Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) IV Semester (Industrial & Production Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	BT52	HSMC	Engineering Economics and Management	70	20	10	-	-	100	3	1	-	4
2	IP42	PCC	Production Process	70	20	10	30	20	150	3	-	2	4
3	IP43	PCC	Theory of Machines & Mechanisms	70	20	10	30	20	150	3	-	2	4
4	IP44	PCC	Material Science & Metallurgy	70	20	10	30	20	150	3	-	2	4
5	IP45	PCC	Machine Design	70	20	10	-	-	100	3	1	-	4
6	IP46	ESC	Software Lab-II	-	-	-	30	20	50	-	-	4	2
			Total	**350**	**100**	**50**	**120**	**80**	**700**	**15**	2	**10**	**22**
7	IP47	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-	-	8
8	IP48	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code IP47 for the award of Honours (Minor Specialization).									

Note: MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator.

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

HSMC: Humanities and Social Sciences including Management Course, PCC: Professional Core Course, ESC: Engineering Science Course, DLC: Distance Learning Course, MC: Mandatory Course

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COURSE CONTENTS w.e.f. July 2023

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
BT52	Engineering Economics & Management	End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab work	100	L	T	P	4
		70	20	10	-	-		3	1	-	

Course Objectives:

- To enhance the knowledge of economics concept for engineers.
- To acquire the knowledge of market structure and demand supply chain.
- To acquire the knowledge of industrial management & productivity
- To enhance the knowledge of inventory and quality control.

Course Content

Engineering Economics & Management
(BT52)

MODULE 01. Introduction to Engineering Economics and Managerial Economics Concept of Efficiency, Theory of Demand, Elasticity of Demand, Supply and Law of Supply indifference Curves, Budget Line, Welfare Analysis, Scope of Managerial Economics, Techniques and Applications of Managerial Economics.

MODULE 02. Market Structure Perfect Competitions Imperfect- Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions.
Demand Forecasting and cost Estimation Characteristics of Forecasts, Forecasting Horizons, Steps to Forecasting, Forecasting Methods, Seasonal Adjustments, Forecasting Performance Measures, Cost Estimation, Elements of cost, Computation of Material Variances Break-Even Analysis.

MODULE 03. Introduction: Concept, Development, application and scope of Industrial Management. Productivity Definition, measurement, productivity index, types of production system, Industrial Ownership

MODULE 04. Management Aspects, Functions of Management, Project Management, Value Engineering, Project Evaluation, Work simplification-process charts and flow diagrams, Production Planning, Decision Making.

MODULE 05. Inventory Control: Inventory, Cost, Deterministic Models
Quality Control: Process control, SQC, Control charts, Single, Double and Sequential Sampling, Introduction to TQM.

TEXT BOOKS:

1. Principles of Management by Tripathy and Reddy
2. Mechanical estimation and costing, T.R. Banga & S.C. Sharma, 17th edition 2015
3. Engineering Economy, Riggs J.L. McGraw Hill, 2002
4. Engineering Economy, Thuesen H.G. PHI, 2002

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REFERENCE BOOKS:

1. Management Fundamentals – Concepts, Application, Skill Development- Robers Lusier – Thomson
2. Basics of Engineering Economy, Leland Blank & Anthony Tarquin, McGraw Hill Publication (India) Private Limited
3. Engineering Economics, R. Panneerselvam, PHI publication
4. Fundamentals of Management: Essential Concepts and applications, Pearson Education, Robbins S.P. and DeCenzo David A.
5. Economics: Principles of Economics, N Gregory Mankiw, Cengage learning
6. Modern Economics Theory, By Dr. K. K. Dewett & M. H. Navalur, S. Chand Publication

Course outcomes:

At the completion of this course, students should be able to-

C01	To understand the basics of engineering economics.
C02	To understand the market competition, demand forecasting & cost estimation.
C03	To understand the scope of industrial management.
C04	To understand the management aspects, production planning & value engineering.
C05	To understand the inventory control & quality control.

Mapping of course outcomes (COs) and program outcomes (POs):

Course Outcomes	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12
C01	2	2	1	0	0	2	1	1	0	1	1	1
C02	2	2	1	1	1	0	0	1	0	1	0	1
C03	2	1	1	1	1	0	0	1	0	1	1	1
C04	3	3	2	2	2	2	1	0	1	1	1	1
C05	2	1	2	2	1	2	1	0	1	1	1	1

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
IP42	Production Process	End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab work	150	L	T	P	4
		70	20	10	30	20		3	-	2	

Course Objective:

- To describe crucible furnaces, gating system.
- To describe Solidification and Special casting process.
- To know the process of Metal Forming: Nature of plastic deformation working of different types of gears,
- To know Forging, Extrusion, Wire drawing process
- To know grinding, balancing, dressing and truing, honing, Lapping, super finishing operations.

