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

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAM SCHEME				
									CT1	CT2	TA/CA	ESE	TOTAL
1	PCC	BME3501	Heat and Mass Transfer	3	-	-	3	3	15	15	10	60	100
2	PCC	BME3502	Dynamics of Machine	3	-	-	3	3	15	15	10	60	100
3	PCC	BME3503	Design of Machine Element	3	-	-	3	3	15	15	10	60	100
4	PCC	BME3504	Lab-Heat and Mass Transfer	-	-	2	2	1	-	-	25	25	50
5	PCC	BME3505	Lab-Dynamics of Machine	-	-	2	2	1	-	-	25	25	50
6	PEC	BME3506-09	Professional Elective-I	4	-	-	4	4	15	15	10	60	100
7	PEC	BME3510-13	Professional Elective-II	3	-	-	3	3	15	15	10	60	100
8	OEC	B$$XX**01-14**	Open Elective-I	4	-	-	4	4	15	15	10	60	100
9	MCC	BAU3505	Heritage	2	-	-	2	Audit	-	-	-	-	-
			Total	**22**	**-**	**4**	**26**	**22**	**90**	**90**	**110**	**410**	**700**

L-Lecture T-Tutorial P-Practical

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

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

Course Category	HSMC (Hum., Soc.Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	PCC (Professional Core Courses)	PEC (Professional Elective Courses)	OEC (Open Elective courses from other discipline)	Project / Seminar /Industrial Training	MCC (Mandatory Courses)
Credits	-	-	--	11	7	4	-	Yes
Cumulative Sum	7	26	24	34	7	4	1	--

PROGRESSIVE TOTAL CREDITS: 81 + 22 =103

BoS Chairman Head Department of Mechanical Engineering Tulsiramji Gaikwad Patil College of Engineering & Technology, NAGPUR.

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

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

Principal Principal Tulsiramji Gaikwad Patil College Of Engineering and Technology, Nagpur

Program: Mechanical Engineering

List of Electives offered by Mechanical Engineering

Professional Elective

Professional Elective-I	Professional Elective- II	Professional Elective-III	Professional Elective-IV	Professional Elective-V
Semester V	**Semester V**	**Semester VI**	**Semester VI**	**Semester VI**
BME3506:Power Plant Engineering	BME3510:Renewable Energy System	BME3606:Automotive System	BME3610:Industrial Fluid Power	BME4706:Stress Analysis
BME3507:Computer Aided Designing	BME3511:Control System Engineering	BME3607:Mechanical Vibrations	BME3611:Finite Element Analysis	BME4707:Material Handling System
BME3508:Advance Manufacturing Techniques	BME3512:Tool Design	BME3608:Industrial Robotics	BME3612:Optimization Techniques	BME4708:Composite Mechanics
BME3509:Production Management	BME3513:Industrial Engineering	BME3609:Operation Research	BME3613:Product Design and Development	BME4709:Total Quality Management

Open Elective

List of Open Elective

Sr. No.	Course Code	Course Title	Sr. No.	Course Code	Course Title
1	BCSXX01	Cyber Law and Ethics	9	BMEXX09	Nanotechnology and Surface Engineering
2	BCSXX02	Block chain Technology	10	BMEXX10	Automobile Engineering
3	BITXX03	Cyber Security	11	BEEXX11	Power Plant Engineering
4	BITXX04	Artificial Intelligence	12	BEEXX12	Electrical Materials
5	BECXX05	Internet of Things	13	BAEXX13	Avionics
6	BECXX06	Embedded Systems	14	BAEXX14	Unmanned Aerial Vehicles
7	BCEXX07	Introduction to Art and Aesthetics	15	BBTXX15	Biomaterials
8	BCEXX08	Metro Systems and Engineering	16	BBTXX16	Food and Nutrition Technology

BoS Chairman
Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of Engineering & Technology, NAGPUR.

