RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
Applied Mathematics – III (BTME301T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Applied Mathematics – III	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	A primary objective is to introduce and develop advanced mathematical skills of students that are imperative for effective understanding of engineering subjects.
2	The topics covered will equip them with the techniques to understand advanced level Mathematics and its applications that would enrich logical thinking power.
3	Understand the impact of scientific and engineering solutions in a global and societal context.
4	Create the groundwork for post-graduate courses, specialized study, and research in mathematics.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Apply Laplace Transform to solve ordinary differential equations, Integral equations and Integro-differential Equations.
CO2	Apply Fourier series in the analysis of periodic functions in terms sine and cosine encountered in engineering problems and Fourier Transform to solve integral equations.
CO3	Learn the concept of differentiating, integrating and expanding of analytic functions in complex numbers and their applications such as evaluation of integrals of complex functions
CO4	Solve partial differential equations of first order, higher order with constant coefficients and of second order using method of separation of variables.
CO5	Analyze real world scenarios to recognize when matrices are appropriate, formulate problems about the scenarios, creatively model these scenarios in order to solve the problems using multiple approaches.

SYLLABUS	
Contents	**No of hours**
Unit I **LAPLACE TRANSFORM** Definition, Properties (Statement only), Evaluation of integrals by Laplace transform, Inverse Laplace transform using partial fraction method and properties of Laplace transform, Convolution theorem (Statement only), Laplace transform of periodic functions (Statement only), Unit step function and unit impulse function (Statement only), Applications of Laplace transform to solve ordinary differential equations, Integral equations & Integro-differential equations.	08
Unit II **FOURIER SERIES & FOURIER TRANSFORM** **Fourier Series:** Periodic functions and their Fourier expansions, Even and odd functions, Change of interval, Half range expansions. **Fourier Transform:** Definition and Properties (excluding FFT), Fourier integral theorem, Applications of Fourier transform to solve integral equations.	08
Unit III **FUNCTIONS OF COMPLEX VARIABLES** Analytic function, Cauchy-Riemann conditions, Harmonic function (Excluding orthogonal system), Milne-Thomson method, Cauchy integral theorem & integral formula (Statement only), Taylor"s & Laurent"s series (Statement only), Zeros and singularities of analytic function, Residue theorem (Statement only).	08
Unit IV **PARTIAL DIFFERENTIAL EQUATIONS** Partial differential equations of first order first degree i.e. Lagrange"s form, Linear homogeneous equations of higher order with constant coefficients, Method of separationsof variables, Simple applications of Laplace transform to solve partial differential equations (One dimensional only).	08
Unit V **MATRICES** Linear dependence of vectors, Eigen values and Eigen vectors, Reduction to diagonal form, Singular value decomposition, Sylvester's theorem (Statement only), Largest eigen value and corresponding eigen vector by iteration method.	08

Text/Reference Books:

(1) Advanced Engineering Mathematics (Wiley), Erwin Kreyzig.
(2) Higher Engineering Mathematics (Khanna Publishers), B. S. Grewal.
(3) Advanced Engineering Mathematics (S. Chand), H. K. Dass.
(4) Applied Mathematics for Engineers and Physicists, L. A. Pipes and L. R. Harville.
(5) Advanced Mathematics for Engineers, Chandrika Prasad.
(6) A text book of Engineering Mathematics (Laxmi Publication), N. P. Bali & M. Goyal.

RTM Nagpur University- Mechanical Engineering
B. Tech 3rd Semester
Manufacturing Processes (BTME302T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Manufacturing Processes	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To understand the pattern making, gating system, moldings process and casting process.
2	To expose the students to the principles of the metal joining methods.
3	To study metal forming techniques, rolling, drawing, sheet metal forming, shearing operations and knowledge about process behavior.
4	To learn about plastics, ceramics and glass along with properties, types, applications and shaping

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand the importance of manufacturing processes, techniques of pattern making and molding with their properties. Design gating system along with selection ofdifferent types of melting furnaces and special casting process.
CO2	Get acquainted with the basic concept of joining process, welding process and its types, defects and application.
CO3	Get acquainted with the forming process for metal, mechanics of forming process along with different types of rolling machine.
CO4	Understand and define press working process along with its classification, types and terminology, different types of dies and introduction to shaping operation.
CO5	Understand introduction to plastics, ceramics and glasses, its properties, application, forming and its shaping.

SYLLABUS	
Contents	**No of hours**
Unit I **Pattern Making & Moulding:** - Pattern making: Types, materials used, Pattern making allowances, color codes. **Moulding sand:** Composition, molding sand properties, Sand testing - Grain fineness, moisture content, clay content and permeability test. **Core making:** - Types, core material & its properties. **Gating System & Casting Processes:** - Elements of gating systems, riser. **Melting furnaces** - Types, Cupola, **Casting defects** - Types, Causes & remedies **Types of casting:** Investment Casting, Centrifugal Casting, Slush Casting, Die Casting, Shell moulding and CO_2 moulding.	08
Unit II **Joining Processes:** - Welding, brazing and Soldering Broad classification of welding processes, types and Principles. Electrodes, weldability of Metals, Welding equipments. Fixtures, Arc Welding & Gas Welding Processes, TIG Welding, MIG Welding, Spot Welding, Plasma Arc welding and Electron Laser Beam welding. Inspection, Defects in various joints and their remedies.	08
Unit III **Forming Process for metals:**- Rolling, Forging, Extrusion, Drawing, Types & classification, Applications, Principles of all processes	08
Unit IV **Sheet metal working**: - Classification, types of presses, press terminology, Force analysis in press working (PROBLEMS NOT EXPECTED) , Die cutting operation, types of dies, Die and punch allowance, introduction to shaping operations, bending, forming and drawing.	08
Unit V Introduction to Plastics, Properties & types, applications, Forming & Shaping of plastics –Extrusion, injection moulding, Blow moulding, wire drawing, Compression moulding, Transfer moulding, Embossing, Calendaring. Ceramic Structure, Properties, and Applications, Shaping Ceramics, Glasses Structure, Properties, and Applications, Forming and shaping of glass, Composite materials, Processing of metal matrix and ceramic matrix composites (overview)	08

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students as assignments.

References:

Text Books Recommended:

1. Workshop Practice, H. S. Bawa, Tata Mc-Graw Hill
2. Manufacturing Engineering & Technology, Kalpakjian, Pearson
3. Modern Materials and Manufacturing Process, R. Gregg Bruce, John E. Neely,Pearson Education
4. Degarmon's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kohser, Wiley India
5. Workshop Technology (Volume I), Hajra Chaudhary, Media Promoters &Publishers
6. Workshop Technology (Vol. I & II), B. S. Raghuwanshi, Dhanpat Rai & Co.
7. Manufacturing technology (Vol. I), P. N. Rao, Tata Mc-Graw Hill
8. Manufacturing Science, Ghosh & Malik, East West Press.
9. Textbook of Production Engineering, P.C. Sharma, S. Chand & Co.
10. "ASM Metals Hand Book on Casting", 1992.
11. Parmer R.S; "Welding Processes& Technology", Khanna Publishers, 1994.
12. Lancaster J.F., George Allen and Unwin, 1991, "Metallurgy of Welding".
13. Metals Hand Book, Vol 6, 8th edition, ASM, 1971.
14. AWS Welding Hand Book,Vol 1 to 4 AWS.