Course content:

PRODUCTION PROCES
(IP42)

Module-1: Melting Practices Cupola, capacity of a cupola, cupola operation, zones of cupola, cupola Efficiency, melting furnaces for non-ferrous metals, classification of crucible furnaces, gating system, pouring basin, sprue, runner, gates, types of gates, riser, gating design, numerical simulation, main consideration in design and position of risers, types of risers, feeder location and shapes use of exothermic materials, use of chills.

Module-I1: Solidification and Special casting process: Solidification of casting, permanent mould Casting, slush casting, die casting, centrifugal casting, investment casting, continuous casting, casting defects and their remedies, cleaning of castings, repair of casting, inspection of casting. Solid modeling of castings.

Module-1II: Metal Forming: Nature of plastic deformation, stress-strain relation in elastic and plastic deformation, concept of flow stress, deformation mechanism, hot and cold working, rolling principal, rolling stand arrangement, roll passes, breakdown passes, roll pass sequence, analysis of rolling

Module-1V: Abrasive processes: Grinding wheel, specification, characteristics, abrasive types, grinding operations, cylindrical grinding, surface grinding, Centre less grinding, form grinding, internal cylindrical grinding, wheel balancing, dressing and truing, honing, Lapping, super finishing, polishing, and buffing

Module-V: Forging, Extrusion, and other Processes: Forging operations, forging design, drop forging die design, die inserts. Extrusion- principle, forward and backward extrusion, extrusion analysis, impact extrusion, hydrostatic Extrusion, extruding tubes. Wire drawing- Rod and tube drawing, tube making, swaging, drawing analysis.

References:

1. Rao P.N; Manufacturing Technology-foundry, forming; TMH Publishing House
2. Ravi B; Metal casting- CAD and Analysis; PHI Publishing House
3. Jain P.L; principles of foundry technology; TMH Publishing House
4. Hennie & Roshanthall; Metal casting; McGraw Hill New York
5. Chambell J.S; Manufacturing Science; McGraw Hill New York

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List of experiments (Expendable):

1. Study of molding and casting process.
2. make any one type of wooden pattern using simple tool.
3. Study of forging machine and demonstration various operation of forging.
4. Study of rolling process.
5. To perform grinding operations.
6. Study of crucible furnace.
7. Study of various extrusion process.

Course Outcomes:

At the completion of this course, students should be able to-

CO1	To work with crucible furnaces, gating system.
CO2	To describe Solidification and Special casting process.
CO3	To express the process of Metal Forming: Nature of plastic deformation working of different type of gears
CO4	To understand Forging, Extrusion, Wire drawing process
CO5	To explain grinding, balancing, dressing and truing, honing, Lapping, super finishing operations.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	0	2	1	1	0	2	0	0	1
CO2	1	2	2	1	1	0	1	0	1	0	0	0
CO3	1	0	1	2	2	0	0	0	1	0	0	0
CO4	1	1	2	2	2	2	1	0	0	0	0	0
CO5	1	3	2	3	1	1	0	0	0	0	0	1

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
IP43	Theory of Machines& Mechanisms	End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab work	150	L	T	P	4
		70	20	10	30	20		3	-	2	

Course Objective:

- To describe the working of different mechanism used in machines.
- To find velocity and acceleration of links of different mechanism.
- To know the working of different types of gears, gear trains and cams.
- To know the applications of gyroscopic principle.
- To know the working principles of belt, rope and chain drive.

Course content:

THEORY OF MACHINE & MECHANISM
(IP43)

Module I

Mechanisms and Machines: Mechanism, machine, planer mechanisms, kinematic pairs, kinematic chains and their classification, degrees of freedom, Grubler's criterion, kinematic inversions of four bar mechanism and slider crank mechanism, equivalent linkages, straight line motion mechanisms, pantograph, Davis and Ackermann's steering mechanisms,

Module II

kinematic analysis of planer mechanisms using graphical techniques, relative velocity method, instantaneous center method and its application, Kennedy's theorem, Coriolis component of acceleration.

Module III

Governors: Types, porter, proell, hartnell, wilson-hartnell, effort and power, controlling force controlling force, sensitiveness, hunting, isochronisms, and stability of governors. Fly wheel, turning moment diagram, energy stored.

Gears: Classification of gears, nomenclature, involutes and cycloidal tooth profile properties, synthesis of tooth profile for spur gears, tooth system, conjugate action, velocity of sliding, arc of contact, path of contact, contact ratio, interference and undercutting, helical, spiral, bevel and worm gears.

