Tulsiramji Gaikwad-Patil College of Engineering &Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTION & SYLLABI

Programme: Mechanical Engineering

Scheme of Instructions: Third Year B.Tech. In Mechanical Engineering Semester–V (AsPerNEP2020)

Sr. No.	Course Category	Course Code	Course Title	T/P	Contact Hrs/Wk			Credits	Exam Scheme				
					L	P	Hrs		CT-1	CT-2	CA	ESE	TOTAL
1	PCC	BME33501	Heat Transfer	T	3	-	3	3	15	15	10	60	100
2	PCC	BME33502	Kinematics and Dynamics of Machinery	T	3	-	3	3	15	15	10	60	100
3	PCC	BME33503	Design of Machine Elements	T	3	-	3	3	15	15	10	60	100
4	OEC	B$$32XX	Open Elective–III	T	2	-	2	2	7	8	5	30	50
5	PEC	BME33504-07	Programme Elective–I	T	4	-	4	4	15	15	10	60	100
6	MDM	BBA33502	Business Development Formulation	T	3	-	3	3	15	15	10	60	100
7	PCC	BME33508	Heat Transfer Lab	P	-	2	2	1	-	-	25	25	50
8	PCC	BME33509	Dynamics of Machine Lab	P	-	2	2	1	-	-	25	25	50
9	PCC	BME33510	Design of Machine Elements Lab	P	-	2	2	1	-	-	25	25	50
			Total		**18**	**6**	**24**	**21**	**82**	**83**	**130**	**405**	**700**

L-Lecture SL-Self Learning P-Practical NHL-Notional Hrs/Wk (Total Notional Hrs)

CT1-ClassTest1 TA/CA-Teacher Assessment/ Continuous Assessment

CT2-ClassTest2 ESE-End Semester Examination (For Laboratory End Semester performance)

Course Category	PCC (Programme Core Courses)	PEC (Programme Elective Courses)	(MDM) Multidisciplinary Minor	OEC (Open Elective courses from other discipline)	VSEC (Vocational and Skill Enhancement Course)	HSSM (Humanities Social Science and management) (VEC/IKS/AEC)	FP/CP/OJT/RM/ Project (Experimental Learning Courses)
Credits	12	4	3	2	-	-	-
Cumulative Sum	32	4	9	8	6	12	2

PROGRESSIVE TOTAL CREDITS :85+21 =106

HOD	Dean Academics	Vice Principal	Principal	May,2025	1.00
				Date of Release	Version

Applicable for AY 2025-26 Onwards

HOD Mechanical Engineering Tulsiramji Gaikwad Patil College of Engineering, Nagpur

Dean Academics Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur

Dr. Pragati Patil Vice-Principal Tulsiramji Gaikwad Patil College of Engineering & Technology, Nagpur

Dr. Premanand Naktode Principal TGPCET, Nagpur

Programme: Mechanical Engineering

List of **Program Electives** offered By Mechanical Department (NBA Accredited)

Program Elective-I	Program Elective-II	Program Elective-III	Program Elective-IV	Program Elective-V
Semester V	**Semester VI**	**Semester VI**	**Semester VII**	**Semester VIII**
BME33504: Industrial Economics and Management	BME33605: Hydraulic and Pneumatic Systems	BME33609: Finite Element Method	BME34704: Total Quality Management	BME34803: Material Handling System
BME33505: Computer Aided Design	BME33606: Mechanical Measurement and Metrology	BME33610: Advanced Manufacturing techniques	BME34705: Finite Element Analysis	BME34804: Computer Integrated Manufacturing
BME33506: Automotive System	BME33607: Automotive maintenance and Industrial Safety	BME33611: Operation Research	BME34706: Design of Mechanical drives	BME34805: Renewable Energy System
BME33507: Smart Manufacturing	BME33608: Control System Engineering	BME33612: Industrial Robotics	BME34707: Advanced Mechanical Vibration	BME34706: Composite and Nano Materials

Program: Mechanical Engineering

List of **Open Electives** offered Mechanical Engineering Department (NBA Accredited)

Open Elective-I	Open Elective-II	Open Elective-III
III-Semester	**IV-Semester**	**V-Semester**
BME32306:Basics of Manufacturing Technology and Processes	BMEXX10:Automobile Engineering	B$$32XX:Additive Manufacturing

				May,2025	1.00	Applicable for AY2025-26 Onwards
Chairperson	**Dean Academics**	**Vice Principal**	**Principal**	**Date of Release**	**Version**	

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Third Year (Semester-V) B.Tech. Mechanical Engineering

BME33501: Heat Transfer

Teaching Scheme	
Lectures	3Hr/Week
Tutorials	-
Total Credits	3

Examination Scheme	
CT	30 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
DurationofESE:03Hrs	

Course Objectives:

1	Students will learn the different modes of heat transfer like conduction, convection & Radiation,
2	To acquaint Heat transfer through extended surfaces.
3	Students will understand the concept of convection, free and forced convection
4	To Solve lumped parameter transient heat transfer problems.
5	To Predict heat exchanger performance