Reference Books Recommended:

1. Workshop Technology, Vol I & II, WAJ Chapman, Elsevier Butterworth-Heinemann.
2. Manufacturing Processes, M. Begman.
3. Processes & Materials of Manufacturing, R. Lindberg, Allyn & Bacon.

RTM Nagpur University Mechanical Engineering
B. Tech 3rd Semester
Manufacturing Processes Lab (BTME302P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Manufacturing Processes Lab	-	-	2	1	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Think in core concept of their engineering application by studying various topics involved in branchspecific applications.
CO2	Understand the relevance and importance of the Different manufacturing techniques and real lifeapplication in industry.
CO3	Design the gating and riser system needed for casting and requirements to achieve defect free casting.
CO4	Analyze the welding process behavior and requirements to achieve sound welded joint while weldingdifferent similar and dissimilar engineering material
CO5	Understand the plastic, glass and ceramic Processing

Sr. No.	List of Practical's
01	Study of Cupola Furnace.
02	Study of Moulding Techniques
03	Study of Casting Process
04	Study of Pattern Making
05	Study of Joining Processes
06	Study of Forming Processes
07	Study of Drawing Processes
08	One Job – Pattern Making
09	One Job – Casting
10	One Job – on TIG/ MIG/ Resistance welding
11	Demonstration on Plastic, Glass and Ceramic Processing (Industrial Visit)

Suggested References:

1. Workshop Technology, Vol I & II, WAJ Chapman, Elsevier Butterworth-Heinemann.
2. Manufacturing Processes, M. Bagman.
3. Processes & Materials of Manufacturing R. Lindberg, Allyn & Bacon

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
FLUID MECHANICS (BTME303T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Fluid Mechanics	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	Understand fluid properties and differentiate various fluid flow types.
2	Analyze fluid statics principles and determine pressure distribution on surfaces and buoyancy of bodies.
3	Explore fluid dynamics equations and their applications in fluid flow scenarios.
4	Differentiate laminar and turbulent flows and apply dimensional analysis techniques in fluid mechanics.
5	Calculate energy losses in pipes and analyze lift and drag forces on immersed bodies.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Analyze fluid behaviors based on properties and identify fluid flow types in practical applications.
CO2	Apply fluid statics principles to assess pressure distributions, determine buoyancy, andanalyze stability.
CO3	Demonstrate proficiency in solving fluid dynamics problems using the Navier-Stokesequation, Bernoulli's equation, and related principles in various engineering scenarios.
CO4	Differentiate laminar and turbulent flows, apply dimensional analysis techniques,and interpret dimensionless parameters.
CO5	Calculate energy losses in pipes, understand fluid behavior in series and parallelconfigurations, and analyze lift and drag forces.

SYLLABUS

Contents	No of hours
Unit I **Fluid Properties:** - Types of fluids, Mass Density, Specific Weight, Specific Gravity, Newton's Law of Viscosity, Dynamic Viscosity, Stroke's Theorem, Surface Tension, Capillarity, Compressibility, Vapour pressure. **Fluid Kinematics:** - Types of Flow- steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational.	08
Unit II **Fluid Statics:** - Pressure, Measurement of pressure using manometers, Hydrostatic law, Pascal's law, Pressure at a point, Total pressure, Centre of pressure, Pressure on a plane (Horizontal, vertical, Inclined) and Curved Surfaces, Archimedes's principle, Buoyancy and stability of floating and submerged bodies, Metacentric height. ,	08
Unit III **Fluid Dynamics:** - Introduction to Navier-Stroke's Equation, Euler equation of motion along a stream line, Bernoulli's equation, application of Bernoulli's equation to pitot tube, venturi meter and orifice meter. ,	08
Unit IV **Laminar And Turbulent Flow:** - Definition, Relation between pressure and shear stresses, Laminarflow through round pipe, turbulent flow and velocity distribution. **Dimensional Analysis:** - Dimensional Analysis, Dimensional Homogeneity, Rayleigh method & Buckingham's pi Theorem. ,	08
Unit V **Flow Through Pipes:** - TEL, HGL, Energy losses through pipe, Darcy-Weisbach equation, Minor losses in pipes, TEL, HGL, pipes in series and parallel, Siphons, Transmission of power. **Flow around Immersed Bodies:** - Lift and Drag, Classification of Drag, Flow around circular cylinder and Aerofoil, Development of lift on Aerofoil. ,	08

References:

Text Books Recommended:

1. Fluid Mechanics, Dr. R.K. Bansal, Laxmi Publication (P) Ltd. New Delhi
2. Engineering Fluid Mechanics, Kumar K.L., S. Chand & company Ltd. Eurasia
3. Fluid Mechanics & Hydraulic Machines, R.K. Rajput, S. Chand & Company Ltd.
4. Hydraulic and Fluid Mechanics, Modi P.N. and Seth S.M., Standard Book House.
5. Fluid Mechanics & Fluid Power Engineering – D. S. Kumar, S.K. Kataria & Sons

Reference Books Recommended:

1. Introduction to Fluid Mechanics, James E.A., John and Haberm W.A., Prentice Hall of India
2. Fluid Mechanics, Jain A.K., Khanna Publication
3. Fluid Mechanics, Manish R. Moroliya & N.Z. Adkane, Sara Book Publications.
4. Engineering Fluid Mechanics, Garde R.J. and Miraj Goankar, Nemchand & Bros,Roorkee, SCITECH,Publication (India) Pvt. Ltd.
5. Fluid Mechanics and Fluid Power Engineering, Dr. D.S. Kumar, S.K. Kataria& sons
6. Fluid Mechanics, Frank M. White, McGraw Hill Publication
7. Fluid Mechanics, Cengel & Cimbla, Tata McGraw Hill
8. Fluid Mechanics, Streeter V.L. and Wylie E.B., McGraw Hill International Book co.
9. Fluid Mechanics with Engineering Applications, E. Finnemore & Franzini, Tata Mc-Graw Hill
10. Hydraulic Machines-Theory and Design, V. P. Vasandani, Khanna Publishers
11. Fluid Mechanics, A. K. Jain, Khanna Publishers
12. Hydraulic & Compressible Flow Turbo-machines, A. T. Sayers, Mc-Graw Hill

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
Kinematics of Machines (BTME304T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Kinematics of Machines	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	Make student conversant with the process of motion transformation, develop ability to critically analyze the machines, mechanisms and controlling devices, and contrive newmechanisms.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Perform kinematic and dynamic analysis (Displacement, Velocity, acceleration, Inertia forces) of a given mechanism using graphical method.
CO2	Understand the concept of compliant mechanisms.
CO3	Contrive or synthesize new mechanisms for specific requirements.
CO4	Construct cam profiles and analysis the follower motion.
CO5	Understand Geometry of gear, its types, analysis of forces and motions of gear teeth. Study of gear trains.