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

Vice Principal
Tulsiramji Gaikwad-Patil College Of Engineering & Technology, Nagpur

05/04/23
Principal
Principal
Tulsiramji Gaikwad Patil College Of Engineering and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3501:Heat and Mass Transfer

Teaching Scheme	
Lectures	3 Hrs/week
Tutorial	-
Total Credit	3

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03 Hrs .	

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 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

Unit I	**Introduction to heat transfer:** Modes/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 ofheat and electricity, derivation ofGeneralized heat conduction equation in Cartesian coordinates, Generalized heat conduction equation in cylindrical co-ordinates. One dimensional steady state conduction equation for the plane wall, Cylinder and its Numerical, overall heat transfer coefficient.
Unit II	**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. **Unsteady state heat conduction**: Lumped heat capacity method, Biot and Fourier numbers, and its significance.
Unit III	**Convection:**, Types of convection, Hydrodynamic and thermal boundary layer, Laminar and turbulent flow over a flat plate and through a duct, Friction factor, Drag and drag co-efficient. **Free and Forced Convection:** Dimensional analysis in 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, critical heat flux, burnout point, Nucleate boiling.

Unit IV	**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.
Unit V	**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. **Mass Transfer:** Analogy between heat and mass transfer, mass diffusion, Fick's law of diffusion, boundary conditions, steady mass diffusion through a wall, transient mass diffusion, mass convection, limitations of heat and mass transfer analogy.
Text Books	
1	S. P Sukhatme, A Text Book of Heat Transfer, University Press, 4th Edition, 2005
2	Fundamentals of Heat and Mass Transfer, K. N. Seetharam & T.R. Seetharam, Willey.
3	R.C. Sachdeva: Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd. (I), 2010
Reference Books	
1	J.P. Holman: Heat Transfer; McGraw-Hill, 1996
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/

BME3501	Course Outcomes	CL	Class Sessions
BME3501.1	**Compare** the different modes of heat transfer and calculation of thermal resistance and Thermal Conductivity	3	9
BME3501.2	**Apply** the concept of internal heat generation for the calculation of heat transfer rate. Also learn about various types of fins and their significance in steady state conduction.	4	9
BME3501.3	**Apply** appropriate empirical correlations to estimate forced convection and free convection heat transfer, for internal and external flows.	3	9
BME3501.4	**Evaluate** heat transfer rate by radiation from ideal and actual surfaces and enclosures of different geometries.	5	9
BME3501.5	**Evaluate** heat exchanger performance for the given geometry and knowledge of mass transfer by applying principles of diffusion, mass transfer coefficients and interphase mass transfer.	3	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3502:Dynamics of Machine

Teaching Scheme	
Lectures	3 Hrs/week
Tutorial	-
Total Credit	3

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03 Hrs .	

Course Objectives

1	Demonstratethegyroscopiceffectonairplane,ship, fourwheeler,twowheelerand 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 governor and vibration concept in various machines

Course Contents

Unit I	Concepts in machine element dynamics. D'Alembert principle. Application of these approaches for simple two degree of freedom systems. Simple precession and gyroscopic couple. Gyroscopic effect on airplane, ship, four wheeler.
Unit II	Dynamic force analysis of planar linkages such as four bar chain and reciprocating mechanism by graphical method, virtual work method. Cam dynamics and jump-off phenomenon.
Unit III	Static & Dynamic balancing in rotating machines. Balancing machines and field balancing by vector diagram and analytical method.
Unit IV	Turning moment Vs crank angle diagram for single- cylinder and multiple-cylinder engines, punching machines etc. Flywheel selection. Speed governors, centrifugal and inertia type, Watt, Portal, Proel, Hartnell governors, operating characteristics of governors.
Unit V	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)

Text Books

1	Theory of Machine, S. S.Rattan,Tata McGrawHill.
2	MechanismandMachineTheory,J.S.Rao&DukkiPatti,NewAgeInternational(P)Ltd,Publishers.
3	Theory of Machines, P L Ballaney, Khanna Publications.

