

**Autonomous Program Structure of
Second Year B. Tech. Third Semester
(Mechanical Engineering)
Academic Year: 2021-2022 Onwards**

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Practical	Oral		
BSME301	Calculus and Statistics (C&S)	3	1	0	50	50	0	0	100	4
20ME301	Engineering Metallurgy (EM)	3	0	0	50	50	0	0	100	3
20ME302	Engineering Thermodynamics (ET)	2	1	0	50	50	0	0	100	3
20ME303	Machining and Machine Tool Operations (MMTO)	3	0	0	50	50	0	0	100	3
20ME304	Strength of Materials (SOM)	3	1	0	50	50	0	0	100	4
20HS 301	Universal Human Values-2	2	1	0	50	50	0	0	100	3
20ME305L	Computer Aided Machine Drawing lab (CAMD Lab)	0	0	4	25	0	25	0	50	2
20ME301L	Engineering Metallurgy Lab (EM Lab)	0	0	2	25	0	0	25	50	1
20ME303L	Machining and Machine Tool Operations Lab (MMTO Lab)	0	0	2	25	0	25	0	50	1
20AC301	Audit Course (AC)	0	0	2	0	0	0	0	0	No Credit
	Total	16	4	10	375	300	50	25		
	Grand Total	30			675		75		750	24

S. Y. B. Tech. – Semester-I

Course Code	Calculus & Statistics		L	T	P
20BSME301			3	-	-
Pre-requisite	First order linear ordinary differential equations, Basics of Vector Algebra, Integration – basic properties, standard results, Beta & Gamma Functions, Basics of probability.		Syllabus Version		
			V:1.1		
Course Objectives:					
To make students					
<ol style="list-style-type: none"> To provide sound knowledge of engineering mathematics Strengthen thinking power to analyze Solve engineering problems in their respective areas. 					
Course Outcomes:					
Students will be able to					
After successful completion of the course, student will be able to					
<ol style="list-style-type: none"> Solve Higher order Linear differential Equations and analyze its solution. Obtain Fourier & Laplace Transform of various functions and solve Partial differential Equations using Fourier Transforms. Select a drive element from manufacturer's catalogue. Apply knowledge of vector differentiation & vector integration to solve problems. Statistically analyze the given data, calculate probabilities of various events using probability theory 					
Unit/Module: 1	Higher Order Linear Differential equation and application	6 hours	CO: 1		
Higher order Linear differential Equation with constant coefficients, Applications in solving Engineering problems. Mass Spring system, Damping effects, Resonance.					
Unit/Module: 2	Transforms	8 hours	CO: 2		
<p>Fourier Transforms: Finite Fourier Sine transform, Finite Fourier Cosine transforms, Inversion formula for Sine transform, Inversion formula for Cosine transform. Finite Fourier Sine and Cosine Transforms of derivatives. Discrete Time Fourier Transforms (DTFT) of standard sequences, Existence of DTFT, Properties of DTFT, Inverse DTFT.</p> <p>Laplace Transform : Definition of Laplace transform , Inverse Laplace transform , Laplace and Inverse Laplace Transform of standard functions and problems.</p>					

Unit/Module: 3	Partial Differential Equations	5 hours	CO: 3
Basic Concepts, Types of P.D.E. (Hyperbolic, Elliptic, Parabolic). Use of Finite Fourier Transforms for solving of P.D.E			
Unit/Module: 4	Vector Differentiation	4 hours	CO: 4
Physical interpretation of vector differentiation, vector differential operator, Gradient, Divergence, Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, vector identities.			
Unit/Module: 5	Vector Integration	5 hours	
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem.			
Unit/Module: 6	Statistics and Probability Distribution	6 hours	
Measure of Central tendency, Measure of Dispersion, Probability, Random variables, Distributions – Binomial , Poisson, Normal , Weibull.			
		Total Lab hours:	34 hours
Text Books:			
1.	B. S. Grewal, „Higher Engineering Mathematics “, Khanna Publications.		
2.	B. V. Ramana, „Higher Engineering Mathematics “, Tata McGraw Hill Publications (2007)		
3.	Peter V. O'neil, 'Advanced Engineering Mathematics' ,Thomson Brooks / Cole, Singapore (5th edition) (2007).		
Reference Books:			
1.	C.R.Wylie, L.C. Barrette, „Advanced Engineering Mathematics“, McGraw Hill Publications, New Delhi.(6th edition)(2003)		
2.	Erwin Kreyszig , 'Advanced Engineering Mathematics' Wiley Eastern Ltd. (8th Student Edition), (2004).		
3.	S.C. Gupta, V.K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10th revised edition) (2002).		