SYLLABUS

Contents	No of hours
Unit I - INTRODUCTION 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, Exact straight line mechanism, Approx. straight line mechanism, Pantograph mechanism. Introduction to compliant mechanisms	08
Unit II- KINEMATIC ANALYSIS 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.	08
Unit III – KINEMATIC SYNTHESIS a. Synthesis of mechanisms, Graphical b. Synthesis of mechanisms analytical technique. Restricted to design of crank rocker and slider crank mechanism only.	08
Unit IV - Cams and followers a. Types of cams and followers, types of follower motion, velocity and acceleration diagrams, Construction of cam profile. b. Introduction to cams with specified contours (No analytical treatment).	08
Unit V – Gears and Gear trains a. Classification of gears, Types of gears, Spur gears - terminology, conjugate gear tooth action and law of gearing, involute and cycloidal profile , contact ratio, Interference and under cutting, methods of avoiding interference, minimum number of teeth,. b. Helical gears: Nomenclatures, center distance, force analysis. Spiral Gears, Worm and worm Gears, Bevel Gears; their terminologies, center distance, force analysis and efficiency, Gear Trains.	08

References:

Text Books Recommended:

1. Theory of Machine, S. S. Rattan, Tata McGraw Hill.
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.

Reference Books Recommended:

1. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, Oxford University Press.
2. Theory of Machines, Sadhu Singh, Pearson publications.
3. Advanced Mechanism Design–Analysis and Synthesis, A.G.Erdman and G.N.Sandor, Vol. I and II,Prentice – Hall.
4. "Mechanisms and Mechanical Devices Source Book", Neil Sclater, Nicholas P Chrironis, McGraw-Hill.
5. Kinematics and Linkage Design, A. S. Hall, Jr., Prentice – Hall.
6. Mechanism Synthesis and Analysis, A. H. Soni, McGraw Hill.

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
Machine Drawing and Solid Modeling (BEME305P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Machine Drawing and Solid Modeling	-	1	2	2	50	50	100

Sr. No.	Course Objective The objective of this course is–
1	To make students conversant with machine drawing standards, techniques, symbols, notations, creation of 2-D and 3-D detailing of parts, GD&T, drawing reading, productiondrawing and process sheet.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Interpret and describe basic elements of standard machine drawing like lines, dimensions, tolerances, symbols etc.
CO2	Create 2-D detailing, sectional views of machine elements from given isometric view.
CO3	Understand and apply concepts of GD&T for creating part and assembly drawing.

SYLLABUS	
Contents	**No of hours**
Unit I **Basic Drawing Standards:** Drawing Sheets, Name Blocks, Types of Lines, Types of Dimensioning, Applying Tolerances, Standard Components and their representations, Standard Features, Machining Symbols, Welding Symbols, Surface Finish Symbols, Heat Treatment, Manufacturing Instructions, Allowances, Materials.	05
Unit II **Orthographic projections:** 2-D orthographic projection of machine elements, Sectional views, Dimensioning and detailing.	05
Unit III **GD & T:** Concepts of Limit, Fits and Tolerances (Standard, types, application and selection for assembly and manufacturing method), Surface Finish requirement for assembly, Manufacturing Method, Geometry suitable for assembly. Principals and practical applications of geometrical dimensioning andtolerance.	05

Sr. No.	List of Tutorials
01	Drawing Sheets, Name Blocks, Types of Lines, Standard dimensioning methods, Applying Tolerances.
02	Standard Components and their representations, Standard Features.
03	Machining Symbols, Welding Symbols, Surface Finish Symbols.
04	Heat Treatment, Manufacturing Instructions, Allowances, Materials.
05	2-D orthographic projection of machine elements
06	2-D orthographic projection of machine elements
07	Sectional views
08	Dimensioning and detailing.
09	Limit, Fits and Tolerances (Standard, types, application and selection for assembly and Manufacturing method)
10	Geometrical dimensioning and tolerances (symbols, applications) datum's, referencing.
11	Industrial Drawing Reading: Students to be give industrial (production) drawing of different components, they will be asked to study the drawing thoroughly, understand and interpret the meanings of symbol and notations and there importance.

References:

Text Books Recommended:

1. Naryana K.L., Kannaiah R., Venkata Reddy K "Machine Drawing", New Age Int.Pub.
2. Naryana K.L., Kannaiah R., Venkata Reddy K "Production Drawing ", New Age Int.Pub.
3. N.D.Bhatt "Machine Drawing; Ed", Charotar Publishing House.

Reference Books Recommended:

1. PSG College of Technology "Design data", DPV Printers, Coimbature, 1 2000.
2. "Engg. Drawing practice for schools & colleges", Bureau of Indian Standards, 1 Ed.; , 2002.st 1998

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
Material Science and Engineering (BTME306T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
III	Material Science and Engineering	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To impart Knowledge for analyzing different Microstructure and Crystalline nature of metals.
2	To impart knowledge of Iron-Iron carbide equilibrium diagram and microstructure ofcommercial steels and Cast Iron.
3	To provide the knowledge of various heat treatment processes.
4	To provide basic knowledge of non-ferrous alloys.
5	To impart basic knowledge of powder Metallurgy for Powder metallurgical components.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Student will be capable to distinguish micro structure and analyze the effect to crystalline nature of metals, construct and analyze Iron-Iron carbide equilibrium diagram.
CO2	Student will be able to study the commercial steels with their applications and properties.
CO3	Student will be able to analyze and implement suitable heat treatment processes.
CO4	Student will be able to analyze the Cast Iron and their properties.
CO5	Student will be able to perceive the basics of powder Metallurgy for powder metallurgical components.

SYLLABUS

Contents	No of hours
Unit I **Engineering Materials:** Classification, properties and applications of various engineering materials. Crystalline nature of metals, especially microscopic and macroscopic examinations of metals. Solidification of metals, cooling curves, alloys and solid solutions, types and their formations, modified Gibbs's phase rule, Lever rule for phase mixtures and their application in system. **Study of equilibrium diagrams:** Different phases and various invariant reactions in Iron-Iron carbide equilibrium diagram, critical temperatures. Microstructure of slowly cooled steels. Estimation of carbon from microstructures, structure property relationship as per the variations in carbon content.	08
Unit II **Plain Carbon Steels:** Classification and application of plain carbon steels. Alloy steels, examples of alloy steel, Effect of alloying elements on properties of steels, Austenite and ferrite stabilizers, Hadfield Manganese Steel, ball Bearing Steels, HCHC steels etc. **Tool Steels:** Classification, composition, application and commercial heat treatment practice for HSS, Secondary hardening, red hardness. **Stainless Steels** - Classification, composition, application and general heat treatment practice for Stainless Steels. Classification and applications of steels sensitization of stainless steels and weld decay.	08
Unit III **Heat treatment** and its importance. Annealing, Normalizing, Hardening, Quench Cracks, Hardenability test. Limitations of Fe-Fe3C diagram, TTT diagram and its construction and related Heat Treatment Processes such as Austempering, Martempering, and Patenting. Retained Austenite, Effects and elimination of retained austenite, Tempering. Case/Surface hardening treatments such as Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening. Hardenability test.	08
Unit IV **Cast Iron** – Classification, White cast Iron, Gray Cast Iron, Nodular Cast Iron, Malleable Cast Iron, and Chilled and alloy Cast Iron. (Production route, Composition, Microstructure and applications) Effects of various parameters on structure and properties of Cast Iron, Alloycast Iron such as Ni-resist, Ni-hard. **Non-Ferrous Alloys** – Study of non-ferrous alloys such as brasses (Cu-Zn diagram), defects in brasses, Bronzes (Cu- Sn diagram), Aluminum Alloys (e.g., Al-Si diagram),modified Al-Si diagram, Bearing materials.	08

Unit V	
Powder Metallurgy: Powder manufacture and Conditioning, Production of Sintered Structural Components, Self-lubricating bearing, Cemented Carbides, Ceramics, Sintered Carbide cutting tools. Process of powder metallurgy, advantages and limitations of powder metallurgy	08

References:

Text Books Recommended:

1. Material Science & Engineering, V.R.Raghavan, 1974.
2. Material Science & Engineering, WilliamCallister, 1985.
3. Material Science and Metallurgy for Engineers, V. D. Kodgire, 2011
4. Material Science& Engineering, R.K.Rajput, 2009.
5. Material Science& Engineering, An Introduction, 6th Edition, Donald Askeland, 1984.

