

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI**

**BE/B.Tech. Scheme of Teaching and Examinations
Outcome Based Education (OBE) and Choice Based Credit System
(CBCS) (Effective from the academic year 2018 – 19)**

MECHANICAL ENGINEERING

<p align="center"> VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI Scheme of Teaching and Examination 2018 – 19 Outcome Based Education(OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2018 – 19) </p>

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	BSC	18MAT31	Mathematics	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18ME32	Mechanics of Materials		3	2	--	03	40	60	100	4
3	PCC	18ME33	Basic Thermodynamics		3	0	--	03	40	60	100	3
4	PCC	18ME34	Material Science		3	0	--	03	40	60	100	3
5	PCC	18ME35A or 18ME35B	Metal cutting and forming Metal Casting and Welding		3	0	--	03	40	60	100	3
6	PCC	18ME36A or 18ME36B	Computer Aided Machine Drawing/ Mechanical Measurements and Metrology		1 3	4 0	--	03	40	60	100	3
7	PCC	18MEL37A or 18MEL37B	Material Testing lab Mechanical Measurements and Metrology lab		--	2	2	03	40	60	100	2
8	PCC	18MEL38A 18MEL38B	Workshop and Machine Shop Practice (Consists of Fitting, and Machining) Foundry,Forging and Welding lab		--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49 18KAK39/49 OR 18CPC39	Vyavaharika Kannada (Kannada for communication)/ Aadalitha Kannada (Kannada for Administration) Constitution of India, Professional Ethics and Cyber Law	HSMC	-- 1 -- 1	2 -- -- 1	-- -- -- 04	-- 02 -- 24	100 40 -- 420	-- 60 -- OR	100	1
TOTAL					17	10	04	24	420	480	900	24
					OR	OR		OR	OR	OR		
					19	14		26	360	540		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39 Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

<p align="center">Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs</p>	
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10	NMC	18MATDIP31	Additional Mathematics - I	Mathematics	02	01	--	03	40	60	100	0
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- a) The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B. Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfill the requirements during subsequent semester/s to appear for SEE.
- b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs	
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Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES
(Common to all Programmes)

Course Code	18MAT31	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Module-1

Laplace Transforms: Definition and Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function – problems.

Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform (without proof) and problems, solution of linear differential equations using Laplace transform.

Module-2

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis, examples from engineering field.

Module-3

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.

Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform. Simple problems.

Module-4

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Range - Kutta method of fourth order, Milne's and Adam-Bashforth predictor and corrector method (No derivations of formulae), Problems.

Module-5

Numerical Solution of Second Order ODE's: Runge -Kutta method and Milne's predictor and corrector method.(No derivations of formulae).

Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

Course Outcomes:

At the end of the course the student will be able to:

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5:Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.

- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10 th Edition, 2016
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	44 th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3 rd Edition, 2016
Reference Books				
1	Advanced Engineering Mathematics	C. Ray Wylie, Louis C. Barrett	McGraw-Hill Book Co	6 th Edition, 1995
2	Introductory Methods of Numerical Analysis	S. S. Sastry	Prentice Hall of India	4 th Edition 2010
3	Higher Engineering Mathematics	B.V. Ramana	McGraw-Hill	11 th Edition, 2010
4	A Text Book of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	2014
5	Advanced Engineering Mathematics	Chandrika Prasad and Reena Garg	Khanna Publishing,	2018
Web links and Video Lectures: <ol style="list-style-type: none"> 1. http://nptel.ac.in/courses.php?disciplineID=111 2. http://www.class-central.com/subject/math(MOOCs) 3. http://academicearth.org/ 4. VTU EDUSAT PROGRAMME - 20 				

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

MECHANICS OF MATERIALS

Course Code	18ME32	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:2:0	SEE Marks	60
Credits	04	Exam Hours	03

Course Learning Objectives:

- To know the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.
- To know behaviour & properties of engineering materials.
- To understand the stresses developed in bars, compounds bars, beams, shafts, and cylinders.
- To understand the concepts of calculation of shear force and bending moment for beams with different supports.
- To expose the students to concepts of Buckling of columns and strain energy.

Module-1

Stresses and Strains: Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them.

Module-2

Analysis of Stress and Strain: Introduction to three dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear stress, Mohr circle for plane stress conditions.

Cylinders: Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations.

Module-3

Shear Force and Bending Moment: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads.

Stress in Beams: Bending and shear stress distribution in rectangular, I and T section beams.