	Course Contents	Hours
UnitI	**Introduction to heat transfer:** Modes and laws of heat transfer, conduction, convection & radiation. Fourier's law, Newton's law of cooling, Stefan Boltzmann law; thermal resistance and conductance, thermal diffusivity, analogy between flow of heat and electricity, One dimensional steady state conduction equation for the plane wall, Cylinder and its Numerical, overall heat transfer coefficient.	(9)
UnitII	**Conduction with internal heat generation:** Plane wall, cylinder and its Numerical. **Extended Surfaces:** Types and Applications of Fins, Heat transfer through extended surfaces, derivation of temperature distribution equations and heat transfer through fins, Effectiveness and efficiency of a fin.	(9)
Unit III	**Convection:**, Types of convection, Hydrodynamic and thermal boundary layer, Laminar and turbulent flow over a flat plate and through a duct. **Free and Forced Convection:** Physical significance of the dimensionless numbers related to free and forced convection, empirical correlations for free and forced convection for heat transfer in laminar and turbulent flow over a flat plate and through a duct. **Introduction to Condensation and Boiling**: Condensation and its type, Film and drop wise condensation, Modes of boiling, Different boiling regimes, pool boiling.	(9)
UnitIV	**Radiation:** Stefan- Boltzmann law, Emissive power, Surface emission properties, Absorptivity, Reflectivity, Transmissivity, Concept of Black body radiation, Planck's distribution law, Wien's displacement law, The grey, black and real surface. Radiation shape factor, Kirchoff's law, Radiation shields.	(9)
UnitV	**Heat Exchangers:** Heat exchangers classification, overall heat transfer coefficient, heat exchanger analysis, use of log mean temperature difference (LMTD) for parallel, counter and cross flow heat exchangers, fouling factor, The effectiveness-NTU method for parallel and counter flow heat exchangers.	(9)

Text Books	
T.1	S. P Sukhatme, A Text Book of Heat Transfer, University Press, 4th Edition, 2005
T.2	Fundamentals of Heat and Mass Transfer, K. N. Seetharam & T.R. Seetharam, Willey.
T.3	R.C. Sachdeva: Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd. (I), 2010
Reference Books	
R.1	J.P. Holman: Heat Transfer; McGraw-Hill, 1996
R.2	Yunus A. Cengel, Heat Transfer: A Practical Approach, McGraw-Hill Higher Education, 2002

	Useful Links
1	https://nptel.ac.in/courses/112/107/112107256/
2	https://nptel.ac.in/courses/112/106/112106155/
3	hhttps://nptel.ac.in/courses/103/103/103103035/

	Course Outcomes	CL
BME33501.1	**Calculate** the heat transfer rates through conduction, convection, and radiation using heat transfer laws to solve heat transfer problems.	3
BME33501.2	**Apply** the concepts of conduction to solve problem in heat transfer system.	3
BME33501.3	**Illustrate** the concept of hydrodynamic and thermal boundary layers over flat plates for real-world practical applications.	3
BME33501.4	**Analyze** radiation heat transfer between surfaces, focusing on the differences in radiation exchange for grey, black, and real surfaces.	4
BME33501.5	**Evaluate** the heat transfer rate and effectiveness of heat exchangers to assess their performance.	5

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Third Year(Semester-V)B. Tech. Mechanical Engineering

BME33502: Kinematics and Dynamics of Machinery

Teaching Scheme	
Lectures	3Hr/Week
Tutorials	-
Total Credits	3

Examination Scheme	
CT	30 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
DurationofESE:03Hrs	

Course Objectives:

1	To emphasize the importance of Kinematic of Machine and its analysis.
2	To study the basic of Gyroscopic, Governer, cam and gears Mechanism.
3	To study the behavior of Governors and vibration in various machines.

	Course Contents	Hours
UnitI	**Introduction to Kinematic of Machine:** Basic concept of mechanism, link, kinematics pairs, kinematics chain, mechanism, Difference between machine and mechanism, Inversions, machine, simple & compound chain, Degrees of freedom, Estimation of degree of freedom of mechanism by Grubber's criterion and other methods. Harding's notations, Classification of four bar chain , Class-I & Class-II, Kutzbach's criteria, Various types of mechanism such as Geneva wheel, Pawl and ratchet mechanism, Pantograph mechanism.	(9)
UnitII	**Kinematic Analysis:** a. Kinematic analysis of simple mechanisms using vector algebra (Graphical method). Concept of Corioli's component of acceleration. Velocity analysis using Instantaneous center of Rotation method, Kennedy's theorem. b. Kinematic analysis using analytical method and formulation of algorithm for computer program of kinematic analysis of four bar mechanism and slider crank mechanism (Can use excel spread sheets).	(9)
Unit III	**Gyroscopic:** Simple precession and gyroscopic couple. Gyroscopic effect on airplane, Naval ship, four wheeler. **Gears Mechanism**: classification significance, terminology, gear train.	(9)
UnitIV	**Cam Dynamics** :Basics of Cam dynamics and jump-off phenomenon (Numericals on cam is expected) **Governors:** Speed governors, centrifugal and inertia type, Watt, Portal, Proel, Hartnell governors, operating characteristics of governors.	(9)
UnitV	**Vibration:** Types of vibration, degree of freedom, method of vibration analysis of un-damped and damped free & forced vibration system. Types of damping, Logarithmic decrement, magnification factor, vibration isolation and transmissibility. Whirling of shaft and critical speed of rotors. Torsional oscillation of two-disc and three disc rotors, torsional vibration of a geared system (Without Inertia Effect).	(9)

Text Books

T.1	Theory of Machine, S. S. Rattan,Tata Mc Graw Hill.
T.2	Mechanism and Machine Theory, J. S. Rao &Dukki Patti, New Age International (P) Ltd, Publishers.

Reference Books	
R.1	Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, Oxford University Press.
R.2	Theory of Machines, Sadhu Singh, Pearson publications.

