KLE Dr. M. S. Sheshgiri
College of Engineering and Technology Belagavi
Department of Mathematics

1. **Course Code & Title:** 17MAT31, Engineering Mathematics - III
2. **Course:** Core
3. **Contact Hours: 5**0
4. **Type of Course:** Theory
5. **Class schedule:** 04 hours / Week
6. **Marks: CIE** – 40, SEE – 60
7. **Course Assessment Methods:** Internal Assessment Tests and University Exam
8. **Text Books:**
    1. B. S. Grewal : Higher Engineering Mathematics, Khanna publishers, 43rd edition, 2015.
    2. E. Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, 10th edition, 2015
9. **Reference Books:**
    1. N. P. Bali and Manish Goyal : A text book of Engineering mathematics, Laxmi publishers, 7th edition, 2010.
    2. B.V.Ramana : Higher Engineering M athematics, Tata McGraw-Hill, 2006.
    3. H. K Dass and Er. RajnishVerma ,"Higher Engineerig Mathematics", S. Chand publishing, 1st edition, 2011.

10. Topics Covered

Lecture No.	Topic	Teaching/ Learning Strategies	Assess-ment Tools Strategy	% of Portion	Cumulative portion covered
	Module – I Deals with the expansion of a given function as trigonometric Fourier series, also to find Fourier series expansion for the given numerical data. (L1&L2)				
1	**Fourier Series:** Periodic functions, Dirichlet's conditions	Lecture, Questioning, Discussion, Hands on Problem	I.A. Tests	20 %	20 %
2, 3, 4	Fourier Series of Periodic functions with period 2π and with arbitrary period 2c				
5, 6	Fourier series of even and odd functions				
7, 8	Half range Fourier Series,				
9, 10	Practical Harmonic analysis. Illustrative examples from engineering field.				
	At the end of the topic the students are able to: 1. Expand a function in terms of sine and cosine series. 2. Know the use of periodic signals and Fourier series to analyze circuits and system Communications. 3. Compute Fourier coefficients by practical harmonic analysis.				
	MODULE – II Deals with the concept of infinite Fourier transforms and Inverse Fourier transforms. Introduces the definitions, properties, problems on Z – transforms and solve difference equations. (L1&L2)				
11, 12	**Fourier Transforms:** Infinite Fourier transform	Lecture, Questioning, Discussion, Hands on Problem	I.A. Tests	20 %	40 %
13	Fourier Sine and Cosine transforms				
14, 15	Inverse Fourier transform				
16	**Z-transform:** Difference equations, basic definition, z-transform-definition				
17	Standard z-transforms				
18	Damping rule, Shifting rule, Initial value and final value theorems (without proof) and problems				
19	Inverse z-transform				
20	Applications of z-transforms to solve difference equations				
	At the end of the topic the students are able to: 1. Find Fourier sine & cosine transform of a function. 2. Solve problems on Inverse Z- Transforms and apply the same to solve difference equations. 3. Find the Z- Transforms of discrete functions.				
	MODULE – III Deals with Correlation and regression lines. Introduce least squares method to fit a curve. Numerical methods to find the roots of algebraic and transcendental equations.				