Module-4

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

Torsion: Circular solid and hollow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections.

Module-5

Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I and II and their applications.

Course Outcomes: At the end of the course, the student will be able to:

- CO1: Understand simple, compound, thermal stresses and strains their relations and strain energy.
- CO2: Analyse structural members for stresses, strains and deformations.
- CO3: Analyse the structural members subjected to bending and shear loads.
- CO4: Analyse shafts subjected to twisting loads.
- CO5: Analyse the short columns for stability.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

SI No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Mechanics of Materials	J M Gere, B J Goodno,	Cengage	Eighth edition 2013
2	Fundamentals of Strength of Materials	P N Chandramouli	PHI Learning Pvt. Ltd	2013
3	Strength of Materials	R K Rajput	S. Chand and Company Pvt. Ltd	2014
Reference Books				
1	Strength of Materials	R. Subramanian	Oxford	2005
2	Strength of Materials	S. S. Ratan	Tata McGraw Hill	2nd Edition, 2008
3	Mechanics of materials Strength of Materials	S C Pilli and N Balasubramanya	Cengage	2019
4	Mechanics of Materials	Ferdinand Beer, Russell Johnston, John Dewolf, David Mazurek	McGraw Hill Education (India) Pvt. Ltd	Latest edition
5	Mechanics of Materials	R C Hibbeler	Pearson	Latest edition

B. E. MECHANICAL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - III			
BASIC THERMODYNAMICS			
Course Code	18ME33	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: <ul style="list-style-type: none"> Learn about thermodynamic system and its equilibrium Understand various forms of energy - heat transfer and work Study the basic laws of thermodynamics including, zeroth law, first law and second law. Interpret the behaviour of pure substances and its application in practical problems. Study of Ideal and real gases and evaluation of thermodynamic properties 			
Module-1			
Fundamental Concepts & Definitions: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer.			
Module-2			
Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems. First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Extension of the First law to control volume; steady flow energy equation(SFEE), important applications.			
Module-3			
Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. Reversed heat engine, schematic representation, importance and superiority of a reversible heat engine and irreversible processes, internal and external reversibility. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles. Problems Entropy: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate.			
Module-4			
Availability, Irreversibility and General Thermodynamic relations. Introduction, Availability (Exergy), Unavailable energy, Relation between increase in unavailable energy and increase in entropy. Maximum work, maximum useful work for a system and control volume, irreversibility. Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.			
Module-5			

<p>Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases, Air- Water mixtures and related properties.</p> <p>Real gases – Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Beattie-Bridgeman equation, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gases.</p>				
<p>Course Outcomes: At the end of the course, the student will be able to:</p> <ul style="list-style-type: none"> • CO1: Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems. • CO2: Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics. • CO3: Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties. • CO4: Interpret the behavior of pure substances and its application in practical problems. • CO5: Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations. 				
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten full questions carrying equal marks. • Each full question will be for 20 marks. • There will be two full questions (with a maximum of four sub- questions) from each module. • Each full question will have sub- question covering all the topics under a module. • The students will have to answer five full questions, selecting one full question from each module. 				
Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Basic and Applied Thermodynamics	P.K.Nag,	Tata McGraw Hill	2nd Ed., 2002
2	Basic Engineering Thermodynamics	A.Venkatesh	Universities Press,	2008
3	Basic Thermodynamics,	B.K Venkanna, Swati B. Wadavadagi	PHI, New Delhi	2010
Reference Books				
3	Thermodynamics- An Engineering Approach	YunusA.Cenegal and Michael A.Boles	Tata McGraw Hill publications	2002
4	An Introduction to Thermodynamcis	Y.V.C.Rao	Wiley Eastern	1993,
5	Engineering Thermodynamics	.B.Jones and G.A.Hawkins	John Wiley and Sons.	