4	Theory Of Machines ,Khurmi, R. S .and Gupta, J. K. S. chand Publication
Reference Books	
1	Theory of Machines and Mechanisms, J.E .Shigley and J.J. Uicker,Oxford University Press.
2	TheoryofMachinesandMechanism,Ghosh&Mallik,AffiliatedEast-WestPress,NewDelhi
3	Theory of Machines, SadhuS ingh, Pearson publications.
4	Theory of Machines, P L ballany, khanna Publisher
5	Theory of Machin s Ghosh, Amitabha ;Mallik, Asok Kuma ,East west Press
Useful Links	
1	https://nptel.ac.in/courses/112104114/
2	https://nptel.ac.in/courses/112/104/112104121/

BME3502	Course Outcomes	CL	Class Sessions
BME3502.1	**Apply** the knowledge of gyroscope for the field applications	3	9
BME3502.2	**Analyze** the dynamics of planer linkage and cam follower	4	9
BME3502.3	**Analyze** the concept of unbalanced forces and couple need for balancing of rotating masses in machines and achieve balancing to avoid failure.	4	9
BME3502.4	**Apply** the concept of governor and Flywheel for the automobiles field application.	3	9
BME3502.5	**Analyze** the free and forced vibration for single degree of freedom system	4	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

TulsiramjiGaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3503:Design of Machine Element

Teaching Scheme	
Lectures	3 Hrs/week
Tutorial	-
Total Credit	3

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03 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.

Course Contents

Unit I	**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. Design of riveted joint.
Unit II	**Welded Joint Riveted Joint:** Design of bolted and welded joints under axial and eccentric loading conditions. Design of Brackets & Levers. **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.
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. Design of rigid and flexible coupling.
Unit IV	**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.

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

BME3503	Course Outcomes	CL	Class Sessions
BME3503.1	**Apply** principals of static loading for design of Cotter joint, Knuckle joint	3	9
BME3503.2	**Design** bolted, welded joints& pressure vessels.	4	9
BME3503.3	**Design** the power transmission shaft & coupling.	3	9
BME3503.4	**Apply** principle of loading to design power screw and spring.	3	9
BME3503.5	**Design** clutches, brakes for automobile applications	4	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3504:Heat and Mass Transfer Lab

Teaching Scheme		Examination Scheme	
Lectures	2Hrs/week	**CA**	25 Marks
Total Credit	1	**ESE**	25Marks
		Total	50Marks
		Duration of ESE: 03 Hrs.	

Course Objectives

1	To demonstrate and perform basic principles finding thermal conductivity of various materials like asbestos, brass etc.
2	To demonstrate basic method for determination of overall heat transfer coefficient of composite slabs.
3	To perform experimentation for determination of heat transfer coefficients in free and forced convection.
4	To demonstrate basic method for determination of emissivity of grey body and Stefan Boltzmann's constant.
5	To perform experimentation for determination of heat transfer coefficients, effectiveness and heat transfer rates in Heat Exchangers.

Sr. No.	List 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

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

	2010
Reference Books	
1	J.P. Holman: Heat Transfer; McGraw-Hill, 1996
2	Yunus A. Cengel, Heat Transfer: A Practical Approach, McGraw-Hill Higher Education, 2002

BME3504	Course Outcomes	CL	Lab Sessions
BME3504.1	**Analysis** the performance of Thermal conductivity for different material	3	2
BME3504.2	**Demonstrate** the performance of free convection	4	2
BME3504.3	**Execute** the performance of forced convection and condensation	3	2
BME3504.4	**Analysis** of radiation heat transfer and utilize that knowledge in designing any heat transfer application	3	2
BME3504.5	**Explore** the importance of Heat Exchanger	3	2

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3505:Dynamics of Machine Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs/Week	**CA**	25 Marks
Total Credit	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 03 Hrs .	