	Useful Links
1	https://www.digimat.in/nptel/courses/video/112104121/L01.html
2	https://www.digimat.in/nptel/courses/video/112105268/L01.html

	Course Outcomes	CL
BME33502.1	**Illustrate the** mechanisms and kinematic pairs, by Grubber's and Kutzbach's criteria to classify four-bar chains.	3
BME33502.2	**Explain** the kinematic analysis of simple mechanisms, to determine velocity and acceleration.	3
BME33502.3	**Analyze** the gyroscopic effects on airplane to determine the stability and behavior of systems.	4
BME33502.4	**Apply** the principles of cam dynamics and governors to solve problems related to cam jump-off phenomenon and governor characteristics,	3
BME33502.5	**Analyze** the vibration behavior of undamped system to determining the logarithmic decrement, magnification factor, and vibration isolation on system performance,.	4

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Third Year(Semester-V)B. Tech. Mechanical Engineering

BME33503: Design of Machine Elements

Teaching Scheme		Examination Scheme	
Lectures	3Hr/Week	CT	30
Tutorials	-	CA	10
Total Credits	3	ESE	60
		Total	100 Marks
		DurationofESE:03Hrs	

Course Objectives:

1	To familiarize the students with the concept of design and design procedure of machine elements.
2	To familiarize the students with selection of material for different machine elements.
3	To design machine elements subjected to static loading.
4	To design machine elements subjected to fluctuating loading.
5	To understand design procedure of various mechanical joints, machine components such as shaft, keys, brakes clutches, power screws, pressure vessel, spring.

	Course Contents	Hours
UnitI	**Introduction to Machine Design:** Introduction to Machine Design Concept of machine design, basic procedure of design of machine elements, use of standards in design. Engineering Materials Review and selection of various engineering material properties, factors governing selection of engineering materials, BIS designation of steels, Alloying elements in steels and effects and application. Theories of failure, Design for Fatigue & manufacturing considerations in design, basis of good design, failure of machine parts, Mechanical properties. Design of Knuckle joint, Socket & Spigot type cotter joint.	(9)
UnitII	**Welded Joint:** Design of bolted and welded joints under axial and eccentric loading conditions. **Cylinder & Pressure Vessels:** Types of pressure vessel, stresses induced in pressure vessel, Lame's, Clavarino's and Bernie's equations. Design of cylindrical & spherical pressure vessels. Design of nut, bolt, gasket & covers for pressure vessel.	(9)
Unit III	**Design of shaft:** Design of shaft for power transmission, static and fatigue criteria for shaft design, ASME codes for shaft design, Design of keys.	(9)
UnitIV	**Design of power screw:** Thread forms, multiple threaded screws, terminology of power screw, design of screw jack. **Design of Springs:** Spring material, Helical compression & tension springs under static and variable loads, Leaf spring, Laminated Springs.	(9)

UnitV	**Clutches and Breaks:** Kinematics of Friction Drives such as Brakes, Clutches Design of Friction Clutch, Single Plate, Multiple Plate, Cone, Centrifugal Clutch, Design of Brake, Shoe Brake, Band Brake, Internal Expanding brake.	(9)

Text Books	
T.1	"Design of Machine Elements: Theory and Problems" Bhandari V.B. T Denett And Co. Publication 3 Edition.
T.2	"Design of Machine Elements" Shiwalkar B.D. TDenett And Co. Publication 3 Edition.
T.3	"Machine Design An Integrated Approach", R.L Norton, Pearson Education Publication, 3rd Edition
Reference Books	
R.1	"Machine Component Design", Robert C. Juvniall, Willey Ltd., 5th Edition
R.2	Design Data Book, Shiwalkar B.D

	Useful Links
1	http://nptel.ac.in/courses/112105124/
2	https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/lecture-notes/

	Course Outcomes	**CL**
BME33503.1	**Apply** the principles of machine design and material selection to solve the problems on mechanical engineering components.	3
BME33503.2	**Classify** welded joints and pressure vessels by applying strength and pressure theories to ensure structural integrity and safety under loading conditions.	4
BME33503.3	**Analyze** solid and hallow shaft using standard design procedures and codes to determine power transmission strength.	4
BME33503.4	**Explain** the principles of axial loading and torque to solve problems on power screws for mechanical transmission systems.	4
BME33503.5	**Design** clutches and brakes for automobile applications considering performance, safety, and material selection.	4

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Third Year (Semester-V) B. Tech. Mechanical Engineering

B$$32XX: Open Elective-III (Additive Manufacturing)

Teaching Scheme	
Lectures	2Hr/Week
Tutorials	-
Total Credits	2

Examination Scheme	
CT	15 Marks
CA	5 Marks
ESE	30 Marks
Total	50 Marks
DurationofESE:02 Hrs	

Course Objectives:

1	Aware of rapidly evolving and widely used fabrication technology
2	Aware of the technology for conceptual modeling, prototyping and rapid manufacturing
3	Impart detailed knowledge of wide applications of Additive Manufacturing (AM) in industry and society; and in particular, key applications of AM such as rapid tooling, medical AM and rapid manufacturing
4	Give students an understanding of 3D printers
5	Understand implementation strategies of Additive Manufacturing Technologies

