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

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
			3	-	-	Duration-3hrs.

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

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.

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

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

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
			L	T	P	
Departmental Core-DC	Metal Cutting and Machine Tools	120502/ 190502	3	1	-	Max.Marks-70 Min.Marks-22 Duration-3hrs.

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

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

CO1: **apply** cutting mechanics to metal machining based on cutting force and power consumption.
CO2: **operate** lathe, milling machines, drill press, grinding machines, etc.
CO3: **select** cutting tool materials and tool geometries for different metals.
CO4: **choose** appropriate machining processes and conditions for different metals.
CO5: **optimize** parameters for material removal in unconventional machining processes.
CO6: **identify** the process parameters, their effect and applications of different 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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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 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'sT heory.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.

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

CO1. state principles of heat and mass transfer to basic engineering systems
CO2. develop basic concepts of heat transfer, differentiate between heat transfer and thermodynamics, modes of heat transfer (rates) i.e. Conduction, Radiation and convection.
CO3. analyze and **solve** heat transfer problem of conduction, convection and radiation
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
CO5. formulate and **solve** one dimensional conduction with and without heat generation, convection and radiation heat transfer problems.
CO6. create solution techniques which include both closed form and numerical methods of heat conduction and Convection.

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, DhanpatRai& 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 Engineerig Publication.
5. CengelYunus 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 by drop and film wise condensation method.
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.

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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	

Syllabus

UNIT I -Air Standard Cycles and Vapor Power Cycles: Carnot, Sterling, Ericssion, 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.

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.

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

CO1: selection of various types of fuels based on required applications.

CO2: outlining the basics of Refrigeration and Air conditioning

CO3: solve analytical problems of thermal engineering.

CO4: compare different turbo machines depending on their behavior and their merits and demerits.

CO5: select proper fluid machines for appropriate operation.

CO6: design of various types of combustion chambers for Internal Combustion Engines.

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, DhanpatRai& 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 engines.
2. Performance test of two stoke diesel engine and four stroke diesel engines.
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 inPelton, Francis, Kaplan Turbine
8. Study of Axial Compressor

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

CO1. Conduct constant speed and variable speed tests on IC engines and interpret their performance.

CO2. Estimate energy distribution by conducting heat balance test on IC engines.

CO3. Evaluate performance parameters of steam power plant.

CO4. Determine performance parameters of refrigeration and air-conditioning systems.

CO5. Evaluate the performance of different thermodynamic cycles.

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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	

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.

UNIT-V

Rolling contact bearings:

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

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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/

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.