RTM Nagpur University- Mechanical Engineering
B. Tech 3rd Semester
Skill Development -
(Basics of Computer Aided Drafting) (BTME307P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	Skill Development- (Basics of ComputerAided Drafting)	-	-	2	1	50	-	50

Sr. No.	COURSE OBJECTIVE
1	Students will be able to use Software (AUTOCAD) for creation of 2D models, and Drawings.

COURSE OUTCOME

Students will learn

- How to create simple parts, assemblies and drawings.
- How to use different feature-based tools to build, review and modify a model.
- How to create and analyze assemblies and how to produce a drawing with different views.
- Learn how to dimension the drawing and annotate the views.

Skill Development-(Basics of Computer Aided Drafting)
Contents
Module I: Sketcher - Creating Profiles. PLM Objects, Sketch Support, Simple elements, constraining sketches, simple and complexprofiles, transforming sketches, saving documents. Practice-1 : Hands on Session on Sketcher Workbench. Module II: Part Design -Creating Basic Features. Extruded Features, revolved features, holes, threads, taps, drafts, fillets, chamfers, shelling andstiffeners, relational dimensions. Practice-2 : Hands on Session on Sketch Based Features & Dress Up Features. Module III: Reviewing & Modifying. Measuring the model, re using the data, editing features. Practice-3 : Hands on Session on Measuring Tools & Editing Features. Module IV: Finalizing Design. Adding parameters, reusing features, rendering, weight calculation. Practice-4: Hands on Session on Parametric Design. Module V: Creating & Managing Products. Positioning Components, constraining Components, Analyzing weight distribution, replacing and revising parts. Practice-5: Hands on Session on Assembly Design. Module VI: Creating Drawings 4. Creating Drawing, Modifying, dimensioning, Annotations, Finalizing & Printing Practice-6 : Hands on Session on Drawing Conventions. Module VII: Master ExerciseHeat Sink, PC Card Slide. Practice-7 : Modeling of Heat Sink.
Text Books/ Reference Books/ Reference Material 1. Mechanical Design Fundamentals : Dassault Systemes Companion Learning Space Material

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
SPORTS (BTME308P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	SPORTS	-	-	2	-	-	-	-

Sr. No.	COURSE OBJECTIVE
1	Through sports, students should able to build a wide range of abilities and skills such as leadership, confidence, teamwork, patience, self-reliance, trust, and many more which facilitate the overall development of an individual
2	Students should learn to manage time between their lectures, sports, and personal life.

EXPECTATION FROM INSTITUTES

1. Provide sports facilities
2. Provide platforms for participation in events
3. Develop interest for sports amongst students
4. Conduct regular events (every month) in college for all indoor and outdoor sports

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
YOGA (BTME308P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	YOGA	-	-	2	-	-	-	-

Sr. No.	COURSE OBJECTIVE
1	To introduce basic wellness principles and practices of Yoga to students
2	To bring awareness of the fundamentals of Yoga for wellness in their daily lives
3	To bring peace and harmony in the society at large by introducing the Yogic way of life.

EXPECTATION FROM TRAINERS

1. Brief to origin of Yoga.
2. History and Development of Yoga: Vedic Period, Classical Period, Post classical period, Modern Period.
3. Etymology and Definitions of Yoga in classical Yoga texts.
4. Meaning, Aim and Objectives of Yoga.
5. Misconceptions about Yoga.
6. True Nature of Yoga.
7. Principles of Yoga.
8. Basis of Yoga.

RTM Nagpur University - Mechanical Engineering
B. Tech 3rd Semester
National Service Scheme (NSS) (BTME308P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	National Service Scheme (NSS)	-	-	2	-	-	-	-

COURSE OBJECTIVE

- Understand the community in which they work.
- Understand themselves in relation to their community.
- Identify the needs and problems of the community and involve them in problem-solving.
- Develop among them a sense of social and civic responsibility.
- Utilize their knowledge in finding practice solutions to individual and community problems.
- Develop competence required for group-living and sharing of responsibilities.
- Gain skills in mobilizing community participation.
- Acquire leadership qualities and democratic attitudes
- Develop capacity to meet emergencies and natural disasters.
- Practice national integration and social harmony

EXPECTATION FROM TRAINERS

1. To assist and guide the NSS unit for implementation of NSS programs at college level
2. To advise in organizing camps, training and orientation programs for the NSS volunteers
3. To visit the NSS units for monitoring and evaluation.
4. To ensure implementation of NSS regular activities and special camping programs

RTM Nagpur University- Mechanical Engineering
B. Tech 3rd Semester
National Cadet Corps (NCC) (BTME308P)
Syllabus (Practical)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
III	National Cadet Corps (NCC)	-	-	2	-	-	-	-

ABOUT NCC
1. NCC is the Indian military cadet corps wing of the Indian armed forces. 2. NCC offers training to the students of schools and colleges. 3. This is not compulsory training for all students.

Sr. No.	OUTCOMES EXPECTED
1	During the training of NCC, candidates should get the basic military training. This trainingshould be conducted to develop the interest of young students in all three forces; the army, the navy and the air force of India. Students should be able to check their abilitiesto join the Indian Defence Services.

Sr. No.	AIM
1	To create an organized, trained and motivated youth, create soldiers for the nation, develop the leadership skills in the youth.

EXPECTATION FROM INSTITUTES
• Create awareness amongst students about NCC • Make understand the students about the importance of NCC • Conduct regular Drills and Training exercises • Conduct Regular exams • Arrange for Training Camps

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Machining Processes (BTME401T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	**Machining Processes**	03	-	-	03	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	Understand basic mechanism of metal removal processes.
2	Working mechanisms of various machine tools and machining principles.
3	To know surface finishing and allied processes.
4	Understand the importance of machining processes and be able to apply the suitable machining processes for an engineering product.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand fundamentals of metal cutting
CO2	Understand basic construction and operations of lathe shaping, planning
CO3	Understand basics of milling and milling cutters. slotting
CO4	To know about the surface finishing processes.
CO5	Understand the basic of drilling, boring, reaming and broaching.

