material of spring.
CO5 **Design** the different types of gear like spur gear, helical gear , worm gear , bevel gear and also able to know their practical applications.
CO6 **Create** a gear box for modern Automotive vehicles and can use this for the benefits of society.

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Manufacturing Processes

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Manufacturing Processes	120403/190404	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

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 **e**xamine 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 (Subject Code – 100106)

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.

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 &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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Engineering Thermodynamics

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Engineering Thermodynamics	120404/190403	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

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 (Subject Code – 100204)

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

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 change of Ideal gas, Available energy, T-S diagram, Availability and Irreversibility.

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

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

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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: Investigate the effectiveness of energy conversion device in mechanical power generation

CO5:.**Analyze** air standard cycles applied in prime movers.

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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120405: Production Lab

Category	Title	Code	Credit-2			Practical Slot
			L	T	P	
Departmental Lab Core-DLC	Production Lab	120405	-	-	4	Max.Marks-50 Min.Marks-16

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

Laboratory Course Outcomes: After the completion of the course Lab student will be able to:

CO1 Define the different conventional method of material removal and function of different parts.
CO2 Apply the theory of metal cutting in experiments.
CO3 Perform step, taper turning, knurling and threading.
CO4 Produce stepped surface using shaper and keyway using milling machine.
CO5 Demonstrate knowledge of different machine tools used in machine shop.
CO6 Evaluate the chip thickness ratio, shear angle and material removal rate.