Course Code	Engineering Metallurgy	L	T	P
20ME301		3	-	-
Pre-requisite	Engineering Physics, Engineering Chemistry, Engineering mathematics	Syllabus Version		
		V:1.1		
Course Objectives:				
Course prepares students to				
<ol style="list-style-type: none"> 1. Understand type of materials 2. Understand properties of materials. 3. Understand Constraints in Engineering Industry 4. Correlate the constraints and materials 				
Course Outcomes:				
Students will be able to.				
<ol style="list-style-type: none"> 1. Correlate the relationship between processing-structure-property-performance of materials to define and evaluate properties relevant to engineering 2. Define and evaluate properties relevant to mechanical engineering 3. Cite usual types of failures in materials correlate the structure and integrity of materials with common failures and write their causes. 4. Read binary phase diagram, predict and quantify phase transformation using phase diagrams. 5. Specify metals and alloys used in engineering industry. 6. Select method for modification of properties. 				
Unit/Module: 1	Crystal Structure:	6hours	CO: 1	
Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.				
Unit/Module: 2	Mechanical Property measurement:	6hours	CO: 2	
Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.				
Unit/Module: 3	Static failure theories:	8 hours	CO: 3	
Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT)				

Unit/Module: 4	Phase diagrams:	6 hours	CO: 4
Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.			
Unit/Module: 5	Metals and alloys:	6 hours	CO: 5
Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys			
Unit/Module: 6	Heat treatment of Steel:	6 hours	CO: 6
Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening			
Total Lecture hours:		36 hours	
Text Books:			
1.	Callister's Material Science and Engineering", W.D. Callister, D.G. Rethwisch, Wiley, 2016, Second edition.		
2.	Materials engineering, science, processing and design, Michael Ashby, Hugh Shercliff, David Cebon, Butterworth-Heinemann, 2008		
Reference Books:			
1.	"Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988.		
2.	"Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003		
3.	"Material selection in mechanical design", Michael Ashby, Butterworth-Heinemann, 3/e, 2005		
4.	An Introduction to properties, Applications and design, Third edition, Ashby and Jones, Butterworth Heinemann.		
5.	Relevant ISO and Indian standards		

Course Name	Engineering Thermodynamics	L	T	P
Course Code	20ME302	2	1	-
Pre-requisite	Engineering Physics, Engineering Mathematics, Engineering Chemistry	Syllabus Version		
		V:1.1		
Course Objectives:				
To make students				
<ol style="list-style-type: none"> 1. To state and illustrate laws of thermodynamics 2. To understand concept of entropy and availability. 3. To get conversant with properties of steam, vapor processes and steam trap. 4. To analyze the performance of various thermodynamics cycles. 				
Course Outcomes:				
Students will be able to				
<ol style="list-style-type: none"> 1. Students will be able to apply laws of Thermodynamics to various processes. 2. Students will understand the concept of entropy and availability. 3. Students will gain the knowledge about steam properties and steam trap. 4. Students will be able to do performance calculations for various thermodynamic cycles. 				
Unit :- 1	Laws of Thermodynamics	6 hours	CO: 1	
First law of thermodynamics, second law of thermodynamics, zeroth law of thermodynamics. First law applied to closed system and open system, Second law of thermodynamics, Corollaries of Carnot theorem, Second law applied to heat engine, heat pump and refrigeration cycles.				
Unit :- 2	Entropy	4 hours	CO: 2	
Clausius Inequality, Entropy – a system property, Evaluation of entropy change for solids, liquids and ideal gases, Principle of increase of entropy- entropy generation.				
Unit :- 3	Properties of Steam	5 hours	CO: 3	
Formation of steam, Properties of steam, First law applied to steam processes, Steam trap.				
Unit :- 4	Thermodynamic Vapour Cycles	5 hours	CO: 4	
Carnot cycle, Rankine cycle , Reheat and Regeneration				
Unit :- 5	Thermodynamic Gas Cycles	5 hours	CO: 4	
Otto cycle, Diesel cycle, Dual cycle				

	Total Lab hours:	25 hours	
Text Books and Reference Books			
1.	Principles of Engineering Thermodynamics- Moran, Shapiro, Boettner, Baily Eighth Edition, Wiley Publication.		
2.	P. K. Nag, Engineering Thermodynamics, 5th Edition, Tata McGraw Hill Publications		
3.	C.P. Arora, Engineering Thermodynamics, Tata McGraw Hill		
4.	S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers		
5.	Cengel and Boles, „Thermodynamics – An Engineering Approach“, 7th Edition, Tata Mc Graw Hill Publication.		
6.	Rayner Joel, “Basic Engineering Thermodynamics”, Addison Wesley Longman		