Machining Processes (Theory) SYLLABUS	
Contents	No of hours
Unit I **Introduction to Machining Parameters**: Introduction to machining, Tool materials, nomenclature and tool geometry of single point cutting tool, tool materials properties, classification, HSS, carbide tool, coated tools, diamond coated tool. Theory of Metal Cutting: Introduction. Orthogonal and Oblique cutting. Mechanics of Metal Cutting. Merchant's circle, Chip formation, cutting force calculations, cutting fluids, cutting speed, feed and depth of cut on power requirement, Estimation of tool life.	09
Unit II Lathe: Introduction, types, construction of simple lathe, mechanism and attachments for various operations, machine specifications, basis for selection of cutting speed, feed and depth of cut, time estimation for turning operations such as facing, step turning, taper turning, threading, knurling. Introduction to Capstan, Turret Lathe and fundamentals of NC. **Shaper:** Introduction, types, specification, description of machines, cutting parameters. Mechanism of shaper: Quick return mechanism, Crank & slotted link mechanism, Table feed mechanism, attachments for shaper, work holding devices, shaper operations. **Planer:** Introduction, specifications, description, types of planner, open side planner, pit planner Mechanism for planner: Driving mechanism, feeding mechanism, planner cutting tools, cutting parameters.	10
Unit III **Milling:** Introduction. Specification, types, column & knee type milling machine, fixed bed type milling machines, production milling machines, special purpose milling machines such as thread milling Machines, profile milling machine, Gear Milling. Hobbing machines. Mechanisms & Attachments for Milling, Cutting parameters, Types of milling operations, Types of milling cutters, Tool geometry & their specifications. Indexing - simple, compound and differential. **Slotter:** Introduction, specifications, description, type of drives for slotter, types of slotting machines -production slotter, puncher slotter, tool room slotter, slotter tools.	09
Unit IV **Grinding**: Operations, grinding wheel, specifications & selection, cylindrical & centreless grinding operation, surface grinding, tool & cutter grinding, time estimation for grinding operations. **Super finishing process:** Honing, Lapping, super finishing, polishing, buffing, 'metal spraying, galvanizing and electroplating. Process parameters and attainable grades of surface finish, surface measurement.	09

Unit V **Drilling:** introduction, tools for drilling, classification of drills, twist drills, drill size and specifications, tipped drills, type of drilling machines-portable drilling machine. bench drilling machine, right drilling machine, radial drilling machine, universal drilling machine, multisided drilling machine. Drilling machines operations, time estimation for drilling. **Reaming:** Introduction, description of reamer, type of reaming operations. **Boring:** Introduction, types of boring machine, horizontal boring machine, vertical boring machine, jig machine, micro boring. boring operations. **Broaching:** Introduction, type of broaches, nomenclature of broaches. types of broaching machines.	09

Sr. No.	List of Tutorials
01	Based on above syllabus

References:

Text Books Recommended:

1. Workshop technology (Vol. II), V. S. Raghuwanshi, Dhanpat Rai & Sons
2. Manufacturing Science, Ghosh & Mallik, East West Press
3. Manufacturing technology (Metal cutting & Machine tools) Vol. II, P. N. Rao, Tata Mc-Graw Hill
4. Workshop technology, H. S. Bawa, Tata Mc-Graw Hill
5. Introduction to Manufacturing Processes, J. A. Schey, Tata Mc-Graw Hill
6. Workshop Technology (Volume II), Hajra Chaudhary, Media Promoters & Publishers

Reference Books Recommended:

1. Manufacturing Engineering & Technology, S. Kalpakjian & S.R. Schmid
2. Technology of Machine Tools, Krar & Oswald
3. Manufacturing Processes, M. Begman
4. Processes & Materials of Manufacture, R. Lindberg
5. Production Technology, HMT

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Machining Processes Lab (BTME401P)
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Machining Processes Lab	-	-	02	01	25	25	50

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand basic cutting tools.
CO2	Working of lathe and turning operation
CO3	Shaping and planning operation
CO4	Milling and drilling operation
CO5	Grinding and surface finishing

List of Practical's

Minimum Eight out of following shall be performed:

Sr. No.	List of Practical's
01	Study of Single Point Cutting Tool.
02	Study of Various forces on single point cutting tools.
03	Study of multiple point cutting tools (milling, drilling)
04	Study of Lathe Machine.
05	Study of Shaper mechanisms.
06	Study of milling machine
07	One Job on Milling.
08	One Job on Drilling, Boring
09	One Job on Thread Cutting, Taper Turning.
10	One Job on Surface Grinding.

Suggested References:

1. Manufacturing Engineering & Technology, S. Kalpakjian & S.R. Schmid
2. Technology of Machine Tools, Krar & Oswald
3. Manufacturing Processes, M. Begman
4. Processes & Materials of Manufacture, R. Lindberg Production Technology, HMT

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Hydraulic Machines (BTME402T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examinatio	Total	
IV	**Hydraulic Machines**	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	This course includes hydraulic turbines, centrifugal pumps, positive displacement pumps and miscellaneous water lifting devices
2	At the end of this course, students will understand practical applications of fluid; based on momentum and angular momentum principles involved in hydraulic machines.
3	Also understand design parameters and performance characteristics of various hydraulic machines & devices.
4	To learn more about power generation by using water

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Classify turbomachine, components of HEPP, Design of Pelton wheel
CO2	Design of Francis and kaplan Turbine,Governing OF turbine
CO3	Design of centrifugal Pumps
CO4	Design of reciprocating Pumps
CO5	Learn miscellaneous Water Lifting Device

SYLLABUS	
Contents	No of hours
Unit I Theory of turbo machines and their classification, Elements of hydro-electric power plant, Impulse Turbine:- principle, constructional features, Installation of Pelton Turbine, Velocity Diagram and Analysis, Working proportions, Design parameters, Governing.	7
Unit II Reaction or pressure Turbine:- principles of operation, Degree of reaction, comparison over Pelton Turbine, Classification Of Draft tube, Cavitation in Turbine, Francis Turbine, Propeller Turbine, Kaplan Turbine:- Types, Constructional features, Installations, Velocity Diagram and analysis, Working proportions, Design parameters, Governing.	7
Unit III Centrifugal pumps:- Principle of operation, Classification, Component of Centrifugal Pump installation, Priming , Fundamental equation, Various heads, Velocity triangles and their analysis, or, Effect of outlet blade angle, Vane shapes, Losses and Efficiencies of pumps, Multi staging of pumps, Design Consideration, Working proportions, N.P.S.H., Cavitations in pumps ,	7
Unit IV Positive Displacement Pumps:- Basic principle, Classification, Reciprocating pump working,Design Main Components, Slip, % slip, negative slip, Work Done, Indicator Diagram, effect of acceration head and friction head on indicator diagram ,Cavitations, Air vessels,Seperation. ,	7
Unit V Miscellaneous Water Lifting Device: - Air lift pumps, Hydraulic Ram, Submersible pump, Regenerative pumps, Gear pump, screw pump, Vane pump	7

References:

Text Books Recommended:

1. Fluid Mechanics & Fluid Power Engineering – R.K.Rajput, S.Chand Publications

2. Fluid Mechanics & Machines – R. K. Bansal, Laxmi Publications

Reference Books Recommended:

