Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)
(AICTE Model Curriculum Based Scheme)
Bachelor of Technology (B.Tech.) VI Semester (Mechanical 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			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	ME61	PEC	Professional Elective Course-II	70	20	10	-	-	100	3	1	-	4
2	ME62	OEC	Open Elective Course-I	70	20	10	-	-	100	3	1	-	4
3	ME63	PCC	Heat and Mass Transfer	70	20	10	30	20	150	3	-	2	4
4	ME64	PCC	Metal Cutting & Machine Tools	70	20	10	30	20	150	3	-	2	4
5	ME65	PCC	Industrial Engineering	70	20	10	30	20	150	3	-	2	4
6	ME66	PI	Minor Project	-	-	-	60	40	100	-	-	4	2
7		MC	Industrial Training	Minimum Four weeks Duration. Evaluation will be done in 7th semester.									
Total				**350**	**100**	**50**	**150**	**100**	**750**	**15**	2	**10**	**22**
8	ME67	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-		8
9	ME68	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 ME67 for the award of Honours (Minor Specialization).									

Note: 01. Departmental BOS will decide list of three/four optional subjects those are available in MOOC,OEC as well for PEC.
02. MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator.
03. Industrial training should be apart from laboratory work unertaken in the college rather it should have industrial orientation and practical aspects/field work. Report to be sbmitted at the beginning of 7th semester and students have to give a presentation in the Department. Evaluation will be done in 7th semester.

Professional Elective Course-II		
S.No.	**Subject Code**	**Subject Name**
1	ME61A	Mechanics of Materials-II
2	ME61B	Robotic Engineering
3	ME61C	Finite Element Method

Open Elective Course-I		
S.No.	**Subject Code**	**Subject Name**
1	ME62A	Power Plant Engineeirng
2	ME62B	Intellectual Property Right
3	ME62C	Automotive Fuels & Emission

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

PEC: Professional Elective Course, OEC: Open Elective Course, PCC: Professional Core Course, PI: Project and Internship, DLC: Distance Learning Course, MC: Mandatory Course

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME61A	Mechanics of Materials-II	70	20	10	-	-	100	3	1	-	4

Course Objective:

During the course the student will be able to learn about:

1. The theory of elasticity including strain/displacement and Hooke 's law relationships.
2. Analyze solid mechanics problems using classical methods and energy methods.
3. Obtain stresses and deflections of beams on elastic foundations

Course Contents:

Module 1: Strain Energy or Resilience:

Strain Energy- Elastic, plastic and rigid members, Stresses due to different types of axial loading, Gradually applied loads, Impact loads, Deflection of beam using strain energy method, Strain energy stored due to bending, The first theorem of Castigliano and its applications, Laminated Springs or Leaf springs.

Module 2: Conjugate Beam Method, Propped Cantilevers and Beams:

Conjugate Beam Method: Deflection and slope of simply supported beam (point load at the centre, carrying an eccentric point load), Relation between actual beam and conjugate beam. Propped Cantilever And Beam: Shear force and Bending moment for a propped cantilever carrying (point load at the centre and propped at the free end, uniformly distributed load and propped at free end).

Module 3: Fixed Beam and Continuous Beam:

Relation between the free B.M. diagram and the fixed B.M. diagrams, Slope and deflection, Effect of sinking of supports, Fixed beam subjected to couple, Degree of fixity, Advantages and disadvantages of fixed beam, Clapeyron's theorem of three moments, Column Analogy method.

Module: 4: Thick Cylindrical Shells:

Introduction, Stresses in a thick cylindrical shell, Lamme's equation, Hoop stresses and radial pressure distribution, Stresses in Compound thick cylinders, Thick spherical shells.

Module 5: Theories of Failures:

Maximum normal stress theory; maximum shear stress theory, Principal stress theory; Maximum normal and shear strain energy theory; Maximum distortion energy theory; Application of theories to different materials and loading conditions.

HOD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

Evaluation

Evaluation will be continuous an integral of the class as well through external assessment.

References:

l. Beer FP, Johnson Mechanics of Materials, Sixth Edition; MC Graw Hills.