Module IV

Gears: Classification of gears, nomenclature, involutes and cycloidal tooth profile properties, synthesis of tooth profile for spur gears, tooth system, conjugate action, velocity of sliding, arc of contact, path of contact, contact ratio, interference and undercutting, helical, spiral, bevel and worm gears.

Gear Trains: Simple, compound, epicyclic gear trains; determination of gear speeds using vector, analytical and tabular method; torque calculations in simple, compound and epicyclic gear trains.

Module V

Cams: Classification of followers and cams, radial cam nomenclature, analysis of follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), pressure angle, radius of curvature, synthesis of cam profile by graphical approach, cams with specified contours

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Gyroscopic Action in Machines: Angular velocity and acceleration, gyroscopic torque/ couple, gyroscopic effect on naval ships, stability of two and four wheel vehicles, rigid disc at an angle fixed to a rotating shaft.

References:

1. Rattan SS; Theory of machines; TMH
2. Ambekar AG; Mechanism and Machine Theory; PHI.
3. Sharma CS; Purohit K; Theory of Mechanism and Machines; PHI.
4. Thomas Bevan; Theory of Machines; CBS PUB Delhi.
5. Rao JS and Dukkipati; Mechanism and Machine Theory; New Age Delhi.
6. Dr.Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi –
7. Ghosh, A,.Mallik,AK; Theory of Mechanisms & Machines, 2e,; Affiliated East West Press, Delhi.

List of experiments (Expandable)

1. To study all inversions of four-bar mechanisms using models
2. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism
3. Determination of velocity and acceleration in above using method of graphical differentiation
4. To study working of differential gear mechanism.
5. To study working of sun and planet epicycle gear train mechanism using models
6. To plot fall and rise of the follower versus angular displacement of cam and vice versa.
7. Study of universal gyroscope
8. Analytical determination of velocity and acceleration in simple mechanism using Roven's Method.

Course Outcomes:

At the completion of this course, students should be able to-

CO1	Describe the working of different mechanisms and their inversions.
CO2	Draw velocity and acceleration of different links of a mechanism using different methods.
CO3	Design different types of gears and gear trains.
CO4	Draw cam profile for different follower motions.
CO5	Analyze Gyroscopic effect on Naval ship and Stability of Two- and Four-Wheel Vehicles.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	1	1	1	0	2	1	2
CO2	3	2	2	2	1	0	0	2	1	3	1	1
CO3	2	2	3	2	2	2	2	1	2	1	2	3
CO4	1	2	2	3	1	0	0	2	1	3	1	1
CO5	1	1	3	3	2	1	2	1	2	2	3	3

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
IP44	Material Science & Metallurgy	End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab work	150	L	T	P	4
		70	20	10	30	20		3	-	2	

Course Objective:
To study the Properties of Materials and Heat treatment.

Course content:

Material Science & Metallurgy
(IP44)

Module I: Crystal Atoms of Solid: Structure of atom binding in solids metallic, Vander walls, ionic and covalent, Space lattice and crystal system arrangement of atoms in BCC, FCC and HCP crystal. Manufacture of refractory and ferrous metals, properties uses and selection of acid, basic and natural refractory, metallurgical coke, properties, types, uses and brief description of the manufacturing processes for iron and steel making.

Module II: Plastic Deformation of Metals: Point and line defects in crystals, their relation to mechanical properties, deformation of metal by slip and twinning stress strain curves of poly crystalline materials viz. mild steel cast iron and brass yield point phenomenon. Cold and hot working of metals and their effect on mechanical properties, annealing of cold worked metals, principles of re-crystallization and grain growth phenomenon, fracture in metal and alloys, ductile and brittle fracture, fatigue failure

Module III: Alloy Formation and Binary Diagram: Phase in metal system solution and inter-metallic compounds. Hume-Rottery's rules, solidification of pure metals and alloy equilibrium diagrams of isomorphous, eutectic peritectic and eutectoid system, non-equilibrium cooling and coring iron, iron carbon equilibrium diagram.

Module IV: Heat Treatment of Alloys Principles of Heat Treatment of Steel: TTT curves heat treating processes, normalizing, annealing spheroidizing, hardening, tempering, case hardening, austempering, mar-tempering, precipitation hardening process with reference to Al, Cu alloys

Module V: Properties of Material: Creep Fatigue etc., Introduction to cast iron and steel, Non-Ferrous metals base alloys, Bronze, Brasses, Duralumin, and Bearing Metals. Plastics, Composites, and ceramics: Various types of plastics, their properties and selection. Plastic molding technology, FRP, GRP resins adhesive, elastomers, and their application. Powder Metallurgy: Property and Applications of Powder Metallurgy, Various process, and methods of making products by powder Metallurgy techniques.