Course Contents		Hours
UnitI	**Introduction to Additive Manufacturing and 3D Printing Technology** Development of Additive Manufacturing, Major trends shaping the evaluation of 3D printing, Technology Improvement, Process, Classification of Additive Manufacturing Systems, Advantages and Limitations, Additive V/S Conventional Manufacturing Processes.	(9)
UnitII	**Materials in Additive Manufacturing** Choosing Materials for Manufacturing, Multiple Materials, Metal AM Processes & Materials, Composite Materials, Biomaterials, Hierarchical Materials , Ceramics & Bioceramics, 4D Printing& Bio-Active Materials	(9)
Unit III	**Additive Manufacturing Equipment** Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common Faults and Troubleshooting, Process design	(9)

Text Books

T.1	Additive Manufacturing and 3D Printing Technology: Principles and Applications, Dr. G.K. Awari, Dr. D. P. Kothari, Prof. Vishwjeet Ambade, Dr. C. S. Thorat, CRC Press, Taylor & Francis Group
T.2	Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson • David Rosen • Brent Stucker, Springer New York Heidelberg Dordrecht London
T.3	Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing , Ian Gibson • David Rosen • Brent Stucker, Springer New York Heidelberg Dordrecht London

Reference Books

R.1	Understanding Additive Manufacturing Rapid Prototyping · Rapid Tooling · Rapid Manufacturing Andreas Gebhardt, Hanser Publishers, Munich Hanser Publications, Cincinnati
R.2	Additive Manufacturing of Metals: The Technology, Materials, Design and Production , Li Yang Keng Hsu • Brian Baughman Donald Godfrey • Francisco Medina Mambally kalathil Menon SoerenWiener, Springer

	Series in Advanced Manufacturing

	Useful Links
1	https://onlinecourses.nptel.ac.in/noc21_me115/preview
2	https://onlinecourses.nptel.ac.in/noc20_me50/preview

	Course Outcomes	CL
B$$32XX.1	**Illustrate** the applications and working principles of 3D printing technologies in additive manufacturing for product development.	3
B$$32XX.2	**Select** appropriate materials for additive manufacturing, considering the layer-by-layer deposition requirements of 3D printing.	4
B$$32XX.3	**Interpret** the capabilities of additive manufacturing equipment in terms of requirement of process type, material and application.	4

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Third Year (Semester-V)B. Tech. Mechanical Engineering

BME33504: (PE-I) Industrial Economics and Management

Teaching Scheme		Examination Scheme	
Lectures	4 Hr/Week	CT	30 Marks
Tutorials	-	CA	10 Marks
Total Credits	4	ESE	60 Marks
		Total	100 Marks
		DurationofESE:03Hrs	

Course Objectives:

1	To familiarize the learners with important economic terminologies and key industrial concepts.
2	To create awareness about functions of Industrial management and the concept of marketing and financial management

	Course Contents	Hours
UnitI	**Industrial Economics:** Law of demand, Demand analysis, Types of demand, Determinants of demand, Supply, Law of diminishing marginal utility, Elasticity of demand, Types of elasticity of demand.	(9)
UnitII	**Factors of production,** Firm and Industry, Law of return, Cost concepts, Fixed variable, Average, Marginal and Total cost, Depreciation and methods for depreciation, direct and indirect taxes	(9)
Unit III	**Inflation, effect of inflation,** Monetary and fiscal measures to control inflation, deflation, Market and market structures, Perfect competition, Monopoly, Monopolistic competition, Oligopoly, Concept & overview of share market, Effect of share market on economy, Share market terminologies	(9)
UnitIV	**Definition, nature and scope of management,** functions of management, Meaning and concepts of Marketing management, Market research Marketing Mix, new product development, product life cycle, Channels of distribution, Advertising and sales promotion.	(9)
UnitV	**Meaning, nature and scope of financial management,** Sources of finance, financing organizations break even analysis , Brief outline of profit and loss account, balance sheet, Budgets and their importance, Types of budgets- Rigid and flexible budgets.	(9)

Text Books

T.1	Modern Economics, H. L. Ahuja, S.Chand Publishers
T.2	Modern Economic Theory, K. K. Dewett., S. Chand Publishers
T.3	Industrial Management, Dr. D. K. Bhattacharya, Vikas Publication
T.4	Business Organization and Management S.A. Sherlekar

Reference Books

R.1	Financial Management, Kuchal S.C, Chaitanya Publishing House
R.2	Engineering Economics, D. N. Dwivedi, A. Dwivedi, Vikas Publishing House
R.3	Industrial Management I.K. Chopde, A.M. Sheikh

	Useful Links
1	https://nptel.ac.in/courses/110101005
2	https://archive.nptel.ac.in/courses/110/105/110105075/
3	https://nptel.ac.in/courses/110105067

	Course Outcomes	CL
BME33504.1	**Interpret** demand and supply principles, including elasticity and determinants, in relation to market price dynamics.	3
BME33504.2	**Explain** the principles of production economics, for practical applications in firms and industries.	3
BME33504.3	**Analyze** the causes and effects of inflation and market structures, to determine impact on economic decision-making.	4
BME33504.4	**Summarize** key marketing management principles, to determine customer product preferences.	5
BME33504.5	**Illustrate** the concept of financial management for the development of business.	3

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Third Year (Semester-V)B. Tech. Mechanical Engineering

BME33505: (PE-I) Computer Aided Design

Teaching Scheme	
Lectures	4Hr/Week
Tutorials	-
Total Credits	4

Examination Scheme	
CT	30 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
DurationofESE:03Hrs	

Course Objectives:

1	To learn about engineering design through the use of computer aided design (CAD) software and hardware.
2	To learn about graphical user interface, graphics systems and standards, different geometric modeling techniques like wire frame modeling, solid modeling etc.
3	To learn the fundamental concepts of the theory of the finite element method and to develop the skills needed to apply Finite Element Methods to Problems in Mechanical Engineering.
4	To enable the students to formulate the design 1D and 2D Problems into FEA.
5	To formulate FEM to Truss and CST Element.