2. Stephen Timoshenko; Strength of materials;partlÆ2; CBS Pub.

3. Singh Arbind K; Mechanics of Solids; PHI

4. R Subramannian, Strength of materials OXFORD University press, Third Edition.

5. Egor P. Popov; Engineering Mechanics of Solids; PHI

6. S Ramamurthum, Strength of materials,Dhanpat Rai.

Course Outcomes:

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

CO1	Estimate strain energy stored due to bending.
C02	Calculate Shear force, Bending moment, Slope and deflection in Beams.
C03	Analyze stresses in thick cylinders and spheres.
CO4	Design elements of machine, structure and members by using different theories of failures.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

HEAD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME61B	Robotic Engineering	70	20	10	-	-	100	3	1	-	4

Course Objective:

1. Introduction and need of industrial robots.
2. End Effectors and Drive systems industrial robots
3. Understanding the basic principle Sensors.
4. Understanding the basic principle robotics programming

Course Content:

Module-I

Introduction: Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

Module-II

End Effectors and Drive systems: Drive systems for robots, salient features and comparison, different types of end effectors and applications.

Module-III

Sensors: Sensor evaluation and selection Piezoelectric sensors linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image Processing and object recognition.

Module-IV

Robot Programming: Teaching of robots, manual, walk through, teach pendant, off line programming concepts and languages, applications.

Module-V

Safety and Economy of Robots: Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robot.

Evaluation:

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References:

HEAD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

1. Nagrath IJ and Mittal RK; Robotics and Control; TMH
2. GrooverM.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-The Appl; TMH
3. Groover M.p; CAM and Automation; PHI Leaming
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy; Introduction to Al Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics Control, sensing; TMH
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,
9. Bhupendra Gupta, A text book of Industrial Robotics: Dhanpat Rai Publishing company, New Delhi.
10. GhosalAshitava; Robotics Fundamental concepts and analysis; Oxford
11. Saha S; Introduction to Robotics; TMH I I. Yu Kozyhev; Industrial Robots Handbook; MI

Course Outcomes:

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

CO1	Illustrate the concept of robot and its motion characteristics.
CO2	Identify different types of end effectors and drive systems required for specific applications.
CO3	Explain the working of various types of sensors and their applications.
CO4	Develop programming principles and languages for a robot control system.

Mapping of the 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
CO2	1		2	2								
CO3	1	1	2	1								
CO4	1	2	2	2								

HEAD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME61C	Finite Element Method	70	20	10	-	-	100	3	1	-	4

Course Objectives:

During the course the student will be able to learn about:

1. The fundamental concepts of the theory of the finite element method.
2. The use of the basic finite elements for structural applications using truss, beam, frame, and plane element.

Course Contents:

Module 1: Introduction

Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, Modelling of infinite Degree of freedom(D.O.F.) system into finite D.O.F. system, Basic steps in finite element problem formulation, General applicability of the method.

Module 2: Element Types and Characteristics

Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, generalized co-ordinates and nodal shape functions. ID bar and beam elements, 2D rectangular and triangular elements, Axisymmetirc elements.

Module 3: Assembly of Elements and Matrices

Concept of element assembly, Global and local Co-ordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Choleksy decomposition methods, Numerical integration, ID and 2D applications.

Module 4: Higher Order and ISO-parametric Elements

One dimensional quadratic and cubic elements, Use of natural Co-ordinate system, Area Co- ordinate system, continuity and convergence requirements, 2D rectangular and triangular requirement.

Module 5: Static & Dynamic Analysis

Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation, of mass matrices for ID elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

References:

1. Rao, S.S., The Finite Element Method in Engineering, 2nd ed., Peragamon Press, Oxford.
2. Robert, D Cook. David, S. Ma[kins, and Michael E. Plesha, Concepts and Application of Finite Element Analysis 3rd ed, John Wiley.
3. Chandrupatla, TR. anBelegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
4. Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.

Evaluation

Evaluation will be continuous and integral part of the class well through external assessment.

Course Outcomes:

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

CO1	Make use of finite element method to solve simple problems from Structural & Dynamic domain.
C02	Develop the concept of various elements and their characteristics.
C03	Create element and global stiffness, displacement and force matrices for ID abd 2D FEA.
CO4	Apply the finite element analysis using available commercial FEA tools.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

Subject Code	Subject name	Maximum Marks Allotted					Total Marks	Hours/Week			Total Credits
		Theory			Practical						
ME62A	Power Plant Engineering	End Sem	Mid-sem Exam	Quiz/ Assignment	End sem	Lab Work	100	L	T	P	4
		70	20	10	-	-		3	1	-	

Course Objective:

1. Understanding the process of converting various renewable energy sources to electric power, Layout of renewable energy power plant and their advantages and limitations.
2. Understand layout of working principle of fossil thermal power plant. & co-generation system, including coal handling system, pulverization of coal, steam generation system, steam turbine, condenser, cooling tower and control systems.
3. Understand the layout of nuclear plant, nuclear fuels & chain reactions, components and working principle of different types of nuclear power plants.
4. Understand the layout of hydroelectric power plant with plant components, hydrologv- hydrographs, flow duration curve, mass curve & power control systems.
5. Understand the power plant economics, estimate the prediction loads, and factors.