<p align="center">B. E. MECHANICAL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - III MATERIAL SCIENCE</p>			
Course Code	18ME34	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: <ul style="list-style-type: none"> The foundation for understanding the structure and behaviour of materials common in mechanical engineering. Topics to explore the mechanical properties of metals and their alloys, polymers, ceramics, smart materials and composites. To understand modifications of material properties by heat treatment processes. Selections of different materials for various applications are highlighted. Impart knowledge of various failure modes of materials. 			
Module-1			
Introduction to Crystal Structure: Coordination number, atomic packing factor, Simple Cubic, BCC, FCC and HCP Structures, Crystal imperfections—point, line, surface and volume imperfections. Atomic Diffusion: Phenomenon, Fick's laws of diffusion (First and Second Law); Factors affecting diffusion. Mechanical Behaviour: Stress-strain diagrams showing ductile and brittle behaviour of materials, Engineering stress and true strains, Linear and non-linear elastic behaviour and properties, Mechanical properties in plastic range: Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness. Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals.			
Module-2			
Failure of Materials Fracture: Type I, Type II and Type III, Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, S-N diagram, fatigue testing. Creep: Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness, numerical on diffusion, strain and stress relaxation. Alloys, Steels, Solidification: Concept of formation of alloys: Types of alloys, solid solutions, factors affecting solid solubility (Hume-Rothery rules), Binary phase diagrams: Eutectic, and Eutectoid systems, Lever rule, Intermediate phases, (The same type of process will study in Iron Carbon Phase Diagrams) Gibbs phase rule, Effect of non-equilibrium cooling, Coring and Homogenization Iron-Carbon (Cementite) diagram: description of phases, Effect of common alloying elements in steel, Common alloy steels, Stainless steel, Tool steel, Specifications of steels. Solidification: Mechanism of solidification, Homogeneous and Heterogeneous nucleation, Crystal growth, cast metal structures, Solidification of Steels and Cast irons. Numerical on Lever rule.			
Module-3			
Heat Treatment, Ferrous and Non-Ferrous Alloys: Heat treating of metals: Time-Temperature-Transformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Recrystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Martempering, Austempering, Concept of hardenability, Factors affecting hardenability. Surface hardening methods: carburizing, cyaniding, nitriding, flame hardening and induction hardening, Age hardening of aluminium-copper alloys and PH steels. Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel.			
Module-4			
Composite Materials : Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber-reinforced composites, Fundamentals of production of composites, characterization of composites, constitutive relations of composites, determination of composite properties from component properties, hybrid composites. Applications of composite materials. Numerical on determining properties of composites.			

Module-5**Other Materials, Material Selection**

Ceramics: Structure type sand properties and applications of ceramics. Mechanical/ Electrical behaviour and processing of Ceramics.

Plastics: Various types of polymers/plastics and their applications. Mechanical behaviour and processing of plastics, Failure of plastics.

Other materials: Brief description of other materials such as optical and thermal materials.

Smart materials–fiber optic materials, piezo-electrics, shape memory alloys–Nitinol, superelasticity.

Biological applications of smart materials–materials used as implants in human Body, selection of materials, performance of materials in service. Residual life assessment–use of non-destructive testing, economics, environment and Sustainability.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand the mechanical properties of metals and their alloys.

CO2: Analyze the various modes of failure and understand the microstructures of ferrous and non-ferrous materials.

CO3: Describe the processes of heat treatment of various alloys.

CO4: Acquire the Knowledge of composite materials and their production process as well as applications.

CO5: Understand the properties and potentialities of various materials available and material selection procedures.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Foundations of Materials Science and Engineering	Smith	McGrawHill	4th Edition, 2009.
2	Material science and Engineering and Introduction	William D. Callister	Wiley	2006
3	Materials Science	Shackelford, & M. K. Muralidhara	Pearson Publication	2007
Reference Books				
3	Materials Science and Engineering	V. Raghavan	PHI	2002
4	The Science and Engineering of Materials	Donald R. Asklund and Pradeep P. Phule	Cengage Learning	4th Ed., 2003
5	Mechanical Metallurgy	George E. Dieter	McGraw-Hill.	
6	ASM Handbooks	American Society of Metals		
7	Elements of Materials Science and Engineering	H. Van Vlack,	Addison-Wesley Edn	1998
8	An introduction to Metallurgy	Alan Cottrell	University Press India	1974.