1. Fluid Mechanics with Engineering Applications, E. Finnemore & Franzini, Tata Mc-Graw Hill

2. Hydraulic Machines-Theory and Design, V. P. Vasandani, Khanna Publishers

3. Fluid Mechanics, A. K. Jain, Khanna Publishers 4. Hydraulic & Compressible Flow Turbo-machines, A. T. Sayers, Mc-Graw Hill . Mechanics of Fluids, Merle C. Potter, CL-Engineering

6. Fluid Mechanics, John F. Douglas, Pearson

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
FLUID MECHANICS & HYDRAULIC MACHINES Lab (BTME402P)
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	FLUID MECHANICS & HYDRAULIC MACHINES LAB	-	-	02	01	25	25	50

Course Outcomes	
After successful completion of this Practical course the student will be able to	
CO1	Explain what is Stability condition of floating bodies, Law of conservation of Energy.
CO2	Apply Frictional losses and Hydraulic co-efficient in the pipe flow.
CO3	Estimate the Performance characteristics of Pelton Turbine
CO4	Estimate the Performance characteristics of Francis Turbine & Kaplan Turbine.
CO5	Estimate the Performance characteristics of Centrifugal Pump & Reciprocating Pump.

Sr. No.	List of Practical's
01	To determine the metacentric height of given floating vessel.
02	To verify Bernoulli's theorem.
03	To find friction losses in pipe.
04	To find the value of co-efficient of given venture meter fitted in a pipe.
05	To find the value of co-efficient of Discharge for a given orifice meter.
06	Performance characteristics of Pelton wheel.
07	Performance characteristic of Francis Turbine.
08	Performance characteristic of Kaplan Turbine.
09	Performance characteristic of Variable Centrifugal speed pump
10	Performance characteristic of Reciprocating pump.
11	To find Reynold's Number

Suggested References:

1. Fluid Mechanics, Frank M. White, McGraw Hill Publication
2. Hydraulic Machines-Theory and Design, V. P. Vasandani, Khanna Publishers
3. Fluid Mechanics, John F. Douglas, Pearson
4. Introduction to Fluid Mechanics, James E.A., John and Haberm W.A., Prentice Hall of India

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
MECHANICS OF MATERIAL (BTME403T)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	MECHANICS OF MATERIAL	3	-	-	3	30	70	100	3

Sr. No.	Course Objective The objective of this course is–
1	To study different types of stresses, strain and deformation induced in the mechanical components due to external loads.
2	To study Shear force and Bending moment, Stresses in beam under various loading conditions.
3	To understand phenomena of Deflection of Beam and Strain Energy.
4	To design and analyse shaft for various loading conditions
5	To understand design process and failure phenomena of Column & Struts.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Demonstrate fundamental knowledge about various types of loading and stresses induced
CO2	Draw the SFD and BMD for different types of loads and support conditions.
CO3	Estimate the strain energy in mechanical elements. And analyse the deflection in beams.
CO4	Can design shaft for various loading conditions.
CO5	Understand theory of failure and effective designing of column and Struts.

MECHANICS OF MATERIAL SYLLABUS (Theory)	
Contents	No of hours
Unit I Concept of simple stresses and strains: Introduction, stress, strain, types of stresses, stress and strain diagram for brittle & ductile material, elastic limit, Hooks law, modulus of elasticity, modulus of rigidity, factor of safety, analysis of tapered rod, analysis of composite section, thermal stress and strain. Longitudinal strain & stress, lateral stresses and strains, Poisson's ratio, volumetric stresses and strain with uni-axial, bi-axial & tri-axial loading, bulk modulus, relation between Young's modulus and modulus of rigidity, Poisson's ratio and bulk modulus Principal stresses and strains:- Definition of principal planes & principal stresses, analytical method of determining stresses on oblique section when member is subjected to direct stresses in one plane in mutually perpendicular two planes, when member is subjected to shear stress and direct stresses in two mutually perpendicular planes, Mohr's circle for representation of principal stresses ,	12 Hrs.
Unit II Shear force and bending moment: - Types of beam (cantilever beam, simply supported beam, overhung beam etc.), Types of loads (Concentrated and UDL), shear force and bending moment diagrams for different types of beams subjected to different types of loads, sign conventions for bending moment and shear force, shear force and bending moment diagrams for beams subjected to couple, Relation between load, shear force and bending moment. Stresses in beams: - Pure bending, theory of simple bending with assumptions & expressions for bending stress, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections. Shear stresses in beams: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress. ,	10Hrs
Unit III Deflection of beams:- Deflection & slope of cantilever, simply supported, overhung beams subjected to concentrated load, UDL, Relation between slope, deflection & radius curvature Macaulay's method to determine deflection of beam. Strain energy & impact loading: - Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied loads & impact loads. Strain energy stored in bending & torsion . ,	12Hrs

Unit IV Torsion of circular shafts: - Derivation of torsion equation with the assumptions made in it. Torsion shear stress induced in the shaft, when it is subjected to torque. Strength and rigidity criterion for design of shaft. Torque transmitted by solid & hollow circular shaft. Equivalent twisting and bending moment in shaft when it is subjected to bending moment, torque & axial load.	8Hrs
Unit V Column & Struts: - Failure of long & short column, slenderness ratio, assumptions made in Euler's column theory, end conditions for column. Expression for crippling load for various end conditions of column and derivation on column with both ends hinged. Effective length of column, limitations of Euler's formula, Rankine formula.	4Hrs

Sr. No.	List of Tutorials
01	problems on simple and principle stresses
02	problems on Mohr's circle
03	problems on Thermal stresses
04	problems on S.F. & B.M. diagrams
05	problems on Stresses in beam bending
06	problems on shear stresses
07	problems on Macaulay's methods
08	problems on shafts
09	problems on columns & struts

Assignments (Guidelines)

At least one problem on the following topic

1. Stresses in Beams (A two wheeler chassis design concept)
2. Strain energy and deflection (Determination of equivalent load due to impact on the component and its design)
3. Torsion , Column and Struts (Design of frames of solar PV roof top system using software like Stat- Pro)

Note: Preferably The assignments shall be based on live problems. Project based learning may be incorporated by judiciously reducing number of Assignments

References:

Text Books Recommended:

1. Strength of Materials by S. Ramamrutham and R. Narayanan, Dhanpat Rai Publishing Company (P) Ltd, 18th Edition 2017.

2. Strength of Materials by R.K. Bansal, Laxhmi Publications , New Delhi, 6th edition, 2017

3. Strength of Materials by S.S.Rattan, Mcgraw Hill Education, 3rd edition , 2016

Reference Books Recommended:

1. Mechanics of Materials By Beer , Johnston, Dewolf and Mazurek , Tata McGraw- Hill Education , 7th edition , 2015

2. Elements of Strength of Materials by Timoshenko, S.P. and Young, D.H., East West Press, 5th edition, 2011

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Material Testing Lab (BTME403P)
Syllabus (Practical)

Semester	Course Title(Subject)	Hours / Week			Credits	Maximum Marks		
		L	T	P		Continual Assessment	University Examination	Total
IV	Material Testing Lab	-	-	2	1	25	25	50

Sr. No.	Course Objective The objective of this course is–
1	Create specimen for metallographic examination.
2	Analyze the microstructure and investigate various properties of ferrous and nonferrous Materials.
3	Test different Engineering Materials.
4	Analyze the hardenability microstructure.
5	Test Cast Iron.
6	To familiarize material behavior under different loading conditions
7	To acquaint with surface hardness measurement method
8	To familiarize with impact test methods for different materials
9	To study and analyze deflection of beams in various loading conditions.
10	To study and understand behavior of material under various loading conditions.