References:

1. Narula GK, KS and Gupta VK; Material science; TMH
2. Raghavan V; Material Science and Engineering, PHI Publication.
3. Raghavan V; Physical Metallurgy Principles and Practice; PHI
4. Rajendran V and Marikani; Material science; TMH
5. Sriniwasan R; Engineering materials and Metallurgy; TMH
6. Navneet Gupta, Material Science & Engineering, Dhanpat Rai.
7. B. K. Agrawal, Introduction to Engineering Materials, TMH.

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
		End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab work		L	T	P	
IP45	Machine Design	70	20	10	-	-	100	3	1	-	4

Course Objective:

To study the basic design principles and apply the principles to the design of various elements encountered in Mechanical machines and structures.

Course content:

MACHINE DESIGN
(IP45)

Module I:

Stress concentration and fatigue: Causes of stress concentration, stress concentration in tension, bending and torsion, reduction of stress concentration, theoretical stress concentration factor, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, soderberg equation, Gerber parabola, design for finite life, cumulative fatigue damage factor.

Module II:

Shafts: Design of shaft under combined bending, twisting and axial loading, shock and fatigue factors, design for rigidity, design of shaft subjected to dynamic load, design of keys and shaft couplings.

Module III:

Design of Bearings: Sliding Bearing, hydrodynamics lubrication, mechanical aspects of bearing design, lubricants, journal bearing design, rolling element bearings.

Module IV:

Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories.
Design of friction clutches: Disk, plate clutches, cone & centrifugal clutches.
Design of brakes: Rope, band & block brake, Internal expending brakes, Disk brakes.

Module V:

Design of Power screws types, screw drives, efficiency, stresses in power screws, design procedure and calculation.

References:

1. Shigley J.E; Machine Design; TMH
2. Sharma and Purohit; Design of Machine elements; PHI
3. Wentzell Timothy H; Machine Design; Cengage learning
4. Mubeen; Machine Design; Khanna Publisher
5. Ganesh Babu K and Srithar k; Design of Machine Elements; TMH
6. Sharma & Agrawal; Machine Design; Kataria & sons
7. Maleev; Machine Design.

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Course Outcomes:

At the completion of this course, students should be able to-

CO1	Understand modes of failure, fatigue and different factors used in design.
CO2	Design cotter joints, knuckle joints and welded joints used in different machines.
CO3	Design shafts under combined bending, twisting and axial loading.
CO4	Select bearing for given conditions using design procedure.
CO5	Design different types of Power screws.

Mapping of Course outcomes (COs) with Program Outcomes (POs):

Corse Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	2	2	1	0	3	1	2
CO2	2	2	3	2	2	2	2	1	1	3	2	2
CO3	2	2	3	3	2	2	1	1	0	2	2	2
CO4	1	2	3	2	3	2	2	0	1	3	2	2
CO5	2	2	3	3	2	2	1	0	1	3	2	2

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
IP46	Software lab - II	End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab work	50	L	T	P	2
		-	-	-	30	20		-	-	4	

Course Objective:

- The primary objective of this courseware is to teach students the basic commands necessary for professional 3D mechanical drawing
- Use the precision drafting tools in AutoCAD to develop accurate technical engineering drawings.
- Demonstrate a high level of comfort and confidence with AutoCAD through hands-on practice.

SOFTWARE LAB-2
(IP46)

MODULE1. **Fundamental of 3D AutoCAD:** Need of 3rd dimension, The conventions of AutoCAD, Co-ordinate systems in 3D, Types of 3D Models, Surface Modeling

MODULE2. **Various 3D commands:** 3D move, 3D orbit, 3D rotate, 3D scale, extrude, loft, regen, revolve, blend, offset, sweep, UCS, Revolve, Union, Subtract, Press/Pull, Helix

MODULE3. **Solid Primitives:** Box, Wedge, Cylinder, Cone, Sphere, Torus, Pyramid,

MODULE4. **UCS:** UCS icon, Dynamic UCS, **3D views:** Plan, View Cubic,

MODULE5. **3D Exercise.**

Student Learning Outcomes:

1. Demonstrate basic concepts of the AutoCAD software
2. Apply basic concepts to develop construction (drawing) techniques
3. Ability to manipulate drawings through editing and plotting techniques
4. Understand geometric construction
5. Produce 2D Orthographic Projections
6. Understand and demonstrate dimensioning concepts and techniques
7. Understand Section and Auxiliary Views
8. Become familiar with Solid Modelling concepts and techniques

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