Course Objectives

1	Demonstratethegyroscopiceffectonairplane,ship, fourwheeler,twowheelerand Exhibitskillstowardsapplication of dynamic force analysis
2	Toidentifythemotionofcamandfollowerforvelocitiesandaccelerationcalculation
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	CO1
2	Interpret displacement curve of Cam follower movement with respect to cam rotation	CO2
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

1	Theory of Machine, S. S.Rattan,Tata McGrawHill.
2	Mechanism and Machine Theory,J.S.Rao & Dukki Patti, New Age International (P)Ltd,Publishers.
3	Theory of Machines, P L Ballaney, Khanna Publications.

4	Theory Of Machines ,Khurmi, R. S .and Gupta, J. K. S. chand Publication
Reference Books	
1	Theory of Machines and Mechanisms, J.E .Shigley and J.J. Uicker,Oxford University Press.
2	TheoryofMachinesandMechanism,Ghosh&Mallik,AffiliatedEast-WestPress,NewDelhi
3	Theory of Machines, SadhuS ingh, Pearson publications.
4	Theory of Machines, P L ballany, khanna Publisher
5	Theory of Machin s Ghosh, Amitabha ;Mallik, Asok Kuma ,East west Press
Useful Links	
1	https://nptel.ac.in/courses/112104114/
2	https://nptel.ac.in/courses/112/104/112104121/

BME3505	Course Outcomes	CL	Class Sessions
BME3505.1	**Demonstrate** the performance of gyroscope for the field applications	3	2
BME3505.2	**Analyze** the cam dynamics for follower displacement velocity and acceleration	4	2
BME3505.3	**Solve** the problem of balancing of rotating masses	4	2
BME3505.4	**Draw** performance characteristic curve for Governor	3	2
BME3505.5	**Execute** the free and forced vibration for single/two degree of freedom system	3	2

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3507:Professional Elective-I Computer Aided Designing

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	-
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03 Hrs .	

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

Unit I	**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).
Unit II	**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.
Unit III	**Techniques for Geometric Modeling:** Wire frame modeling, surface modeling, solid modeling methods: primitive creation function, constructive solid geometry, Brepresentation 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
Unit IV	**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.
Unit V	**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
Text Books	
1	Computer Aided Design and Manufacturing, Groover, M.P., Prentice-Hall of India, 5th Edition, 2005.
2	CAD/CAM Theory and Practice, Zeid Ibrahim, Tata McGraw Hill, 4th edition, 2001.
Reference Books	
1	Automation Production Systems and Computer Integrated Manufacturing, Groover, M. P., Prentice-Hall of India, 2nd Edition.
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/

BME3507	Course Outcomes	CL	Class Sessions
BME3507.1	**Summarize** the basic concept of computer aided design.	2	9
BME3507.2	**Apply** transformation techniques on 2-D and 3-D entities.	3	9
BME3507.3	**Analyze** the concept of various modeling techniques.	4	9
BME3507.4	**Analyze** the 1-D bar and 2-D trusses using FEM technique.	4	9
BME3507.5	**Analyze** the CST elements structure by FEM method.	4	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3508:Professional Elective-I Advanced Manufacturing Techniques

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	-
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03 Hrs .	

Course Objectives

1	This course is designed to provide students with an overview of a wide variety of non-traditional machining processes for processing of engineering materials
2	It will help students to learn principles, operations, capabilities, process parameters, economics and application of various non-traditional machining processes, various unconventional welding techniques
3	It will help students to learn and understand the importance of non-traditional machining processes and unconventional welding techniques.
4	In all to generate interest in learning and develop the ability in students to select and apply suitable processes for an engineering product.