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Analyze the Microstructure and investigate various properties of ferrorous and Non ferrous Materials . Analyse the stress strain behaviour of materials
CO2	Analyse the effect of tensile, shearing force and can utilized the gained while tackling real life engineering problems for different types of Materials
CO3	Understand Microstructures and their Applications for various uses
CO4	Measure torsional strength , hardness of material
CO5	Incorporate the various important concepts learnt while designing components

****NOTE**: At least 10 Experiments should be included in the Journal-At least 5 from Serial Number 1 to 7 and at least 5 from serial Number 8 to 14). This Practical load shall be equally shared by subject teachers handling subjects Material Science & Engineering and Mechanics of Materials.

Sr. No.	Material Testing Lab -List of practical's
01	To study the Metallurgical Microscopes & Preparation of specimen for metallographic examination.
02	Micro-structural examination of different types of Steels
03	Micro-structural study of White Cast Iron and Grey Cast Iron
04	Micro-structural study of Malleable Cast Iron and Nodular Cast Iron
05	Study of Universal Testing Machine
06	Determination of tensile properties of ductile material
07	Determination of properties of brittle material
08	Compression test on materials
09	Shear test on metals
10	Impact test on materials
11	Torsion test of metal shaft
12	Determination of bending strength by deflection of beam
13	Measurement of hardness with the help of Rockwell Hardness Tester
14	Measurement of hardness with the help of Brinell Hardness Tester

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Engineering Thermodynamics (BTME404T)
Syllabus(Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Engineering Thermodynamics	3	-	-	3	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	This course deals with the fundamentals of Thermodynamics, including thermodynamic systems and properties, relationships among the thermos-physical properties, the laws of thermodynamics and applications of these fundamental laws in thermodynamic systems
2	To present a comprehensive and rigorous treatment of classical thermodynamics while retaining an engineering perspective.
3	Explain the working principle of various power cycles used in thermal systems.

Course Outcomes	
After successful completion of this course, the student will be able to:	
CO1	**Explain** thermodynamics concepts, **relate** laws of the ideal gas, **identify** various thermodynamic processes and apply the laws to **determine** the energy transfer in terms of heat and work.
CO2	**Explain** the first law of thermodynamics and **apply** the law to **evaluate** open, closed systems, thermal components and devices.
CO3	**Interpret the** second law of thermodynamics, entropy, and apply the law to evaluate heat engine, heat pump, and refrigerator performance.
CO4	**Relate** various steam properties, and **analyze** the different types of processes using steam as working fluid to **determine** the energy transfer in terms of heat and work.
CO5	**Compare** various power cycles and **analyze** the cycles to **determine** the energy transfer in terms of heat, work and efficiency.

Engineering Thermodynamics Syllabus	
Contents	No of hours
Unit I Basic concepts of Thermodynamics, Systems and their types, Property, State, Process, Phase, Cycles. Comparison of microscopic and macroscopic approaches. Path and point functions. Thermodynamic Equilibrium. Zeroth law of thermodynamics and its significance for temperature measurement Introduction to First law of thermodynamics, Energy transfer, Heat and work transfer. Ideal Gas laws: Boyle‟s law, Charle‟s law, Gay-Lussac‟s law, Avagadro‟s law, Equation of state, General gas equation, Specific Heat, Universal gas constant. Thermodynamic Processes: Constant pressure, Constant volume, Isothermal, Isentropic and Polytropic process, representation on P-V and T-s Diagram, Calculation of Heat transfer, Work done, Change in Internal Energy and Enthalpy for these processes.	10
Unit II The first law of Thermodynamics for Closed System undergoing a process and cycle (Control Mass System) and Open System (Control Volume System) Steady Flow process applies to Compressor, Pump, Turbine, Boiler, Steam Nozzle, Throttling Device, Heat Exchanger, Fan and blower. (Analytical treatment on First law applied to thermodynamic processes and cycles and Steady low energy equation applied to various flow devices is expected). ,	9
Unit III Second Law of Thermodynamics:- Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat Pump, Kelvin-Plank and Clausius Statements, Perpetual Motion Machine I and II, Carnot Cycle, Thermodynamic Temperature scale. Entropy:- Clausius Inequality, Entropy, Principle of Increase of Entropy, Change in Entropy for different thermodynamics processes with T-S Diagram, Reversible and Irreversible Processes. (Simple analytical treatment on COP calculation is expected) ,	9
Unit IV Properties of Steam:- Formation of steam and its thermodynamic properties like Sensible Heat, Latent Heat, Critical State, Triple Point, Wet Steam, Dry Steam, Superheated Steam, Dryness Fraction, Enthalpy, Internal Energy of Steam, External Work Done during Evaporation, T-S Diagram, Mollier Chart, Work and Heat Transfer during various Thermodynamic Processes with steam as working fluid. Measurement of Dryness Fraction using various Calorimeters. (Analytical Treatment using steam table and Mollier chart is expected) ,	9

Unit V Power Cycles: - Otto Cycle, Diesel Cycle, Dual Cycle, Brayton Cycle, Representation on P-v and T-s diagrams. The equation for work done, heat transfer, air standard efficiency, and mean effective pressure. Comparison of Otto, Diesel and Dual cycles. Introduction to simple vapour power cycle, i.e., Rankine cycle (Analytical treatment in terms of calculation Work done & efficiency analysis is expected on Otto Cycle, Diesel Cycle and Dual Cycle)	9
Total Hours	46

Sr. No.	List of Tutorials
01	Application of first law to control mass (closed system) system
02	Application of first law to control volume (open system) system
03	Determination of Heat transfer, Work done, Change in Internal Energy and Enthalpy of various thermodynamic processes and cycles.
04	Determination of various properties of steam by using Steam table and Mollier chart
05	Application of second law to heat engine, refrigerator and heat pump.
06	Thermodynamic analysis of Otto cycle.
07	Thermodynamic analysis of Diesel cycle.
08	Thermodynamic analysis of Dual cycle and Brayton cycle.