	Course Contents	Hours
UnitI	**Introduction of CAD,** features of CAD software and their selection Difference between Conventional & CAD design and simple algorithms for the generation of basic geometric entities like line, circle by using parametric & non-parametric equations. Introduction to 2D viewing, window and viewport, line clipping & polygon clipping (no algorithms).	**(9)**
UnitII	**2D transformation:** Translation, Scaling, Rotation, Reflection & Shear, Concept of homogeneous representation & concatenation. Inverse Transformation (enumeration of entity on graph paper) 3D Transformation: Translation, Scaling, Rotation about principle and arbitrary axis, Reflection about principle and arbitrary plane etc.	**(9)**
Unit III	**Techniques for Geometric Modeling:** Wire frame modeling, surface modeling, solid modeling methods: primitive creation function, constructive solid geometry, B representation technique, etc. Introduction to Analytic Curves, Synthetic Curves: Bezier curve, Cubic spline curve and B-Spline curve. Parametric representation of surfaces Assembly modeling: Representation, mating conditions, representation schemes, generation of assembly sequences and importance of precedence diagram.	**(9)**
UntIV	**Finite Element Analysis:** One Dimensional Problem: Fundamental concept of finite element method, Plain stress and strain, Finite Element Modeling, Potential Energy Approach, Galerkin Approach, Coordinate and Shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Quadratic Shape Function, Temperature Effects, Torsion of a circular shaft.	**(9)**
UnitV	**Truss & Two Dimensional FEM:** Plane truss problems, Finite element method for beams: Introduction, element formulation, load vector, boundary condition, shear force and bending moment, beams on elastic support.	**(9)**

Text Books	
T.1	Computer Aided Design and Manufacturing, Groover, M.P., Prentice-Hall of India, 5th Edition, 2005.
T.2	CAD/CAM Theory and Practice, Zeid Ibrahim, Tata McGraw Hill, 4th edition, 2001.
Reference Books	
R.1	Automation Production Systems and Computer Integrated Manufacturing, Groover, M. P., Prentice-Hall of India, 2nd Edition.
R.2	CAD/CAM Principals and Applications, Rao, P.N. Tata McGraw Hill, 2002.

	Useful Links
1	https://nptel.ac.in/courses/112/102/112102101/
2	https://nptel.ac.in/courses/112/102/112102102/

	Course Outcomes	CL
BME33505.1	**Summarize** the application of computer-aided design (CAD) for creating geometric entities.	4
BME33505.2	**Apply** Matrices of 2D and 3D transformations, to solve problems in computer graphics.	3
BME33505.3	**Analyze** modeling techniques to determine their effectiveness in solving engineering problems.	4
BME33505.4	**Interpret** trusses using FEM technique to find efficient simulation of complex systems.	3
BME33505.5	**Explain** the application of FEM in plane truss problems, to determine structural behavior under loads and boundary condition.	4

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Third Year (Semester-V)B. Tech. Mechanical Engineering

BME33506: (PE-I) Automotive System

Teaching Scheme	
Lectures	4Hr/Week
Tutorials	-
Total Credits	4

Examination Scheme	
CT	30 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
DurationofESE:03Hrs	

Course Objectives:

1	To recognize the fundamentals and applications of various types of automobiles and its major components.
2	To illustrate the importance and working of transmission and drive line components.
3	To explore components and working of steering, braking and suspension system.
4	To identify engine components and subsystems.
5	To demonstrate the importance and functioning of various electrical, electronic devices and recent trends in automobiles.

	Course Contents	Hours
UnitI	**Introduction:** Classification of automobiles, Major components and their functions. Chassis Different vehicle layout. **Power train:** Engine, Basic Components, Classification, Two Stroke, Four Stroke, Petrol Engine, Diesel Engine, Fuel Supply systems: Necessity, Introduction to Carburetor and Fuel Injection system.	(9)
UnitII	**Clutch:** Necessity, requirements of a clutch system. Types of Clutches, Gearbox- Necessity of transmission, principle, types of transmission, Automatic Transmission. **Transmission system:** Propeller shaft, Universal joint, constant velocity joint,Differential,2 Wheel Drive, 4Wheel drive. **Steering systems:** Principle of steering, steering geometry and wheel alignment, Power Steering. Under steer, Over steer.	(9)
Unit III	**Suspension systems**: Need, Function of spring and shock absorber, conventional suspension, Independent suspension System, Active suspensions. **Brakes**: Function, Classification, Basic Components. Drum Brakes, Disc Brakes, Hydraulic brakes, Air Brakes,	(9)
UnitIV	**Electrical systems:** Battery construction ,maintenance, testing and charging, cutout ,lighting circuit, horn, side indicator, wiper and panel board instruments. Battery, magneto and electronic ignition systems. Automobile air-conditioning. **Wheels and Tyres:** Types of wheels, wheel dimensions, tyre, desirable tyre properties, types of tyres, comparison of radial and bias-ply tyres, tyre construction, tyre materials, factor affecting tyre life, precautions regarding the tyres and wheel balancing.	(9)