B. E. MECHANICAL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - III			
METAL CUTTING AND FORMING			
Course Code	18ME35A/45A	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: <ul style="list-style-type: none"> To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools. To introduce students to different machine tools to produce components having different shapes and sizes. To develop the knowledge on mechanics of machining process and effect of various parameters on machining. To acquaint with the basic knowledge on fundamentals of metal forming processes To study various metal forming processes. 			
Module-1			
Introduction to Metal cutting: Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tool materials and applications.			
Introduction to basic metal cutting machine tools: Lathe- Parts of lathe machine, accessories of lathe machine, and various operations carried out on lathe. Kinematics of lathe. Turret and Capstan lathe.			
Module-2			
Milling: Various Milling operations, classification of milling machines, Vertical & Horizontal milling, up milling & down milling. Indexing: need of indexing, simple, compound & differential indexing. Drilling: Difference between drilling, boring & reaming, types of drilling machines. Boring operations & boring machines. Shaping, Planing and Slotting machines- machining operations and operating parameters. Grinding: Grinding operation, classification of grinding processes: cylindrical, surface & centerless grinding.			
Module-3			
Introduction to tool wear, tool wear mechanisms, tool life equations, effect of process parameters on tool life, machinability. Cutting fluid-types and applications, surface finish, effect of machining parameters on surface finish. Economics of machining process, choice of cutting speed and feed, tool life for minimum cost and production time. Numerical problems.			
Module-4			
MECHANICAL WORKING OF METALS Introduction to metal forming processes & classification of metal forming processes. Hot working & cold working of metals. Forging: Smith forging, drop forging & press forging. Forging Equipment, Defects in forging. Rolling: Rolling process, Angle of bite, Types of rolling mills, Variables of rolling process, Rolling defects. Drawing & Extrusion: Drawing of wires, rods & pipes, Variables of drawing process. Difference between drawing & extrusion. Various types of extrusion processes.			
Module-5			
Sheet Metal Operations: Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in drawing, Trimming, and Shearing. Bending — types of bending dies, Bending force calculation, Embossing and coining. Types of dies: Progressive, compound and combination dies.			

Course Outcomes: At the end of the course, the student will be able to:

CO1: Explain the construction & specification of various machine tools.

CO2: Discuss different cutting tool materials, tool nomenclature & surface finish.

CO3: Apply mechanics of machining process to evaluate machining time.

CO4: Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

CO5: Understand the concepts of different metal forming processes.

CO6: Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Manufacturing Technology Vol I & II	P.N.Rao	Tata McGraw Hill Pub. Co. Ltd., New Delhi	1998
2	A textbook of Production Technology Vol I and II	Sharma, P.C.,	S. Chand & Company Ltd., New Delhi	1996
3	Manufacturing Science	Amithab Gosh &A.K.Malik	East-West press	2001
Reference Books				
3	Workshop Technology Vol. I and II	Chapman W. A. J.	Arnold Publisher New Delhi	1998
4	Elements of Manufacturing Technology Vol II,	Hajra Choudhary, S. K. and Hajra Choudhary, A. K.	Media Publishers, Bombay	1988
5	Metal Forming Handbook	Schuler	Springer Verlag Publication	
6	Metal Forming: Mechanics and Metallurgy	Hosford,WF and Caddell,R.M	Prentice Hall	1993
7	Manufacturing Engineering and Technology	Kalpakjian	Addision Wesley CongmenPvt. Ltd.	2000
8	Production Technology	HMT		

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

COMPUTER AIDED MACHINE DRAWING

Course Code	18ME36A/46A	CIE Marks	40
Teaching Hours/Week (L:T:P)	1:4:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To acquire the knowledge of CAD software and its features.
- To familiarize the students with Indian Standards on drawing practices.
- To impart knowledge of thread forms, fasteners, keys, joints and couplings.
- To make the students understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.
- To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.

Part A

Part A

Introduction:

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap. Conversion of pictorial views into orthographic projections of simple machine parts (with and without section). Hidden line conventions. Precedence of lines.

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections.

Conversion of pictorial views into orthographic projections of simple machine parts. Hidden line conventions. Precedence of lines.

Conversion of pictorial views into orthographic projections of simple machine parts (with section planes indicated on the part).

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

Part B

Keys: Parallel key, Taper key, Feather key, Gib-head key and Woodruff key.

Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

Couplings: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, and universal coupling (Hooks' Joint)

Part C

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.

Assembly Drawings: (Part drawings shall be given)

1. Plummer block (Pedestal Bearing)

2. Lever Safety Valve

3. I.C. Engine connecting rod

4. Screw jack (Bottle type)

5. Tailstock of lathe

6. Machine vice

7. Tool head of shaper

Course Outcomes: At the end of the course, the student will be able to:

CO1: Identify the national and international standards pertaining to machine drawing.

CO2: Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings

CO3: Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.

CO4: Interpret the Machining and surface finish symbols on the component drawings.

CO5: Preparation of the part or assembly drawings as per the conventions.

Scheme of Examination: Two questions to be set from each Part A, part B and Part C. Student has to answer one question each from Part A and Part B for 25 marks each and one question from Part C for 50 marks.