Course Contents

Unit I	**Micro electromechanical Systems(MEMS):** Introduction, micro fabrication for MEMS-bulk micromachining of silicon, surface micromachining of MEMS, wafer bonding for MEMS, LIGA process, micromachining of polymeric MEMS devices, 3D micro fabrication, materials for MEMS.
Unit II	**Abrasive Jet Machining**, Mechanics of AJM-process parameters & Machining parameters. Ultrasonic Machining process, mechanics, process parameters & control, effect of USM on materials. Water Jet Machining,
Unit III	**Electro-Chemical Machining**: Electrochemistry of ECM. Electrochemical Grinding. Electric Discharge Machining. Electron Beam, Laser Beam and Plasma Arc Machining.
Unit IV	**Unconventional welding techniques** such as Inert Gas (MIG & TIG), Electric Resistance welding, Oxyacetylene pressure welding, Laser Beam welding, Electron Beam welding, Plasma Arc welding, Atomic Hydrogen welding & Submerged Arc welding, Stud welding.
Unit V	**Rapid Prototyping Technologies:** Introduction to rapid prototyping, major RP technologies, viz., SLA (Stereolithography), FDM (Fused Deposition Modeling), SLS (Selective Laser Sintering), Thermo Jet Process, 3D Printing.

Text Books	
1	A Text Of Book Manufacturing Technology by Chand And Co.Publication.
2	A Text Of Book Manufacturing Technology II by . Chand And Co.Publication
Reference Books	
1	Elements Of Workshop Technology: Vol.I 1 REVISE Manufacturing Process by Choudhury Hajra,S.K; Choudhury Hajra,A.K;Roy, Nirj har
2	Elements Of Workshop Technology-II by Choudhary S.K. ;Choudhary A.K. Nirjhar Roy
3	Elements Of Workshop Technology: Vol.I 1 REVISE Manufacturing Process by Choudhury Hajra,S.K; Choudhury Hajra,A.K;Roy, Nirj har
Useful Links	
1	https://nptel.ac.in/courses/112/103/112103202/
2	https://www.youtube.com/watch?v=44Db1Z59_eo
3	https://nptel.ac.in/courses/112/107/112107089/

BME3508	Course Outcomes	CL	Class Sessions
BME3508.1	**Summarize** the knowledge of micro fabrication for Micro electromechanical Systems.	2	9
BME3508.2	**Interpret** machining processes parameter of abrasive jet machining.	3	9
BME3508.3	**Illustrate** the principle of machining of Electro-Chemical Machining, Electrochemical Grinding. Electric Discharge Machining.	3	9
BME3508.4	**Differentiate** about welding techniques such as Inert Gas MIG & TIG	4	9
BME3508.5	**Summarize** the concept of Rapid Prototyping Technologies.	2	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BME3510:Professional Elective-II- Renewable Energy System

Teaching Scheme		Examination Scheme	
Lectures	3 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03 Hrs .	

Course Objectives

1	To Understand the various forms of conventional energy resources.
2	To Learn the present energy scenario and the need for energy conservation.
3	Elaborate the concept of various forms of renewable energy
4	Analyze the environmental aspects of renewable energy resources.
5	To utilization of renewable energy sources for both domestics and industrial application

Course Contents

Unit I	**Introduction to Solar Energy:**Solar Energy: Present status of energy scenario. Renewable and non-renewable energy sources. Availability, limitations, application of solar energy. Solar Radiation: Structure of the sun, energy radiated by the sun, angular relationship of earth, and sun position, measurement of solar radiation.
Unit II	**Solar Collectors:** Flat Plate Collectors: Types and constructional details of flat plate collector, energy-balance for a flat plate collector, simple equation and performance curves, selection of flat plate collector.Solar Concentrator: Limitations of flat plate collectors, various types of concentrators, their advantage,simple, thermal energy-balance equations, heliostats, selection of various materials for concentrators and reflecting surfaces.
Unit III	**Solar Energy Systems**: Solar Heating Systems: Solar water and space heating systems, passive solar heating systems, solar heating economics, solar air-heating systems, and typical solar ponds.Solar Distillation Systems: Various solar stills and selection, constructional details, Solar Energy Storage Systems. , Solar photovoltaic system, materials used and their performance, types of solar thermal power plant, working substance used, and temperature required various systems used. Solar Dryer: Types, selection, constructional details, materials used and their performance.
Unit IV	**Wind Energy**: Availability of wind, various types of windmills and their constructional details and performance study, Power generated by windmills. Ocean energy: Introduction, ocean thermal electric conversion, open and closed cycle of OTEC, hybrid cycle, energy from tides, basic principles of tidal power & components of tidal power plants. Single & double basin arrangement, estimation of tidal power and