References:

Text Books Recommended:

1. Engineering Thermodynamics, P. K. Nag, Tata McGraw-Hill Publications
2. Thermodynamics, S. C. Gupta, Pearson Publications
3. Thermal Engineering, P. L. Ballani, Khanna Publications
4. Engineering Thermodynamics, S.S. Khandare, Charotar Publication House
5. Engineering Thermodynamics, R. K. Rajput, Laxmi Publication

Reference Books Recommended:

1. Thermodynamics and Engineering approach, Yunus A. Cengel, Michael A. Boles, Tata McGraw-Hill Publications
2. Engineering Thermodynamics, D. P. Mishra, Cengage Learning Publications
3. Engineering Thermodynamics, Gordon Rogers, Pearson Publications

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Computer Programming (BTME405P)
Syllabus(Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assess	University Exam	Total	
IV	Computer Programming	-	1	2	2	25	25	50	-

Sr. No.	Course Objective The objective of this course is–
1	To to apply knowledge of basic concepts of programming in C to solve mechanical Engineering problems
	Course Outcomes
After successful completion of this course the student will be able to:	
CO1	Understand and explore concepts in basic programming like data types, input/output functions, operators, programming constructs and user defined functions.
CO2	Develop capabilities of writing „C“ programs in optimized, robust and reusable code
CO3	Apply appropriate concepts of data structures like arrays, structures implement programs for various applications

Computer Application/Programming SYLLABUS	
Contents	No of hours
Introduction to C programming: Basic structure of C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types	05
Operators and Expressions: Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and decrement operators, Conditional operators, Bit-wise operators, Arithmetic expressions. Evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.	05
Decision Making: Decision making with 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement. The while statement, The do while statement, The 'for' statement, Jumps in loops.	05
Arrays: One dimensional arrays, Declaration of one dimensional arrays. Initialization of one dimensional arrays, Two dimensional arrays, Initializing two dimensional arrays. Declaring and Initializing String Variables, Reading Strings from Terminal, Writing strings to screen, String handling functions	05
User-defined functions: Need for User Defined Functions, Definition of functions, Return values and their types, Function calls, Function declaration. **Introduction to Pointers:** Introduction, Declaration and initialization of pointers. Examples Structures and Unions: Introduction, Structure and union definition, Declaring structure and union variables, Accessing structure members.	05

Sr. No.	Computer Application/Programming (List of Practical)
01	Development of programs in C To find area/surface area, volume for Planes, Solids. (Applications for cost involved for painting surface of any plane(square, rectangular, hexagonal etc), costing based on metal sheet material required for manufacturing cylinder(ends open/closed/one end open), cone, cube etc. with varying quantity of products)
02	Development of programs in C To find Stress with given force and cross sectional

	area(square, rectangle, circular etc)
03	Development of programs in C To find angular velocities and acceleration of the output and coupler link for four bar chain mechanism.
04	Development of programs in C for given inner, outer radii for single plate clutch and axial force calculate minimum, maximum, and average pressure acting on clutch plate.(or calculating inner outer radii, width of friction lining, axial force etc. for single/multi plate clutch or similar type of simple calculation programme for block brake.
05	Development of programs in C for Addition, Multiplication Matrices.
06	Development of programs in C for any Numerical methods like Newton Raphson, Gauss-Elimination, Gauss-Jordan, Crout's method and Gauss-Seidel Method. Development of programs in C / C+ + for any Numerical methods like Taylor's series method, Runge Kutta method, Euler's modified method, Milne's predictor corrector method, Iterative methods for eigen value & eigen vector determination.
07	Development of programs in C To determine type of flow of fluid(laminar/turbulent/transient) on the basis of Reynolds's Number
08	Development of programs in C To calculate specific density, specific weight, weight if specific gravity is given for liquid

Note: During University practical examination of 50 marks, students are expected to prepare & execute computer programs in C of total 30 marks in one hours duration. Viva-Voce of 20 marks shall be conducted during University practical examination.

References:

Text Books Recommended:

1)Programming in C , P. Dey, M. Ghosh, First Edition, 2007, Oxford University press, ISBN (13): 9780195687910.

2. The C Programming Language, Kernighan B.W and Dennis M. Ritchie, Second Edition, 2005, Prentice Hall, ISBN (13): 9780131101630.
3. Turbo C: The Complete Reference, H. Schildt, 4th Edition, 2000,Mcgraw Hill Education, ISBN-13: 9780070411838.
4. Understanding Pointers in C, Yashavant P. Kanetkar, 4th Edition, 2003, BPB publications, ISBN-13: 978-8176563581
5. C IN DEPTH, S.K Srivastava, Deepali Srivastava, 3rd Edition, 2013, BPB publication, ISBN9788183330480

Reference Books Recommended:

1. An Introduction to Data Structures with Applications, Trembly J. P. And Sorenson P. G., Tata McGraw Hill Pub. Co. Ltd.
2. Fundamentals of Computer Algorithms, Horowitz E. And Sahani S., Galgotia Publications Ltd.
3. Programming in C, Gotterfield B., Schaums Outline Series. 4. Mastering C, R. Venu Gopal Prasad, Tata McGraw Hill Pub. Co. Ltd.

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Professional Ethics (BTME406T)
Syllabus(Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	**Professional Ethics**	3	-	-	3	30	70	100	03

Sr. No.	Course Objective The objective of this course is–
1	The objective of this course is to inculcate the sense of social responsibility among learners and to make them realize the significance of ethics in professional environment so as to make them a global citizen

Course Outcomes	
After successful completion of this course the student will be able to:	
CO1	Understand basic purpose of profession, professional ethics and various moral and social issues
CO2	Analyze various moral issues and theories of moral development
CO3	Realize their roles of applying ethical principles at various professional levels
CO4	Identify their responsibilities for safety and risk benefit analysis.
CO5	Understand their roles in dealing various global issues

Professional Ethics SYLLABUS (Theory)	
Contents	No of hours
Unit I Human Values, Morals, values and Ethics, Integrity, Work ethics, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage ,	08
Unit II Engineering Ethics, Senses of 'Engineering Ethics', Variety of moral issues, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory ,	07
Unit III Engineering as Social Experimentation, Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law ,	07
Unit IV Safety, Responsibilities and rights, Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Collective Bargaining, Professional Rights, Employee Rights	07
Unit V Global issues, Multinational Corporations, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Corporate Social Responsibility	07

References:

Text Books Recommended:

1. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
2. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S. Chand Publications
3. Ethics in Engineering by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
4. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
5. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman, and M. Jayakumaran – University Science Press.
6. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan, and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009.
7. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013

RTM Nagpur University-Mechanical Engineering
B.Tech 4th Semester
Skill Development (Training on Matlab) (BTME407P)
Syllabus (Theory)

Semester	Course Title (Subject)	Hours / Week			Credits	Maximum Marks			Exam Duration (Hrs.)
		L	T	P		Continual Assessment	University Examination	Total	
IV	Skill Development (Training on MATLAB)	-	-	2	1	50	-	50	-

Course Objective

This helps it create a simple environment for solving problems. This easy-to-use environment helps engineers solve high-level problems. It also makes it easier for them to express problems in a mathematical form. The most common uses of MATLAB include computation, development, prototyping and visualization

Course Outcomes

After successful completion of this course the student will be able to use MATLAB to develop, design, simulate, and test their models before it can be developed in the real world. In the field of mechanical engineering, MATLAB will be used for solving problems related to dynamic and static systems, mechanical vibrations, control systems, statics, and more.

Contents- MATLAB- IV Sem- Mechanical Engineering

References:

Text Books Recommended:

1. Timothy A. Davis, MATLAB Primer, 8e, University of Florida, Chapman & Hall/CRC, 2011, ISBN: 978-1-4398-2862-5; Language: English
2. S Kermit, MATLAB Primer, 3e, University of Florida
3. Primer, MATLAB , MathWorks, Inc, 30e

References:

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3. Primer, MATLAB , MathWorks, Inc, 30e