Course Contents:

Module 1: Renewable Energy Power Plants:

Introduction to methods of converting various energy sources of electric power, direct conversion methods renewable energy sources, solar, Wind, tidal, geothermal, bio- thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

Module 2: Fossil Fuel Steam Stations:

Basic principles Of station design, recent trends in turbine and boiler sizes and Steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling burning systems, feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment, instrumentation, testing and plant heat balance. Combined cycle power generation, heat recovery steam generator, co-generation plant.

Module 3: Nuclear power Station:

Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction. Fissionable and fertile materials, thermal neutron fission, important fuels. Moderators and coolants, Types of pressurized water reactor, boiling water reactor, breeder reactor, CANDU reactor, gas cooled reactor.

Module 4: Hydro-Power Station:

HEAD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

Classification Of hydroelectric power plant, introduction to hydrology, plant layout, hydro plant auxiliaries, cost of plant, life of plant, hydro power control, electrical and mechanical components, comparison of hydro power station with thermal power station, automatic and remote control of power plant, safety measures and preventive maintenance of hydro power plant, calculation of available hydro power.

Module 5: Power Station Economies:

Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

References:

1. Nag PR; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons. Delhi
4. Domkundwar; power Plant Engg; Dhanpatrai.* sons,
5. Rajput RK; A text book of Power plant Engg.;Laxmi Publications.
6. Yadav R; Stearn and turbipe and power plant engg by

Course Outcomes:

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

CO1	Define the procedure of site selection for power plant and able to know the procedure to convert renewable fossil fuel energy, nuclear energy & fluid energy into electric power
C02	Explain function of different mechanism of power plant like fuel handling, its combustion , Utilization of potential of energy to convert in power by using mechanical and electrical equipments
C03	To draw the layout of power plant like renewable energy based , fossil fuel based, hydro and nuclear based power plants.
CO4	Estimate the power plant load, maximum demand, load factors, diversity factor, plant factor and their influence on plant design, operation and economics.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

HOD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME62B	Intellectual Property Right	70	20	10	-	-	100	3	1	-	4

Course Objective:

During the course the student will be able to learn about:

1. Concepts of Intellectual property Rights & Copyright issues.
2. Patent, Trade Marks, Designs & GI terminologies.
3. Contemporary Issues & Enforcement of IPR

Course Contents:

Module 1: Introduction

Introduction and Justifications of IPR, Nature of IP, Major forms of IP- Copyright, Patent, Trademarks Designs, Geographic indication, layout design of Semiconductors, Plant varieties, Concept & Meaning of Intellectual Property.

Major international documents relating to the protection of IP - Berne Convention, Paris Convention, TRIPS. The World Intellectual Property Organization (WIPO).

Module 2: Copyright

Meaning and historical development of copyright, Subject matter, Ownership of copyright, Term of copyright, Rights of owner, Economic Rights, Moral Rights. Assignment and licence of rights, Infringement of c6pyright, Exceptions of infringement, Remedies, Civil, Criminal, Administrative, Registration Procedure.

Module 3: Patents

Meaning and historical development. Criteria for obtaining patents, Non patentable inventions, Procedure for registration, Term of patent, Rights of patentee, Compulsory license, Revocation, Infringement of patents, Exceptions to infringement, Remedies, Patent office and Appellate Board.

Module 4:- Trade Marks, Designs & GI

Trade Marks: Functions of marks, Procedure for registration, Rights of holder, Assignment and licensing of marks, Infringement, Trade Marks Registry and Appellate Board.

Designs: Meaning and evolution of design protection, Registration, Term of protection, Rights of holder, unregistered designs.

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

Geographical Indication: Meaning and evolution of GI, Difference between GI and Trade Marks, Registration, Rights, Authorised user.