	energy. .
Unit V	**Bio gas and Recent advancements in energy generations:**Chemistry of biogas generation variables affecting simple gas plants, types of digesters their working andconstruction, application of biogas, use of bio-gas, Recent advancements in energy generations like magneto hydro dynamic power generation, fuel cell technology, hydrogen energy and management of energy in the industries.
Text Books	
1	Renewable Energy Recourses: Basic Principle and Applications: G.N.Tiwari and M.K. Ghosal, Narosa publication.
2	Non-Conventional Energy Resources: B.H. Khan, Tata McGraw Hill.
3	Solar Energy Utilization, G.D. Rai. Khanna pulishers.
Reference Books	
1	Non-Conventional Energy Sources , G.D. Rai, Khanna publishers.
2	Solar Energy, S.P. Shukhatme, Tata McGraw Hill Education.
Useful Links	
1	https://nptel.ac.in/courses/115/103/115103123/
2	https://nptel.ac.in/courses/112/105/112105051/

BME3510	Course Outcomes	CL	Class Sessions
BME3510.1	**Summarize** Renewable and non-renewable energy sources, Solar Energy and Solar radiation	2	9
BME3510.2	**Apply** engineering techniques to solve solar plate collector problems	3	9
BME3510.3	**Describe** the concept of solar energy for various solar energy application.	2	9
BME3510.4	**Describe** the concept of Wind Energy and Ocean energy system**.**	2	9
BME3510.5	**Summarize** advance non-renewable energy sources and its concept	2	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

	Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441 108 **NAAC Accredited (A+ Grade)**	

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

BME3513:Professional Elective-II-Industrial Engineering

Teaching Scheme		Examination Scheme	
Lectures	3 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	3	**TA**	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 03 Hrs .	

Course Objectives

1	This course is designed to familiarize the learners with important economic terminologies and key industrial concepts and to create awareness about functions of Industrial management and the concept of marketing and financial management
2	To apply ergonomics principles in industry and for planning and controlling maintenance system
3	This course design to facility lay out, problem and organization of design process and value engineering and skill to apply methods in value engineering to improve the competitiveness of product/service.
4	This course provides knowledge and skills for designing work system as a form of integrated system, planning and controlling of a production system.

Course Contents

Unit I	**Work study:** Productivity- Concept and objectives of productivity, types of productivity, factors affecting productivity, tools and techniques to improve productivity, measurement of productivity. **Work study** and method study: Definitions, objectives, steps in method study, process charts, string diagram, motion study, micro motion study, SIMO chart.
Unit II	**Work measurement**: Objectives, definition, stop watch study, work sampling, PMTs, MTM and work factor method. **Ergonomics**: Objectives, Human factors in engineering, Man machine system, Display design, design controls, Principles of motion economy, work place design.
Unit III	**Forecasting**: Need for forecasting, classification of forecasting methods, like judgmental techniques, time series analysis, least square method, moving average method, exponential smoothing method. **Break even analysis**: classification of costs, analysis of production costs, Break even analysis.
Unit IV	**Maintenance**: Objectives, Types of maintenance, preventive, predictive, break down maintenance, Reliability and maintainability analysis failure data analysis, reliability, MTBT, MTTR, Batch tub curve, series parallel and stand by system.
Unit V	**Quality Control**: Definition, function, objective characteristics. Quality, Quality of design quality of conformance, process control charts and process capability. **Quality control tools**: Quality assurance and quality planning, quality audit, vendor