UnitV	**Recent Advances in automobile technology:** Electric Vehicle, Hybrid Cars, types of hybrids, Traction control, intelligent highway system, Collision avoidance system, Automatic Cruise Control, Navigational aids, Parking Assistance system. Recent advances in automobiles such as ABS, electronic power steering, Active suspension, collision avoidance, intelligent lighting, navigational aids and electronic brake Distribution system.	**(9)**
Text Books		
T.1	Automobile Engineering Vol. I&II, Kirpal Singh, Standard Publishers.	
T.2	Automobile Engineering, R. K .Rajput, Laxmi Publications.	
Reference Books		
R.1	AutomotiveMechanics:PrinciplesAndPracticesHeitnerJosephPublications	
R.2	Automobile Mechanics, Crause, W.H., Tata Mc Graw Hill	

	Useful Links
	https://www.iav.com/us/engineering
	http://www.sae.org/automotive/

	Course Outcomes	**CL**
BME33506.1	**Interpret** automobile components, uncovering their operational principles	3
BME33506.2	**Analyze** transmission systems to determine their impact on vehicle dynamics.	4
BME33506.3	**Explain** the principles of Chassis, to determine vehicle safety and performance.	4
BME33506.4	**Summarize** maintenance of automotive electrical systems, to know their impact on vehicle performance and safety.	5
BME33506.5	**Illustrate** applications of recent advances in automotive technology, for their impact on vehicle performance, safety, and efficiency.	3

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Third Year (Semester-V) B. Tech. Mechanical Engineering

BME33507: (PE-I) Smart Manufacturing

Teaching Scheme		Examination Scheme	
Lectures	4Hr/Week	CT	30Marks
Tutorials	-	CA	10Marks
Total Credits	4	ESE	60Marks
		Total	100 Marks
		DurationofESE:03Hrs	

Course Objectives:

1	To introduce students to the concepts and principles of smart manufacturing.
2	To familiarize students with Industry 4.0 technologies including IoT and AI in manufacturing.
3	To understand the integration of automation, data analytics, and cyber-physical systems in production.
4	To explore digital transformation and sustainable manufacturing practices.
5	To develop knowledge of real-world smart manufacturing applications and challenges

	Course Contents	Hours
Unit I	**Introduction to Smart Manufacturing**: Concept and evolution of manufacturing systems, traditional vs smart manufacturing, key enablers of smart manufacturing such as cyber-physical systems, digital twin, cloud computing, and big data, benefits and challenges of smart manufacturing.	(9)
Unit II	**Industry 4.0 and IoT in Manufacturing**: Overview of Industry 4.0 and its impact on manufacturing, Internet of Things (IoT) including sensors, actuators, and communication protocols, IoT-based monitoring and control in manufacturing, smart factories and connected machines	(9)
Unit III	**Artificial Intelligence and Machine Learning in Manufacturing**: Introduction to AI and ML concepts, predictive maintenance using AI, quality inspection and defect detection using AI vision systems, process optimization and decision support systems, applications of ML algorithms in production scheduling and inventory management.	(9)
UnitIV	**Automation, Robotics, and Additive Manufacturing**: Industrial automation concepts including PLCs and SCADA systems, robotics in smart manufacturing with emphasis on collaborative robots (cobots), introduction to additive manufacturing (3D printing), integration of additive and conventional manufacturing, role of automation and robotics in flexible production systems.	(9)

UnitV	**Data Analytics, Digital Twins, and Sustainability:** Importance of data in smart manufacturing, applications of data analytics for process improvement, concept of digital twins and their implementation in manufacturing, strategies for sustainable and energy-efficient manufacturing, case studies on digital transformation in industries	**(9)**

Text Books	
T.1	**Smart Manufacturing: Concepts and Case Studies"** by Rajesh Kumar Singh, R. K. Garg, and S. G. Deshmukh
T.2	**"Industry 4.0: The Industrial Internet of Things"by** Alasdair Gilchrist.
Reference Books	
R.1	**Artificial Intelligence in Manufacturing"** edited by S. G. Ponnambalam and Inderdeep Singh.
R.2	**Robotics and Automation in Manufacturing"** by Richard C. Dorf and Thomas F. Kusiak.

	Useful Links
1	https://mrcet.com/downloads/digital_notes/ME/III%20year/Smart%20Manufacturing%20Technologies.pdf
2	https://erp.nitttrbpl.ac.in/poc2023/onlinemode/prgDetails/ET-8_2023-2024.pdf

	Course Outcomes	**CL**
BME33507.1	**Interpret** the role of smart manufacturing's key enablers in enhancing production efficiency, quality, and innovation.	3
BME33507.2	**Explain** how Industry 4.0 transforms manufacturing processes and enables smart manufacturing.	4
BME33507.3	**Apply** artificial intelligence to manufacturing processes, to enhance efficiency, quality, and decision-making.	3
BME33507.4	**Analyze** automation technologies to fit for specific manufacturing production needs..	4
BME33507.5	**Evaluate** data-driven approaches in manufacturing, assessing their effectiveness in driving process improvement responsibility..	5

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Third Year(Semester-V) B.Tech Mechanical Engineering

BBA33502: Business Development Formulation

Teaching Scheme	
Lectures	3Hr/Week
Tutorials	-
Total Credits	3

Examination Scheme	
CT	30 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE:03Hrs	

Course Objectives:

1	Explain the fundamentals and importance of business development in mechanical engineering.
2	Illustrate strategic tools like Business Model Canvas and SWOT for business planning and value creation.
3	Develop practical knowledge in prototyping and product development aligned with user needs and manufacture ability.
4	Analyze basic financial metrics and marketing strategies for a mechanical engineering-based business.
5	Describe legal, ethical, and operational aspects relevant to starting and sustaining a business venture.