21	**Statistical Methods:** Review of measures of central tendency and dispersion	Lecture, Questioning, Discussion, Hands on Problem	I.A. Tests	20 %	60 %
22	Karl Pearson's coefficient of correlation, Problems				
23	Regression analysis and lines of regression (without proof)- problems				
24	**Curve fitting:** Curve fitting by the method of least squares, Fitting of the curves of the form, $y = ax + b$				
25, 26	Fitting of the curves of the form, $y = ax^2 + bx + c$				
27, 28	Fitting of the curves of the form, $y = ae^{bx}$				
29	**Numerical Methods:** Numerical solution of algebraic and transcendental equations by Regular-falsi method				
30	Newton – Raphson method				
	At the end of the topic the students are able to: 1. Find coefficient of correlation and analyze regression lines. 2. Fit straight lines, parabolas and exponential curves. 3. Apply appropriate numerical method to find the root of given equation.				
	MODULE – IV Mainly concerned with the interpolation and the numerical methods to solve the definite integrals.				
31	**Finite differences**: Forward and backward differences	Lecture, Questioning, Discussion, Hands on Problem	I.A. Tests	20 %	80 %
32, 33, 34	Newton's forward and backward interpolation formulae				
35, 36	Divided differences - Newton's divided difference formula				
37, 38	Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems.				
39, 40	**Numerical integration**: Simpson's $(1/3)^{rd}$, $(3/8)^{th}$ rule, Weddle's rule (without proof) -Problems				
	At the end of the topic the students are able to: 1. Apply appropriate interpolation formula to find the value of a function at given value. 2. Find polynomial to given data. 3. Use numerical methods to evaluate the definite integrals.				
	MODULE – V Deals with vector integration, Green's theorem, Stokes theorem and Gauss divergence theorem. Introduce extremal of a functional and discuss Euler's formula to solve variational problems.				
41	**Vector integration:** Line integrals-definition and problems	Lecture, Questioning, Discussion, Hands on Problem	I.A. Tests	20 %	100 %
42	surface and volume integrals-definition,				
43	Green's theorem in a plane				
44, 45	Stokes and Gauss divergence theorem (without proof) and problems				
46	**Calculus of Variations:** Variation of a function and a Functional				
47	Variational problems				
48	Euler's equation				
49, 50	Geodesics , Hanging chain Problems				
	At the end of the topic the students are able to: 1. Verify Green's theorem, Stokes theorem and Gauss divergence theorem. 2. Use Greens theorem, Stokes theorem and Divergence theorem to evaluate integrals over the given surface and volume 3. Solve the variational problems of calculus of variations				

11. Course Outcomes (COs):

17MAT31.1	Expand the given function in terms of Fourier series.
17MAT31.2	Find the infinite Fourier and inverse Fourier transforms of various functions. Find Z-transform of various functions and its applications to solve difference equations.
17MAT31.3	Find the lines of regression and best fit for the data in terms of two variables. Solve Algebraic and Transcendental equations by various numerical techniques to interpolate the value for the given data.
17MAT31.4	Use interpolation formulae to estimate function value for any data. Evaluate definite integrals by numerical methods.
17MAT31.5	Use Curl and Divergence of a vector function in three dimensions, as well as apply Green's theorem, Divergence theorem and Stoke's theorem in various applications. Solve the variational problems of the calculus of variations

12. Person (s) who prepared this description and date of preparation:

Dr. D.S.Revankar
Professor
26th July 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 17ME32, Material Science
2. **Course** **:** Core
3. **Contact Hours** **:** 50
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 04 hours / Week
6. **Marks** **:** CIE marks – 40, SEE marks – 60
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **TEXT BOOKS:**
    1. Smith, Foundations of Materials Science and Engineering, 4th Edition, McGraw Hill, 2009.
    2. William D. Callister, Material science and Engineering and Introduction, Wiley, 2006.
9. **REFERENCE BOOKS:**
    1. V. Raghavan, Materials Science and Engineering, , PHI, 2002
    2. Donald R. Askland and Pradeep P. Phule, The Science and Engineering of Materials, Cengage Learning, 4lh Ed., 2003.
    3. George Ellwood Dieter, Mechanical Metallurgy, McGraw-Hill.
    4. ASM Handbooks, American Society of Metals.

10. COURSE OBJECTIVES:

1. The foundation for understanding the structure and various modes of failure in materials common in mechanical engineering.
2. Topics are designed to explore the mechanical properties of metals and their alloys, polymers, ceramics, smart materials and composites.
3. The means of modifying such properties, as well as the processing and failure of materials.
4. Concepts of use of materials for various applications are highlighted.