	quality rating, acceptance sampling, concept and significance, type of sampling, sampling plan, OC curve.
Text Books	
1	MartandTelsang, Industrial Engineering and production management and S. Chand & co.
2	Work study by ILO.
3	Industrial Engg. Mangement, N.V.S. Raju, Cengage Publication
Reference Books	
1	Total Quality Management: Dale H. Besterfield, Carol Besterfield-Michnaetal, Pearson
2	Total Quality Management-Text and cases, ShridharaBhat K, Himalaya Publishing House
Useful Links	
1	https://archive.nptel.ac.in/courses/112/107/112107292/
2	https://archive.nptel.ac.in/courses/112/107/112107143/
3	https://onlinecourses.nptel.ac.in/noc22_me04/preview

BME3513	Course Outcomes	CL	Class Sessions
BME3513.1	**Apply** concept of productivity and method study.	3	9
BME3513.2	**Ability** to measure work time and design ergonomic system.	2	9
BME3513.3	**Evaluate** the concept of forecasting and break even analysis.	3	9
BME3513.4	**Analysis** maintenance and reliability of equipment.	3	9
BME3513.5	**Interpret** various quality control tools and techniques.	3	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

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

BMEXX10: Automobile Engineering (Open Elective)

Teaching Scheme	
Lectures	4 Hrs/week
Tutorial	-
Total Credit	4

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
TA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03 Hrs.	

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 driveline components.
3	To explore components and working of steering, braking and suspension system and various types of tyres.
4	To identify engine components and subsystems; explain working of engine, formation and control of pollutants.
5	To demonstrate the importance and functioning of various electrical, electronic devices and recent trends in automobiles.

Course Contents

Unit I	**Introduction:** Classification of automobiles, Major components and their functions. Chassis Different vehicle layout. **Powertrain:** Engine, Basic Components, Classification, Two Stroke, Four Stroke, Petrol Engine, Diesel Engine, Fuel Supply systems: Necessity, Introduction to Carburetor and Fuel Injection system.
Unit II	**Clutch:** Necessity, requirements of a clutch system. Types of Clutches, Gear box - 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.
Unit III	**Tyres**: Tyres specification, types, factors affecting tyre performance, Special tyres, tyre treads, Hydroplaning., tyre Rotation. **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, Hydraullic brakes, Air Brakes,

Unit IV	**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.
Unit V	**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.

Text Books	
1	Automobile Engineering Vol. I & II, Kirpal Singh, Standard Publishers.
2	Automobile Engineering, R.K.Rajput, Laxmi Publications.
3	Automobile Engineering Rajput,R.K. Tata Mcgraw Hill.
Reference Books	
1	Automotive Mechanics: Principles And Practices Heitner Joseph Publications
2	Automobile Mechanics, Crause, W.H., Tata McGraw Hill
3	Design And Implementation Of Anticipating Mechanism For An Automobile To Reduce The Injuries And Sometime Death Happen In Road Accident
4	Automotive Engines, Srinivasan S., Tata McGraw Hill
5	Automotive Machanics -- Joseph Heitner, Van Nostrand Reinhold
Useful Links	
1	www.howacarworks.com/basics
2	https://www.iav.com/us/engineering
3	http://www.sae.org/automotive/

BMEXX10	Course Outcomes	CL	Class Sessions
BMEXX10.1	Identify the components and layout of automobile.	2	9
BMEXX10.2	Analyze the mechanics of transmission system.	4	9
BMEXX10.3	Compute the importance of suspension and braking system.	3	9
BMEXX10.4	Demonstrate the functioning of various electrical, electronic devices.	3	9
BMEXX10.5	Understand the recent advances in automobile.	2	9

Head
Department of Mechanical Engineering
Tulsiramji Gaikwad Patil College of
Engineering & Technology, NAGPUR.

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