Module 5: Contemporary Issues & Enforcement of IPR

IPR & sustainable development, The Impact of Internet on IPR. IPR Issues in biotechnology, Ecommerce and IPR issues, Licensing and enforcing IPR, Case studies in IPR

References:

1. P. Narayanan, Intellectual Property Law, Eastern Law House.
2. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI, 2014.
3. N.S Gopalakrishnan ard T,G, Agitha, Principles Of Intellectual property, Eastern Book Co. Lucknow, 2009.
4. Anandpadmanabhan, Enforcement of Intellectual Property, Lexis NevisButterworths, Nagpur, 2012.
5. Managing Intellectual Property the Strategic Imperative, Vinod V. Sople, PHI.
6. PrabuddhaGRnguli, "Intellectual Property Rights" Mcgraw Hill Education, 2016.

Evaluation

Evaluation will be continuous an integral part of the class as well through external assessment.

Course Outcomes:

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

CO1	Outline the concept of Intellectual Property Rights & Copyright issues.
C02	Assess patent, Trade Marks, Designs & GI terminology and terms.
C03	Discuss Contemporary Issues & Enforcement of IPR.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME62C	Automotive Fuels & Emission	70	20	10	-	-	100	3	1	-	4

Course Objective:

During the course the student will be able to learn about:

1. Different types of automobile fuels.
2. The characteristics of different automobile fuels.
3. The effect of different automobile fuels on emission.
4. The Norms on emissions and different emission standards.

Course Content:

Module 1: Introduction Automobile Fuels:

Classification of Automobile alternative fuels(liquid, gaseous, hydrogen, LPG, CNG, Biogas etc J, Desirable characteristics of SI & CI engine alternative fuels, Rating of SI & CI engine fuels, Introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars. Merits and demerits of various alternate fuels.

Module 2: Liquid alternative fuels:

Vegetable Oils: Various vegetable oils for automobile engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics. Alcohols: Properties as engine fuel, alcohols and gasoline blends, performance in automobile engine, methanol and gasoline blends.

Module 3: Biogas:

Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine, Properties of Natural gas, Hydrogen gas, LPG & CNG as engine fuels, storage and handling, performance and safety aspects to all gaseous fuel, metering systems.

Module 4: Automobile emissions:

Types of automobile emissions, emission characteristics, formation of automobile emissions, mechanism of HC , CO and NO in SI engine, exhaust emission and factors affecting the emission, evaporative emission, crankcase emission, lead emission CI engine emissions: formation of smoke, factors affecting the smoke formation, unburned hydrocarbons, carbon monoxide, oxides of nitrogen, smog and comparison of diesel and petrol emissions.

Module 5: Emissions Norms & Measurement:

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

Emission norms as per Bharat Standard up to BS - IV and procedures for confirmation on production. Demerits of automobile emission to environment. Types Of Catalytic Conversion, measurement Techniques Emission Standards and Test Procedure NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards.

References:

1. J B. Heywood. Internal combustion Engines, Wiley
2. Ganeshan V; Internal Combustion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; DhanpatRai
4. R Yadav, Internal Combustion Engines
5. Halderman JD and Mitchell CD; Automotive Engines theory and servicing;' Pearson
6. DomKundwar, Internal Combustion Engines; Dhanpat Rai publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engineering (Palgrave MC Mill an)

Course Outcomes:

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

CO1	Define different types of fuel.
C02	Differentiate Different types of automobile fuels.
C03	Analyse the emissions of different automobile fuels.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

HEAD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

DEAN
Academic
JEC, Jabalpur (M.P.)

Jabalpur Engineering College, Jabalpur (M.P)

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

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME63	Heat & Mass Transfer	70	20	10	30	20	150	3	-	2	4

Course Objective:

1. Understand the application of various experimental modes of heat transfer i.e. conduction convection, radiation and solve problems related to heat transfer and learn about critical thickness of insulation.
2. Extend the conduction and convection laws in extended surfaces and solve unsteady state heat transfer problems applied to various applications.
3. Categories the free and forced convection processes and utilizes empirical relations for laminar and turbulent flow.
4. Solve heat exchanger problems using LMTD and NTU methods with the help of heat transfer data book and learn the basics of mass transfer.
5. Understand boiling and condensation phenomena and the laws ofradiation and solve problem related to radiation heat transfer for black body and gray body.

COURSE CONTENTS:

Module 1: Basic Concepts: Modes of heat transfer, Stefan Boltzman's law; Fourier's law, thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process;

Conduction: Fourier heat conduction equation, its form in rectangular, Cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical- insulation-thickness for pipes, effect of variable thermal conductivity.