11. Topics Covered

Lecture No	Topic	% of Portion	Cumulative Percentage
Module 1			
Basics, Mechanical Behaviour, Failure of Materials The objective of this unit is to Define the meaning of Material Science, understand the classification of materials, and explain importance of material Science and Metallurgy. Importance of crystal structures, shapes of crystals and defects in crystals, meaning of diffusion, types of mechanical behaviours along with types of failures is covered.			
1	Introduction to Crystal Structure – Coordination number, atomic packing factor for simple Cubic, BCC, FCC and HCP structures.	20%	20%
2	Crystal imperfections – point, line, surface and volume imperfections.		
3	Atomic Diffusion: Phenomenon, Fick's laws of diffusion; Factors affecting diffusion.		
4	Stress-strain diagrams showing ductile and brittle behavior of materials, Engineering and true strains, Linear and nonlinear elastic behavior and properties		
5	Mechanical properties in plastic range. Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness.		
6	Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals		
7	Fracture: Type I, Type II and Type III, Fatigue: Types of fatigue loading with examples		
8	Mechanism of fatigue, Fatigue properties, S-N diagram, Fatigue testing.		
9	Creep: Description of the phenomenon with examples, three stages of creep.		
10	Creep properties, Stress relaxation. Concept of fracture toughness.		
At the end of the module, the students are able to: 1. Understand various crystal structures - BCC, FCC & HCP structures. 2. Distinguish between Line, Surface, Point & Volume Defects. 3. Explain Diffusion process & Fick's Laws of Diffusion, Mechanical behaviour & failure types			
Module 2			
Alloys, Steels, Solidification The objective of this unit is to learn the mechanism of Solidification**, t**ypes of nucleation, cast metal structures. To understand the concept of solid solutions, phase diagrams, basic rules behind it, iron carbon equilibrium diagram & TTT diagram.			
11	Concept of formation of alloys: Types of alloys, solid solutions, factors affecting solid solubility (Hume Rothery rules),	20%	40%
12	Binary phase diagrams, eutectic, and Eutectoid systems. Lever rule, Substitutional and interstitial solid solutions		
13	Intermediate phases, Gibbs phase rule Effect of non- equilibrium cooling		

14-15	Coring and Homogenization Iron-Carbon (Cementite) equilibrium diagram.		
16	Description of various phases appearing in Iron-Carbon equilibrium diagram.		
17	Specifications of steels. Solidification: Mechanism of solidification,		
18	Homogenous and Heterogeneous nucleation, Crystal growth, Cast metal structures		
19	Numericals on lever rule		
20	Numericals on lever rule		

At the end of the unit, the students are able to:

1. Explain Mechanism of Solidification.
2. Distinguish between Homogenous & Heterogeneous nucleation.
3. State Hume-Rothary rules for solid solutions.
4. Explain Gibbs phase rule, Iron-Carbon equilibrium diagram.

MODULE 3

Heat Treatment, Ferrous and Non-Ferrous Alloys

21	Heat treating of metals: Time-Temperature-Transformation (TTT) curves	20%	60%
22	Continuous Cooling Transformation (CCT) curves		
23	Annealing: Recovery, Recrystallization and Grain growth, Types of annealing		
24	Normalizing, Hardening, Tempering		
25	Martempering, Austempering, Concept of hardenability, Factors affecting hardenability		
26	surface hardening methods: carburizing,		
27	cyaniding, nitriding, flame hardening and induction hardening,		
28	Age hardening of aluminum-copper alloys and PH steels		
29	Ferrous materials: Properties, Compositions and uses of Grey cast iron,		
30	Malleable iron, SG iron and steel		

At the end of the unit, the students are able to:

1. Construct TTT-curves & CCT-curves.
2. Explain various types of Heat Treatment processes.
3. Describe Age hardening of Al & Cu alloys.

MODULE 4

Other Materials, Material Selection

31-32	Ceramics: Structure types and properties and applications of ceramics. Mechanical behaviour of ceramics.	20%	80%
33-34	Electrical behaviour and processing of Ceramics. Plastics: Various types of polymers/plastics and their applications.		
35-36	Mechanical behaviors and processing of plastics, Failure of plastics.		

37-38	Other materials: Smart materials and shape memory alloys		
39-40	Properties and applications of Smart materials and shape memory alloys		

At the end of the unit, the students are able to:

1. Explain the types and various applications of ceramics.
2. Describe the processing of ceramics and plastics.
3. Explain various types of plastics / polymers along with their applications.
4. Elaborate the novel properties and current applications of smart materials and shape memory alloys.

MODULE 5

Composite Materials

The objective of this unit is to study definition, classification, types of composites, fundamentals of production of FRP's and MMC's, advantages and application of composites

41-42	Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs),	20%	100%
43-44	Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber reinforced composites.		
45-46	Fundamentals of production of composites, Processes for production of composites, Characterization of composites,		
47-48	Constitutive relations of composites, Determination of composite properties from component properties.		
49-50	Numerical problems on determining properties of composites		

At the end of the unit, the students are able to:

1. Identify & classify Various Composites.
2. Describe their Production techniques.
3. State Advantages & applications of composites.