Course Name	Machining and Machine Tool Operations (MMTO)	L	T	P
Course Code	20ME303	3	-	2
Pre-requisite	None	Syllabus Version		
		V:1.1		
Course Objectives:				
To make students				
<ol style="list-style-type: none"> 1. To familiarize with the basic concepts of machining science. 2. To acquaint with various single and multipoint cutting tools designing processes. 3. To make the students understand the economics of machining process 				
Course Outcomes:				
Students will be able to				
<ol style="list-style-type: none"> 1. Identify different machining operation requirements for components considering economics of machining. 2. Select an appropriate single or multipoint cutting tool parameter to evaluate cutting force, power, tool life and surface finish for machining operation. 3. Apply features and applications of non-traditional machining process. 4. Incorporate use of different locating and clamping devices for jigs and fixture design. 5. Discuss the need of automation and its use in manufacturing. 				
Unit/Module: 1	Machine tools	11 hours	CO: 1	
Material removing (turning, drilling and milling) & finishing processes (grinding, lapping, honing) process parameters, economics of machining				
Unit/Module: 2	Metal Cutting Theory	10 hours	CO: 2	
Single and multipoint cutting tools (hobs and form tools), tool geometry and materials. Theory of chip formation in metal machining, force relationships and the merchant equation, power and energy relationships in machining, Tool life and tool wear.				
Unit/Module: 3	Non-conventional machining processes	7 hours	CO: 3	
USM, WJM/WJAM, Chemical Machining, ECM, EDM, LBM, EBM, IBM process parameters and applications.				
Unit/Module: 4	Jig & Fixture	6 hours	CO: 4	
Jig, fixtures types (basic and modular) and applications, design of jigs and fixtures.				

Unit/Module: 5	Automation	7 hours	CO: 5
CNC types, systems, codes, manufacturing automation (machining center, FMS).			
		Total Lecture hours:	42 hours
Lab Work			
1.	Demonstration of physical hazards, safety and precautions.		
2.	Experimental studies on the cutting tool angle measurement.		
3.	Machining of mechanical components using CNC machine (Lathe/Mill/HMC/VMC). Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included.		
4.	Composite job machining involving minimum four operations, employing operations on lathe/CNC, precision turning, screw cutting, boring etc.		
5.	Cutting Force in Turning Process-an Experimental Approach by using dynamometers.		
		Total Lab hours:	22 hours
Text Books:			
1.	Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication.		
2.	Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Pearson Publication.		
Reference Books:			
1.	Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group.		
2.	Jigs and Fixture, P.H. Joshi, Tata McGraw-Hill		
3.	Metal Cutting Principles (2nd Edition), by Milton Clayton Shaw, Oxford University Press.		

Course Name	Strength of Material (SOM)			L	T	P
Course Code	20ME304			3	1	--
Pre-requisites	Engineering Mechanics			Syllabus Version		
				V:1.1		
Course Objectives:						
<p>A. Define stresses, strains and elastic constants and evaluate the principal stresses and principal planes</p> <p>B. Explain basic concepts of shear force and bending-moment.</p> <p>C. Determine the maximum Bending and shear stress in a given beam.</p> <p>D. Develop slope and Deflection equations for beams subjected to various loads.</p> <p>E. Evaluate the buckling strength of columns and torsional strength of circular members</p>						
Course Outcomes:						
Students will be able to						
<ol style="list-style-type: none"> 1. <i>Evaluate</i> principal stress and principal strain. 2. <i>Draw</i> SF and BM diagrams for various beams under different loading conditions. 3. <i>Formulate</i> the bending and shear stresses equations and be able to draw bending and shear stress diagrams. 4. <i>Formulate</i> slope and deflection equations for beams subjected to various loads. 5. <i>Determine</i> torsional strength and buckling strength. 						
Unit :1	Simple and Compound Stress and Strain			10 hours	CO: 1	
<p>Stress, strain, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, and Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram, factor of safety. Stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self-weight. Temperature stresses in simple members, Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear. Graphical solution using Mohr's circle of stresses. Principal stresses in shaft subjected to torsion, Bending moment and axial thrust Concept of equivalent torsion and bending moments</p> <p>Theories of Elastic Failure :-Maximum Principal Stress Theory, Maximum shear stress theory, Maximum distortion Theory, Maximum Strain theory</p>						
Unit : 2	Shear Force and Bending Moment Diagrams			6 hours	CO: 2	
<p>Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading,</p>						