INSTRUCTION FOR COMPUTER AIDED MACHINE DRAWING (15ME36A/46A) EXAMINATION

1. No restriction of timing for sketching/ computerization of solutions. The total duration is 3 hours.

2. It is desirable to do sketching of all the solutions before computerization.

3. Drawing instruments may be used for sketching.

4. For Part A and Part B, 2D drafting environment should be used.

5. For Part C, 3D environment should be used for parts and assembly, and extract 2D views of assembly.

6. Part A and Part B

25 Marks (15 marks for sketching and 10 marks for computer work)

7. Part C

50 Marks (20 marks for sketching and 30 marks for computer modelling)

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Machine Drawing	K.R. Gopala Krishna	Subhash Publication	2005
2	Machine Drawing	N.D.Bhat&V.M .Panchal	Charoratar publishing house	2005
Reference Books				
3	A Text Book of Computer Aided Machine Drawing	S. Trymbaka Murthy	CBS Publishers, New Delhi	2007
4	Engineering drawing	P.S.Gill	S K Kataria and Sons	2013
5	Machine Drawing	N. Siddeshwar, P. Kanniah, V.V.S. Sastri	Tata McGraw Hill	2006

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

MATERIAL TESTING LAB

Course Code	18MEL37A/47A	CIE Marks	40
Teaching Hours/Week (L:T:P)	0:2:2	SEE Marks	60
Credits	02	Exam Hours	03

Course Learning Objectives:

- To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
- To understand mechanical behaviour of various engineering materials by conducting standard tests.
- To learn material failure modes and the different loads causing failure.
- To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

Sl. No.	Experiments
PART A	
1	Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2	Heat treatment: Annealing, normalizing, hardening and tempering of steel. Metallographic specimens of heat treated components to be supplied and students should report microstructures of furnace cooled, water cooled, air cooled, tempered steel. Students should be able to distinguish the phase changes in a heat treated specimen compared to untreated specimen.
3	Brinell, Rockwell and Vickers's Hardness tests on untreated and heat treated specimens.
4	To study the defects of Cast and Welded components using Non-destructive tests like: <ul style="list-style-type: none"> a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing.
PART B	
5	Tensile, shear and compression tests of steel, aluminum and cast iron specimens using Universal Testing Machine
6	Torsion Test on steel bar.
7	Bending Test on steel and wood specimens.
8	Izod and Charpy Tests on Mild steel and C.I Specimen.
9	To study the wear characteristics of ferrous and non-ferrous materials under different parameters.
10	Tensile, shear and compression tests of steel, aluminum and cast iron specimens using Universal Testing Machine
11	Fatigue Test (demonstration only).

Course Outcomes: At the end of the course, the student will be able to:

- CO1: Acquire experimentation skills in the field of material testing.
- CO2: Develop theoretical understanding of the mechanical properties of materials by performing experiments.
- CO3: Apply the knowledge to analyse a material failure and determine the failure inducing agent/s.
- CO4: Apply the knowledge of testing methods in related areas.
- CO5: Understand how to improve structure/behaviour of materials for various industrial applications.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.

Scheme of Examination:

ONE question from part -A:	30 Marks
ONE question from part -B:	50 Marks
Viva -Voice:	20 Marks
Total:	100 Marks

B. E. MECHANICAL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

WORKSHOP AND MACHINE SHOP PRACTICE

Course Code	18MEL38A/48A	CIE Marks	40
Teaching Hours/Week (L:T:P)	0:2:2	SEE Marks	60
Credits	02	Exam Hours	03

Course Learning Objectives:

- To guide students to use fitting tools to perform fitting operations.
- To provide an insight to different machine tools, accessories and attachments.
- To train students into fitting and machining operations to enrich their practical skills.
- To inculcate team qualities and expose students to shop floor activities.
- To educate students about ethical, environmental and safety standards.

Experiments

Sl. No	PART A
1	Preparation of at least two fitting joint models by proficient handling and application of hand tools- V-block, marking gauge, files, hack saw drills etc.
PART B	
2	Preparation of three models on lathe involving - Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning. Exercises should include selection of cutting parameters and cutting time estimation.
PART C	
3	Cutting of V Groove/ dovetail / Rectangular groove using a shaper. Cutting of Gear Teeth using Milling Machine. Exercises should include selection of cutting parameters and cutting time estimation.
PART D (DEMONSTRATION ONLY)	
	Study & Demonstration of power tools like power drill, power hacksaw, portable hand grinding, cordless screw drivers, production air tools, wood cutter, etc., used in Mechanical Engineering.