Module 2: Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in. a thermometer well, fin efficiency, fin effectiveness, applications; Unsteady heat conduction: Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

Module 3: Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham theorem, publication three-dimensional analysis of free land forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

HEAD
Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

Module 4: Heat exchangers: Types- parallel flow, counter flow; evaporator an condensers, overall heat transfers coefficient. Fouling factors, log-mean temperature difference (lmtd), method of heat-exchanger analysis, effectiveness of heat exchanger, NTU method;

Mass transfer: Fick's law-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Module 5: Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from area between black and gray surfaces, shape analogical electrical network, radiation Shields.

Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

References:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad.
2. Holman JP; Heat transfer; TMH
3. Dutta Binay K; Heat Transfer; PHI
4. Kumar DS; Heat and mass transfer; SK Kataria and Sons Delhi
5. Kreith; Heat transfer,
6. Sachdeva RC; Fundamentals of engineering heat and mass transfer,.
7. Gupta & Prakash; Engineering heat transfer,

Evaluation:

Evaluation will be continuous an integral part of the class as well through external assessment.

Course Outcomes:

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

CO1	Illustrate- the real time applications of fluid, solid medium and radiation heat transfer.
C02	Utilize the knowledge of design skills of heat transfer problems for different boundary conditions
C03	Examine the real time applications of heat transfer equipments under different conditions
CO4	Estimate the heat transfer rate for various complex conditions

Mapping of the course outcomes (COs) with program outcomes (POs):

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

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Deptt. of Mechanical Engineering
Jabalpur Engineering College
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Heat & Mass Transfer Lab

List of Experiments: (Can be modified/expanded further)

1. Conduction through a rod to determine thermal conductivity of material.
2. Forced and free convection over circular cylinder.
3. Free convection from extended surfaces.
4. Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate.
5. Calibration of thermocouple.
6. Experimental determination of Stefen-Boltzman constant

Course Outcomes:

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

CO1	Analyze conduction, convection and radiation heat transfer processes
C02	Illustrate the working of various heat transfer equipments

Mapping of the course outcomes (COs) with program outcomes (POs):

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

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

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(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME64	Metal Cutting & Machine Tools	70	20	10	30	20	150	3	-	2	4

Course Objective:

During the course the student will be able to learn about:

1. The course provides students with fundamental knowledge and principles in material removal processes.
2. The fundamentals of machining processes and machine tools.
3. Importance of metal cutting parameters.

Course Contents:

Module 1:

Lathe: Classification of machine tools and their basic components; lathe. specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature.

Module 2:

Grinding: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

Module 3:

Milling: Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.

Drilling & Broaching: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

Module 4:

Shapers: Classification and specifications, principle parts, Quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities.

Gear Cutting: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding, gear testing.

Module 5:

Tool Wear, Tool Life and Machinability: Tool wear mechanisms, Types of tool damage during cutting, Wear and chipping characteristics of different tool materials, Tool wear equations, tool failure criteria, Tool life equations, Effect of process parameters on Tool life, Tool life testing, Machinability Surface finish and surface integrity.

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

References:

1. Rao PN; Manufacturing Technolod vol 11; TMH.
2. HazraChadhary, Workshop Tech-Il; Media promoter Pub.
3. Lindberg RA; Processes and Materials of Manuåcturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; dhanpat Rai Delhi.
5. Alciatori DG, Histand MB; Introduction to Mechatronics and Measurernent System; TMH.
6. HMT; P ; Oduction Processes; TMR

Evaluation

Evaluation Will be continuous an integral part Of the class as well through external assessment.

Course Outcomes:

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

CO1	Classify conventional machine tools and their components.
C02	Demonstrate working and operations of machine tools such as lathe, milling and grinding machines.
C03	Analyze and Estimation of Tool Wear, its variables and tool life.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

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Jabalpur - 482 011 (M.P.)

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Metal Cutting & Machine Tools Lab

List of Experiments: (Can be modified/expanded further)

1. To make a job on lathe machine with all operations like turning, step turning, thread cutting and knurling.
2. Study of center less grinding machine/ tool and Cutter type grinding machine.
3. Study of horizontal/ universal milling machine, dividing head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.
6. To study a sapping machine to learn about working of quick return mechanism.

Course Outcomes: Metal Cutting & Machine Tools Lab:

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

CO1	Learn to build a job on lathe machine.
C02	Experiments with Grinding machine and operations.
C03	Illustrate the working and operations of milling machine.
CO4	Demonstration of shaper machines and operations.
CO5	Analyze Tool wear, its variables and estimation of tool life.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

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Bachelor of Technology (B.Tech.) VI Semester (Mechanical Engineering)

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

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	
ME65	Industrial Engineering	70	20	10	30	20	150	3	-	2	4

Course Objective:

1. To be familiar with production, planning and inventory control techniques used in industrial engineering.
2. TO calculate the activity and project scheduling cost using PERT and CPM techniques.
3. To perform an analysis for inventory and product quality control.
4. To understand the industrial legislation, design of plant layout and work study.

