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

190511/120511: Industrial Engineering

Category	Title	Code	Credits: 3			Theory Paper
			L	T	P	
Departmental Core-DC	Industrial Engineering	190511/120511	2	1	-	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Course Objectives: Industrial engineering is concerned with the design, improvement, installation, and management of integrated systems of men, material, and machine. After completing this course, students will learn a set of skills that includes mathematical modeling, probability and statistics, computer science, human factors, interpersonal skills, project management, and an ability to manage and administer large technical engineering and research projects. Thus, industrial engineering may be thought of as applied problem-solving, from inception to implementation.

Syllabus

UNIT-I

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

Production Planning and Control: Needs of Production Planning and control, objectives of PPC, Principles of PPC, Functioning of PPC, Factor determining the PPC and Elements of PPC.

UNIT-II

Demand Forecasting: Introduction, demand patterns, Need and classification of forecasting techniques, factors affecting forecasting, time series analysis, qualitative methods- measures of forecast accuracy and error analysis in quantitative forecasting.

Aggregate Planning: Introduction to Aggregate Planning, Factors affecting aggregate planning, objectives and aggregate planning strategies, aggregate planning methods.

UNIT-III

Inventory Control: Meaning and types of inventories**,** objectives, and functions, need and classifications-codification and standardization, inventory control terminology, inventory cost relationship, deterministic and probabilistic inventory models, quantity discount, Probabilistic inventory management, economic ordering quantity procurement cost, carrying charges, lead-time, reorder point, selective control of inventory

UNIT-IV

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.

Unit-V

Production Scheduling and control: Production control outline, Gantt chart, n jobs and 2 machine problems, n jobs and 3 machine problems, Johnson's algorithm, scheduling strategies, concept of single machine scheduling, shortest Processing time rule, earliest due date, Model to Minimize total tardiness, branch, and bound technique to minimize tardiness. Floor shop scheduling, Job shop scheduling

Facility Locations, Plant Layout and Material Handling: 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.

Course outcomes: After learning the course the students should be able to:

CO1. **Define** and measure productivity.

CO2. **Understand** Production planning and control required for industry to analyze the engineering problems.

CO3. **Apply** engineering design to produce solutions that meet specified needs of manufacturing industry

CO4. **Analyze** practice through various Management and Operation Tools for Improving Quality and Quantity.

CO5. **Evaluate** various kinds of problems or issues faced by service and manufacturing industries like Inventory control, sales forcasting economic consideration, optimum utilization of resources, productivity.

CO6. **Create** new mathematical models for efficient production planning and control.

Text Books:

1. Industrial Engineering and Production Management, Martand Telsang, S. Chand
2. Production and Operation Management by R. Panneerselvam, PHI, Latest Edition
3. Manufacturing planning and control for SCM by Vollmann; TMH, Latest Edition.
4. 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:

1. Operation Management, IIT Roorkee, Dr. Inderdeep singh, https://nptel.ac.in/courses/112107238

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

190513/120513: Heat and Mass Transfer

Category	Title	Code	Credits -4			Theory Paper
			L	T	P	
Departmental Core-DC	Heat and Mass Transfer	190513/120513/ 120503/190503	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

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

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. Plank'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-molal 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.

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

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

CO1. Formulate and solve one-dimensional conduction with and without heat generation
CO2. Apply the empirical equations to analyze various convection problems
CO3. Evaluate the performance of various types of heat exchangers
CO4. Develop the mathematical and physical concept of radiation heat transfer
CO5. Apply the physics of heat transfer in the processes like Condensation and Boiling
CO6. Analyze and solve the problems in diffusion and convective mass transfer

Text Books:

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, McGraw-Hill
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-Boltzmann 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 during drop and film wise condensation.

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.

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

CO1: Determine the thermal conductivity of metal rod and insulating powder.
CO2: Estimate the Stefan-Boltzmann constant and measurement of emissivity.
CO3: Determine the effectiveness of various types of heat exchangers.
CO4: Evaluate the Heat Transfer coefficient in various heat transfer phenomena.
CO5: Evaluate the diffusion coefficient of liquid vapor in air by Stefan's tube.

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

120515: Machine Design

Category	Title	Code	Credit -4			Theory Paper
Departmental Core-DC	Machine Design	120515/120505	L	T	P	Max.Marks-60 Min.Marks-19 Duration-2hrs.
			2	1	2	

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

Course Pre-Requisites:
1. Mechanics of Materials (Subject Code – 120302)
2. Design of Machine Elements (Subject Code - 120402)

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, 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.

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

UNIT-V

Rolling contact bearings:
Designation, Types, Friction effect, loads, Fatigue, Deflection & deformation, Selection, bearing life.

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

CO1: **Describe** the design procedure used in automotive industry to design the engine parts

CO2: **Classify** the different types of spring, bearing and Gears

CO3: **Choose** the right strategy for designing the machine components based on material and methods

CO4: **Apply** the design procedure for solving and drafting the different design of machine elements

CO5: **Compare** the various curves and design procedure used

CO6: **Selection** of machine elements under various loading and environmental conditions.

Text Books

1. Shigley, J.E., and CharlesMechanical 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/

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

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.
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.

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

1. **Design** and analysis the different part of an I.C Engine like Gear, Spring and Bearing
2. **Compare** the materials used in designing the automobile engine parts.
3. **Use** the software like AUTO CAD, CATIA and ANSYS for modelling and analysis
4. **Select** the spring for a proper application also can select the proper material of spring.
5. **Design** the different types of gear and spring also able to know their practical applications
6. **Create** a gear box for modern Automotive vehicles and can use this for the benefits of society.

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

120520: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-II	120520/ 120411/ 120401	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

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.

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.
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.

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.