12. Course Outcomes (COs):

Upon the completion of the course the students will be able to:

17ME32.1 Describe the mechanical properties of metals, their alloys and various modes of failure.

17ME32.2 Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.

17ME32.3 Explain the processes of heat treatment of various alloys.

17ME32.4. Understand the properties and potentialities of various materials available and material selection procedures.

17ME32.5. Know about composite materials and their processing as well as applications.

13. Person (s) who prepared this description and date of preparation:

Dr. Deepak C. Patil — Associate Professor

Ravishankar N. Chikkanagoudar — Assistant Professor

Aug, 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 17ME33: BASIC THERMODYNAMICS
2. **Course** **:** Core
3. **Contact Hours** **:** 50(10 hours per module)
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 04 hours / Week
6. **Marks** **:** IA – 40, Final – 60
7. **Course Assessment Methods:** Internal Assessment Tests, Assignments and University Exam.

8. **Text Books:**

1. Basic Engineering Thermodynamics, A.Venkatesh, Universities Press, 2008
2. Basic and Applied Thermodynamics, P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002

9. **Reference Books:**

1. Thermodynamics, An Engineering Approach, Yunus A. Cenegal and Michael A. Boles, Tata McGraw Hill publications, 2002
2. Engineering Thermodynamics, J. B. Jones and G. A. Hawkins, John Wiley and Sons.
3. Fundamentals of Classical Thermodynamics, G. J. Van Wylen and R. E. Sonntag, Wiley Eastern.
4. An Introduction to Thermodynamics, Y. V. C. Rao, Wiley Eastern, 1993,
5. B. K. Venkanna, Swati B. Wadavadagi "Basic Thermodynamics", PHI, New Delhi, 2010

10. **Course Objectives:**

1. Learn about thermodynamic systems and boundaries
2. Study the basic laws of thermodynamics including, conservation of mass, conservation of energy or first law, second law and Zeroth law.
3. Understand various forms of energy including heat transfer and work
4. Identify various types of properties (e.g., extensive and intensive properties)
5. Use tables, equations, and charts, in evaluation of thermodynamic properties
6. Apply conservation of mass, first law, and second law in thermodynamic analysis of systems (e.g., turbines, pumps, compressors, heat Exchangers, etc.)
7. Enhance their problem solving skills in thermal engineering.

11. Topics Covered

Lecture No	Topic	% of Portion	
		Module-wise	Cumulative
Module 1 - FUNDAMENTAL CONCEPTS & DEFINITIONS **The objective of this unit is to:** Learn about thermodynamic systems and boundaries. Understand various forms of energy including heat transfer and work Identify various types of properties (e.g., extensive and intensive properties) Enhance their problem solving skills in thermal engineering.			
1	Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples	20%	20%
2	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;		
3	Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium		
4	Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature.		
5	Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer, Numericals on temperature measurement.		
6	Numericals on temperature measurement.		
7	**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,		
8	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		
9,10	Numericals on work and heat interaction.		
At the end of the unit, the students are able to: Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions.			
Module 2- FIRST LAW OF THERMODYNAMICS **The objective of this unit is to:** Understand various forms of energy including heat transfer and work. Study the basic laws of thermodynamics including, conservation of mass, conservation of energy or first law, second law and Zeroth law. Enhance their problem solving skills in thermal engineering.			
11	Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics,	20%	40%
12	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;		

13	Steady flow energy equation (SFEE), important applications.		
14,15	Numericals on FLTD on non-flow and flow process.		
16	**Second Law of Thermodynamics:** limitations of first law of thermodynamics, Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir, Direct heat engine; schematic representation and efficiency.		
17	Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance.		
18	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.		
19,20	Problems on second law related to heat engine, heat pump and refrigerator.		

At the end of the unit, the students are able to:

Determine heat, work, internal energy, enthalpy for flow & non flow process using First and Second Law of Thermodynamics.

Module 3- REVERSIBILITY AND ENTROPY

The objective of this unit is to learn the:

Evaluation of thermodynamic properties.

Enhance their problem solving skills in thermal engineering.

21	Definitions of a reversible process, reversible heat engine, importance and superiority of a reversible heat engine and irreversible processes; factors that make a process irreversible, reversible heat engines.	20%	60%
22	Unresisted expansion, remarks on Carnot's engine, internal and external reversibility,		
23	Definition of the thermodynamic temperature scale. Problems		
24	Problems.		
25	**Entropy:** Clausius inequality, Statement- proof, Entropy- definition, a property,		
26	change of entropy, entropy as a quantitative test for irreversibility,		
27	principle of increase in entropy, entropy as a coordinate.		
28,29,30	Numericals on Clausius inequality, principle of increase in entropy using TDS.		