	Course Contents	Hours
Unit I	**Introduction to Business Development in Engineering Context** Fundamentals of business development: definition, scope, and relevance to engineers, Role of mechanical engineers in startups, MSMEs, and corporate innovation, Overview of industrial ecosystems and value chains, Basics of idea generation and opportunity recognition, Market research and customer needs assessment	(9)
Unit II	**Business Model and Strategic Planning** Business Model Canvas (BMC) for mechanical engineering products/services, Value proposition design, Revenue streams, cost structure, key resources and partners, SWOT and PESTLE analysis, Formulating short-term and long-term strategic goals	(9)
Unit III	**Product Development and Prototyping** Product life cycle and stage-gate model, Role of CAD/CAM, 3D printing, and reverse engineering in prototyping, strategic implications; New product development and consumer adoption process. Packaging and labeling. Case studies: Mechanical engineering-based product startups.	(9)
Unit IV	**Financial and Marketing Planning** Basics of project costing and financial forecasting, Promotion mix– advertising, personal selling, sales promotion, publicity and public relations; Determining advertising budget, budgeting, and funding options (angel investors, VCs, grants), Pricing strategies for engineering products, Marketing mix (4Ps), branding, and digital marketing, Business communication skills	(9)

Unit V	**Legal, Ethical, and Operational Aspects** Intellectual Property Rights (IPR): patents, trademarks, design registration, Regulatory compliances (MSME norms, environmental & safety standards), Business registration processes and company formation, Ethics in engineering business practices, Project management basics (time, quality, risk, resources)	**(9)**

Text Books	
T.1	Timmons, Jeffry A., and Spinelli, Stephen. New Venture Creation: Entrepreneurship for the 21st Century, McGraw-Hill Education.
T.2	Osterwalder, Alexander, and Yves Pigneur. Business Model Generation, Wiley.
Reference Books	
R.1	Barringer, Bruce R., and Ireland, Duane R. Entrepreneurship: Successfully Launching New Ventures, Pearson.
R.2	Hisrich, Robert D., Peters, Michael P., and Shepherd, Dean A. Entrepreneurship, McGraw-Hill Education.

	Useful Links
1	https://www.startupindia.gov.in
2	https://www.msme.gov.in

	Course Outcomes	**CL**
BBA33502.1	**Interpret** the fundamentals of business development, to drive innovation in engineering contexts.	3
BBA33502.2	**Summarize** key concepts of business model development to drive business growth and innovation.	5
BBA33502.3	**Analyze** product development processes, to determine their impact on product lifecycle and market success..	4
BBA33502.4	**Illustrate** financial and marketing planning principles, to enhance effective business strategies for engineering products and services..	3
BBA33502.5	**Explain** key concepts of intellectual property, to navigate the operational aspects of engineering business effectively.	4

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Third Year (Semester-V) B. Tech. Mechanical Engineering

BME33508: Heat Transfer Lab

Teaching Scheme	
Practical	2Hr/Week
	-
Total Credits	1

Examination Scheme	
CT	-
CA	25 Marks
ESE	25 Marks
Total	50 Marks
Duration of ESE: 02 Hrs	

Course Objectives

1	Compare the thermal conductivity of different materials.
2	Demonstrate and understand the process of free convection,
3	Compare the performance of forced convection with natural convection
4	Understand the principles of heat transfer through radiation,
5	Understand the basic function of a heat exchanger in transferring heat between two fluids without mixing them.

Experiment No.	Name of Experiment	CO
1	To determine thermal conductivity of metal rod	CO1
2	To calculate thermal conductivity of insulating powder	CO1
3	To determine thermal conductivity of liquid	CO1
4	To calculate the temperature distribution along the length of pin fin	CO2
5	To determine the Critical Heat Flux at different temperature of water	CO2
6	Determination of Condensation heat transfer coefficient in film wise And drop wise condensation	CO3
7	To calculate heat transfer coefficient in forced convection.	CO3
8	To determine emissivity of non black body	CO4
9	To calculate Stefan Boltzmann Constant	CO4
10	To Explore the importance of Heat Exchanger	CO5

Text Books

T.1	S. P Sukhatme, A Text Book of Heat Transfer, University Press, 4th Edition, 2005
T.2	Fundamentals of Heat and Mass Transfer, K. N. Seetharam & T.R. Seetharam, Willey.
T.3	R.C. Sachdeva: Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd. (I), 2010

Reference Books

R.1	J.P. Holman: Heat Transfer; McGraw-Hill, 1996

R.2	Yunus A. Cengel, Heat Transfer: A Practical Approach, McGraw-Hill Higher Education, 2002

	Useful Links
1	https://nptel.ac.in/courses/112101097
2	https://nptel.ac.in/courses/112101097

	Course Outcomes	CL
BME33508.1	**Analyze** the thermal conductivity of various engineering materials to determine their suitability for thermal applications.	4
BME33508.2	**Demonstrate** the performance of free convection heat transfer to determine influencing parameters through experimental and analytical methods.	3
BME33508.3	**Calculate the** performance of forced convection and condensation processes to determine heat transfer efficiency in thermal systems.	3
BME33508.4	**Analyze** radiation heat transfer mechanisms to find effective heat transfer systems and applications.	4
BME33508.5	**Illustrate** the importance of heat exchangers to enhance their role in energy efficiency and system performance in thermal systems	3

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Third Year (Semester-V) B. Tech. Mechanical Engineering

BME33509: Dynamics of Machine Lab

Teaching Scheme	
Lectures	2Hr/Week
Tutorials	-
Total Credits	1

Examination Scheme	
CT	-
CA	25 Marks
ESE	25 Marks
Total	50 Marks
Duration of ESE : 02 Hrs	

Course Objectives:

1	Demonstrate the gyroscopic effect on air plane, ship, four wheeler, twowheeler and Exhibit skills towards application of dynamic force analysis
2	To identify the motion of cam and follower for velocities and acceleration calculation.
3	To Examine the balancing of the rotating elements to avoid the failure.
4	To learn different types of governors and vibration concept in various machines.