Course Contents:

Module 1: Production, Planning and Control:

Definition and importance, types of production: job, batch & mass production, routing, scheduling, dispatching and follow up. Forecasting elements, time series, regression, causal and Delphi methods. Break even analysis and Gantt Chart, Project scheduling, application of CPM and PERT techniques, Analysis and control of project cost in CPM and PERT, simple numerical problems.

Module 2: Inventory Control:

Definition, types of inventory - Codification and standardization ABC analysis, Economic ordering quantity Procurement cost, carrying charges, lead time, re-order point, simple problems. Definitions, types of inspection and procedure Statistical quality control - Basic theory of quality control, Process capability Control charts for variables - and R, relationship between control limits and specification limits. Control chart for fraction defective (p), control chart for number of defects

Module 3: Job Evaluation and Wage Plans & Industrial Legislation:

Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans. Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, and Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, and Employees provident fund scheme.

Module 4: Work Study:

Definition, advantages and procedure of work-study. Difference between production and productivity, Factors to improve productivity. Method Study: - Definition, objectives and procedure of method study. Symbols, flow process chart (man-machine and material), flow diagram, machine chart,, two hand chart critical examination. Developing a new method Principles of motion economy. Iherblig symbols, SIMO

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Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

chart simple problems. Work Measurement -time study, definition, principle and method of time study Stop watch study - number of reading, calculation of basic time, rating techniques, normal time, allowances, and standard time Simple numerical problems. Work Sampling - Definition, method, advantages and disadvantage of work sampling Applications.

Module 5: Plant Location and Layout:

Definition, factors affecting the site selection of plant, Factor affecting plant layout Types of layout: process, product, combination and fixed position layout Techniques in making layout-Flow diagram, templates, distance volume matrix, travel chart Line balancing, and workstation. Material Handling: principles of economic material handling Hoisting equipment - forklift truck, Cranes- mobile motor cranes, overhead cranes, travelling bridges crane and Derrick crane. Whiler crane Conveying equipment - Package conveyors, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, bucket elevators, belt conveyors, and pneumatic conveyors.

References:

1. SeetharamaL.Narasimhan, Dennis W.McLeavey, Peter J.Billington, "Production Planning And Inventory Control" , PHI, 2nd Edition, 2002.
2. Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 9th Edition, 2002.
3. Monks J G, "Operations Management", McGraw Hill, 1997.
4. Panneerselvam. R, Production and operations Management,PHI,2005
5. Lee J.Krajewski, Larry P.Ritzman, "Operations Management Strategy and Analysis", PHI, 6th Editiom 2003.
6. Kenneth R.Baker, "Introduction to Sequencing and John Wiley & Sons, New York; 2000.
7. Dilip R SzW"Tndustrial PWS Puhli±uigcompany. Boston. 1997.

Evaluation:

Evaluation will be continuous an integral part of the class as well through external assessment.

Course Outcomes:

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

CO1	Define basic concept of industrial engineering and their importance.
C02	Discuss Various Inventory Control Models, Plant layout, work study methods and Industrial Legislations.
C03	Calculate the activity and project scheduling cost using PERT and CPM techniques.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

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Deptt. of Mechanical Engineering
Jabalpur Engineering College
Jabalpur - 482 011 (M.P.)

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Industrial Engineering Lab

List of Experiments: (Can be modified/expanded further)

1. P-chart for fraction defectives.
2. C- chart for number of defectives. (constant sample size)
3. Operating characteristic curve of single sampling attributes plan.
4. Test for normality of sample means. (Normal distribution)
5. Test for normality of sample means. (Universal distribution rectangular)
6. X and R – charts & process capability.
7. Pin board study experiment.
8. Tread mill exercise
9. Rating practice using pack of cards.
10. To draw two handed process chart for bolt, washer & nut assembly.
11. Multiple activity chart (or) man machine chart.

Course Outcomes:

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

CO1	Define basic concept of industrial engineering and their importance.
C02	Discuss Various Inventory Control Models, Plant layout, work study methods and Industrial Legislations.
C03	Calculate the activity and project scheduling cost using PERT and CPM techniques.

Mapping of the course outcomes (COs) with program outcomes (POs):

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

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