At the end of the unit, the students are able to:

Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases.

Module 4 – AVAILABILITY, IRREVERSIBILITY AND GENERAL THERMODYNAMIC RELATIONS, PURE SUBSTANCES

The objective of this unit is to learn the:

Explain the structural behaviour of members subjected to torque, calculate twist and stress induced in shafts subjected to bending and torsion.

Understand the concept of stability and derive crippling loads for columns.

31	Introduction, Availability (Exergy), Unavailable energy (anergy), Relation between increase in unavailable energy and increase in entropy.	20%	80%
32	Maximum work, maximum useful work for a system and control volume,		
33	irreversibility, second law efficiency (effectiveness).		
34	**Pure Substances:** P-T and P-V diagrams, triple point and critical points.		
35	Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor,		
36	saturated vapor and superheated vapor states of pure substance with		

	water as example.		
37	Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams.		
38	Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.		
39,40	Numerical using relations, steam tables and mollier's chart.		
At the end of the unit, the students are able to: Interpret behaviour of pure substances and its applications to practical problems.			
Module 5 – IDEAL GASES AND REAL GASES **The objective of this unit is to learn the:** Use tables, equations, and charts, in evaluation of thermodynamic properties Enhance their problem solving skills in thermal engineering			
41,42	Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes,	20%	100%
43,44	Evaluation of properties of perfect and ideal gases, Air- Water mixtures and related properties.		
45	**Real gases :** Introduction , Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties,		
46	Beattie-Bridgeman equation , Law of corresponding states,		
47	Compressibility factor; compressibility chart		
48,49	Difference between Ideal and real gases, Numerical on ideal and real gases.		
50	Numerical using compressibility chart.		
At the end of the unit, the students are able to: Calculate Thermodynamics properties of real gases at all ranges of pressure, temperatures using modified equation of state including Vander Waals equation, Redlich Wong equation and Beattie-Bridgeman equation.			

12. Course Outcomes (COs):

Upon the completion of the course the students will be able to:

10ME33.1 Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions.

10ME33.2 Determine heat, work, internal energy, enthalpy for flow & non flow process using First and Second Law of Thermodynamics.

10ME33.3 Interpret behaviour of pure substances and its applications to practical problems.

10ME33.4 Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases.

10ME33.5 Calculate Thermodynamics properties of real gases at all ranges of pressure, temperatures using modified equation of state including Vander Waals equation, Redlich Wong equation and Beattie-Bridgeman equation.

12. Person (s) who prepared this description and date of preparation:

Prof. P. I. Ugran
Associate Professor
August, 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** : 17ME34, Mechanics of Materials
2. **Course** : Core
3. **Contact Hours** : 50
4. **Type of Course** : Theory
5. **Class schedule** : 04 hours / Week
6. **Marks** : CIE marks – 40, SEE marks – 60
7. **Course Assessment Methods** : Internal Assessment Tests and University Exam
8. **TEXT BOOKS:**
   - "Mechanics of Materials", by R. C. Hibbeler, Prentice Hall, Pearson Edu., 2005
   - "Mechanics of Materials", James M. Gere, Thomson Fifth edition 2004
   - "Mechanics of Materials", S.I. Units, Ferdinand Beer & Russell Johnstan, TATA McGraw Hill-2003
9. **REFERENCE BOOKS:**
   - "Strength of Materials", S. S. Bhavikatti, Vikas publications House- Pvt. Ltd., 2nd Ed., 2006
   - "Mechanics of Materials", K.V. Rao, G.C. Raju, First Edition, 2007.
   - "Engineering Mechanics of Solids" Egor P. Popov, Pearson Edu. India, 2nd Edition 1998
   - "Mechanics of Solids", Mubeen, Pearson Edu. India, 2002
   - "Strength of Materials", W.A. Nash, Schaum's Outline Series, Fourth Edition-2007
10. **COURSE OBJECTIVES:**
    - Classify the stresses into various categories and define elastic properties of materials and compute stress and strain intensities caused by applied loads in simple and compound sections and temperature changes.
    - Derive the equations for principal stress and maximum in-plane shear stress and calculate their magnitude and direction. Draw
    - Mohr circle for plane stress system and interpret this circle.
    - Determine the shear force, bending moment and draw shear force and bending moment diagrams, describe behavior of beams under lateral loads.
    - Explain the structural behavior of members subjected to torque, calculate twist and stress induced in shafts subjected to bending and torsion.
    - Understand the concept of stability and derive crippling loads for columns. Understand the concept of strain energy and compute strain energy for applied loads.