Course Outcomes: At the end of the course, the student will be able to:

- CO1: To read working drawings, understand operational symbols and execute machining operations.
- CO2: Prepare fitting models according to drawings using hand tools- V-block, marking gauge, files, hack saw, drills etc.
- CO3: Understand integral parts of lathe, shaping and milling machines and various accessories and attachments used.
- CO4: Select cutting parameters like cutting speed, feed, depth of cut, and tooling for various machining operations.
- CO5: Perform cylindrical turning operations such as plain turning, taper turning, step turning, thread Cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time.
- CO6: Perform machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing and Gear cutting and estimate cutting time.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Scheme of Examination:

One Model from Part-A or Part-C:	30 Marks
One Model from Part-B:	50 Marks
Viva – Voce:	20 Marks
TOTAL:	100 Marks

B. E. MECHANICAL ENGINEERING Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER - III			
CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)			
Course Code	18CPC39/49	CIE Marks	40
Teaching Hours/Week (L:T:P)	(1:0:0)	SEE Marks	60
Credits	01	Exam Hours	02
Course Learning Objectives: To <ul style="list-style-type: none"> know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society. Know about the cybercrimes and cyber laws for cyber safety measures. 			
Module-1			
Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.			
Module-2			
Union Executive and State Executive: Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370,371,371J) for some States.			
Module-3			
Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences.			
Constitutional special provisions: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.			
Module-4			
Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering			
Module-5			
Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.			
Course Outcomes: On completion of this course, students will be able to,			
<ul style="list-style-type: none"> CO1: Have constitutional knowledge and legal literacy. 			

<ul style="list-style-type: none"> • CO2: Understand Engineering and Professional ethics and responsibilities of Engineers. • CO3: Understand the the cybercrimes and cyber laws for cyber safety measures. 				
Question paper pattern for SEE and CIE: <ul style="list-style-type: none"> • The SEE question paper will be set for 100 marks and the marks scored by the students will proportionately be reduced to 60. The pattern of the question paper will be objective type (MCQ). • For the award of 40 CIE marks, refer the University regulations 2018. 				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Constitution of India, Professional Ethics and Human Rights	Shubham Singles, Charles E. Haries, and et al	Cengage Learning India	2018
2	Cyber Security and Cyber Laws	Alfred Basta and et al	Cengage Learning India	2018
Reference Books				
3	Introduction to the Constitution of India	Durga Das Basu	Prentice –Hall,	2008.
4	Engineering Ethics	M. Govindarajan, S. Natarajan, V. S. Senthilkumar	Prentice –Hall,	2004

B. E. MECHANICAL ENGINEERING				
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)				
SEMESTER - III				
ADDITIONAL MATHEMATICS – I				
(Mandatory Learning Course: Common to All Programmes)				
(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech. programmes)				
Course Code	18MATDIP31	CIE Marks	40	
Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60	
Credits	0	Exam Hours	03	
Course Learning Objectives:				
<ul style="list-style-type: none">To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.To provide an insight into vector differentiation and first order ODE's.				
Module-1				
Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).				
Vector Algebra: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.				
Module-2				
Differential Calculus: Review of elementary differential calculus. Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Maclaurin's series expansions, problems.				
Partial Differentiation: Euler's theorem for homogeneous functions of two variables. Total derivatives - differentiation of composite function. Application to Jacobians of order two.				
Module-3				
Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems.				
Module-4				
Integral Calculus: Review of elementary integral calculus. Statement of reduction formulae for $\sin^n x$, $\cos^n x$, and $\sin^m x \times \cos^n x$ and evaluation of these with standard limits-Examples. Double and triple integrals, problems.				
Module-5				
Ordinary differential equations (ODE's): Introduction-solutions of first order and first degree differential equations: Variable Separable methods, exact and linear differential equations of order one. Application to Newton's law of cooling.				
Course Outcomes: At the end of the course the student will be able to:				
<ul style="list-style-type: none">CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions. CO4: Learn techniques of integration including the evaluation of double and triple integrals.CO5: Identify and solve first order ordinary differential equations.				
Question paper pattern:				
<ul style="list-style-type: none">The question paper will have ten full questions carrying equal marks.Each full question will be for 20 marks.There will be two full questions (with a maximum of four sub- questions) from each module.				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43 rd Edition, 2015
Reference Books				

1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10 th Edition, 2015
2	Engineering Mathematics Vol.I	RohitKhurana	Cengage Learning	2015