shear force and bending moment. Maximum bending moment and position of points of contra flexure.			
Unit : 3	Bending and Shear Stresses in Beams	8 hours	CO: 3
<p>Bending stresses : Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.</p> <p>Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web.</p>			
Unit : 4	Slope and Deflection of Beams.	6 hours	CO: 4
Relation between bending moment and slope, slope and deflection of determinate beams, double integration method (Macaulay's method), derivation of formula for slope and deflection for standard cases.			
Unit : 5	Torsion and Buckling.	6 hours	CO: 5
<p>Torsion of circular member: Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial force on shafts.</p> <p>Buckling of columns: Concept of buckling of columns, derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions, safe load on columns</p>			
Total Theory Lecture hours:		36 hours	
Tutorial Assignments			
1.	Solving numerical on simple stress and strains		
2.	Analytical and Graphical Solution (Mohr's Circle) for compound stresses.		
3.	Drawing SFD and BMD for standard beam and loading conditions.		
4.	Determine bending stresses and shear stresses in the beam.		
5.	Finding slope and deflection at various locations for standard beam and loading conditions.		
6.	<p>Determination and Graphical representation using Python. (Any One)</p> <p>a) <i>Determine Principal Stresses, Maximum shear stresses and their locations by plotting Mohr's Circle using Python.</i></p> <p>b) <i>Plot SFD and BMD for a given beam using Python.</i></p> <p>c) <i>Find Bending/Shear Stresses and plot Bending/Shear Stress distribution using Python.</i></p>		

Text Books:	
1.	Strength of Materials S. Ramamrutham, Dhanpat Rai Pvt. Ltd.
2.	Elements of Strength of Materials, Timoshenko and Young Affiliated East West Press.
3.	Mechanics of Materials S. S. Rattan, TMH Pvt. Ltd.
4.	Mechanics of Structures S. B. Junnarkar, Charotar Publication
5.	S.S Bhavikatti, "Strength of Materials", Third Edition Vikas Publishing house Pvt Ltd, New Delhi.
Reference Books:	
1.	Mechanics of Materials, by Russell C. Hibbeler
2.	Introduction to Mechanics of Solids - by E.P. Popov, Prentice Hall Publication.
3.	Singer and Pytel - Strength of materials - Harper and row Publication.
4.	B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi.
	Beer and Johnston - Strength of materials - CBS Publication.

Course Code	Engineering Metallurgy Laboratory	L	T	P
20ME301L		-	-	2
Pre-requisite	Engineering Physics, Engineering Chemistry, Engineering mathematics	Syllabus Version		
		V:1.1		
<p>The assessment will consist of two components:</p> <ol style="list-style-type: none"> 1. Evaluation for performing practical and attending demonstrations in predefined closed system of lab instructions (Demonstration and exercise type of lab activity: 5 marks) 2. Task based performance (Structured enquiry type and open ended enquiry type of lab activity: 20 marks) 				
Course Objectives:				
Course prepares students to				
<ol style="list-style-type: none"> 1. To provide first-hand experience of facilities for materials property testing and treating. 2. To provide an understanding of structures in material and their relation to properties 				
Course Outcomes:				
Students will be able to.				
<ol style="list-style-type: none"> 7. Implement safety measures required in the laboratory 8. Measure mechanical properties and propose testing method for mechanical properties considered in design, quality assurance and servicing of engineering components 9. Inspect components for materials integrity using equipments in the laboratory. 10. Identify the phases in metals and alloys and measure grain size using metallography techniques to provide interpretation of microstructures and prepare a laboratory report. 11. Specify metals and alloys and find equivalents using standards. 12. Modify properties of steel by modifying microstructure using different heat treatments 				
Unit/Module: 1	Laboratory safety:	2 hours	CO: 1	
Introduction to laboratory and safety				
Unit/Module: 2	Mechanical Property measurement:	6hours	CO: 2	
Tension, hardness and Impact tests.				
Unit/Module: 3	Inspection of Components:	2 hours	CO: 3	
Non destructive test				
Unit/Module: 4	Metallography:	6 hours	CO: 4	
Study of microstructures of ferrous and non ferrous metals and alloys				

Unit/Module: 5	Metals and alloys specification:	2 hours	CO: 5
Study and use standards for specification of metals and alloys.			
Unit/Module: 6	Modification of material properties:	6 hours	CO: 6
Heat treatment of metals and alloys			
		Total Lecture hours:	24 hours
Text Books:			
3.	Callister's Material Science and Engineering", W.D. Callister, D.G. Rethwisch, Wiley, 2016, Second edition.		
4.	Materials engineering, science, processing and design, Michael Ashby, Hugh Shercliff, David Cebon, Butterworth-Heinemann, 2008		
Reference Books:			
1.	"Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988.		
2.	"Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003		
3.	"Material selection in mechanical design", Michael Ashby, Butterworth-Heinemann, 3/e, 2005		
4.	An Introduction to properties, Applications and design, Third edition, Ashby and Jones, Butterworth Heinemann.		
5.	Relevant ISO and Indian standards		