Sr. No.	List of Experiment	CO
1	Evaluate and compare the magnitude of active couple and Gyroscopic couple with respect to Gyroscope.	CO3
2	Interpret displacement curve of Cam follower movement with respect to cam rotation.	CO3
3	Determine the balancing of rotating masses using numerical.	CO3
4	Determine Performance Characteristic of Simple watt Governor.	CO4
5	Calculate the frequency of Longitudinal vibration in spring mass system.	CO5
6	Determine and compare the torsional frequency through free and damped vibration in logarithmic decay.	CO5
7	Determine natural frequency of torsional vibration in single and Double rotor system.	CO5
8	Calculate radius of gyration of a given body using bifiller suspension.	CO5
9	Determine critical speed of Shaft in Transverse Vibration.	CO5
10	Determine Natural frequency in Cantilever Beam.	CO5

Text Books	
T.1	Theory of Machine, S. S.Rattan,TataMcGrawHill.
T.2	Mechanism and Machine Theory,J.S.Rao&Dukki Patti, New Age International (P)Ltd, Publishers.
T.3	Theory of Machines, P L Ballaney, Khanna Publications.
T.4	Theory Of Machines ,Khurmi, R. S .and Gupta, J. K. S. chand Publication.
Reference Books	
R.1	Theory of Machines and Mechanisms, J.E .Shigley and J.J. Uicker,Oxford University Press.
R.2	Theory of Machines and Mechanism, Ghosh &Mallik, Affiliated East-West Press, New Delhi.
Useful Links	
1	https://nptel.ac.in/courses/112104114/
2	https://nptel.ac.in/courses/112/104/112104121/

	Course Outcomes	CL
BME33509.1	**Demonstrate** the performance of gyroscope for the field applications.	3
BME33509.2	**Analyze** cam-follower dynamics to determine displacement, velocity, and acceleration characteristics.	4
BME33509.3	**Apply** the principles of dynamics to solve problems related to the balancing of rotating masses in mechanical systems.	3
BME33509.4	**Analyze** the performance characteristic curves of mechanical governors for their stability, sensitivity, and range for speed control in engines.	4
BME33509.5	**Compare** free and forced vibration characteristics in single and two degree-of-freedom systems, for their efficiency and dynamic behavior.	4

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Third Year (Semester-V) B. Tech. Mechanical Engineering

BME33510: Design of Machine Elements lab

Teaching Scheme	
Lectures	2Hr/Week
Tutorials	-
Total Credits	1

Examination Scheme	
CT	-
CA	25 Marks
ESE	25 Marks
Total	50 Marks

Duration of ESE : 02 Hrs

Course Objectives:

1	To familiarize the students with the concept of design and design procedure of machine elements.
2	To familiarize the students with selection of material for different machine elements.
3	To design machine elements subjected to static loading.
4	To design machine elements subjected to fluctuating loading.
5	To understand design procedure of various mechanical joints, machine components such as shaft, keys, brakes clutches, power screws, pressure vessel, spring.

Sr. No.	List of Experiment	CO
1	Design of Knuckle joint	CO1
2	Design of Cotter joint	CO1
3	Design of welded joints under axial and eccentric loading conditions	CO2
4	Design of Cylinder & Pressure Vessels.	CO2
5	Design of power transmission shafts.	CO3
6	Design of power screw	CO4
7	Design of Helical springs under static and variable loads.	CO4
8	Design of Leaf springs under static and variable loads.	CO4
9	Design of clutches	CO5
10	Design of Brakes.	CO5

Text Books

T.1	"Design of Machine Elements: Theory and Problems" Bhandari V.B. T Denett And Co. Publication 3 Edition.
T.2	"Design of Machine Elements" Shiwalkar B.D. TDenett And Co. Publication 3 Edition.
T.3	"Machine Design An Integrated Approach", R.L Norton, Pearson Education Publication, 3rd Edition

Reference Books

R.1	Design Data book, B.D. Shiwalkar, Central Techno publications
R.2	Design Data Book, PSG
R.3	Design of Machine Elements, V.B.Bhandari, McGraw Hill

Useful Links	
1	http://nptel.ac.in/courses/112105124/
2	https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/lecture-notes/

	Course Outcomes	CL
BME33510.1	**Apply** principles of static loading to determine safe stresses on joints.	3
BME33510.2	**Analyze** the safe stress on welded joints under axial and eccentric loading conditions, cylinders and pressure vessels for optimal performance and safety, and power transmission shafts for efficient power transmission.	4
BME33510.3	**Calculate** the power transmission capacity of hollow and solid shafts using strength, rigidity, and failure theories.	3
BME33510.4	**Apply** principles of loading to determine safe stress on power screws and springs..	3
BME33510.5	**Summarize** safe stress considerations for clutches and brakes in automobile applications under various loading conditions.	5

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