11. Topics Covered

Lecture No.	Details of topics covered	Percentage of portion	
		Module-wise	Cumulative
Module-1 Stress and strain			
1	Introduction, Hooke's law	**20**	**20**
2	Calculation of stresses in straight		
3	Stepped and tapered sections,		
4	Composite sections,		
5	Stresses due to temperature change,		
6	Shear stress and strain, Lateral strain and Poisson's ratio,		
7	Generalized Hooke's law, Bulk modulus, Relationship between elastic constants.		
8	Examples		
9	Examples		
10	Examples		
Module-2 Analysis of Stress and Strain			
11	Plane stress, Stresses on inclined planes,	**20**	**40**
12	Principal stresses and maximum shear stress,		
13	Principal angles, Shear stresses on principal planes,		
14	Maximum shear tress,		
15	Mohr circle for plane stress conditions.		
16	Thin cylinder: Hoop's stress, maximum shear stress,		
17	circumferential and longitudinal strains, Thick cylinders: Lames equations.		
18	Examples		
19	Examples		
20	Examples		
Module-3 Shear Forces and Bending Moments			
21	Type of beams, Loads and reactions,	**20**	**60**
22	Relationship between loads, shear forces and bending moments,		
23	Shear force and bending moments of cantilever beams,		
24	Pin support and roller supported beams subjected to concentrated loads		
25	and uniformly distributed constant / varying loads.		
26	Pure bending, Curvature of a beam, Longitudinal strains in beams,		

27	Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses.		
28	Examples		
29	Examples		
30	Examples		
Module-4 Torsion & Columns			
31	Circular solid and hallow shafts,	**20**	**80**
32	Torsional moment of resistance, Power transmission of straight and stepped shafts,		
33	Twist in shaft sections,		
34	Thin tubular sections, Thin walled sections		
35	Buckling and stability, Critical load, Columns with pinned ends,		
36	Columns with other support conditions,		
37	Effective length of columns, Secant formula for columns.		
38	Examples		
39	Examples		
40	Examples		
Module-5 Strain Energy & Theories of Failure			
41	Castigliano's theorem I and II	**20**	**100**
42	Load deformation diagram		
43	Strain energy due to normal stresses,		
44	Shear stresses, Modulus of resilience,		
45	Strain energy due to bending and torsion.		
46	Maximum Principal stress theory		
47	Maximum shear stress theory.		
48	Examples		
49	Examples		
50	Examples		

Course Outcomes:

Students will be able

- Understand simple, compound, thermal stresses and strains their relations, Poisson's ratio, Hooke's law, mechanical properties including elastic constants and their relations.
- Determine stresses, strains and deformations in bars with varying circular and rectangular cross-sections subjected to normal and temperature loads
- Determine plane stress, principal stress, maximum shear stress and their orientations using analytical method and Mohr's circle Determine the dimensions of structural members including beams, bars and rods using Energy methods and also stress distribution in thick and thin cylinders

- Draw SFD and BMD for different beams including cantilever beams, simply supported beams and overhanging beams subjected to UDL, UVL, Point loads and couples
- Determine dimensions, bending stress, shear stress and its distribution in beams of circular, rectangular, symmetrical I and T sections subjected to point loads and UDL
- Determine the dimensions of shafts based on torsional strength, rigidity and flexibility and also elastic stability of columns using
- Rankin's and Euler's theory

11. Person (s) who prepared this description and date of preparation:

Dr. Somaraddi R. Basavaraddi
Associate Professor

Dr. Amith H. Gadagi
Assistant Professor

August 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code and Title** : 17ME35B, Machine Tool Operations
2. **Course** **:** Core
3. **Contact Hours** **:** 50
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 04 hours / Week
6. **Marks** **:** IA – 40, Final – 60
7. **Course Assessment Methods** **:** Internal Assessment Tests and University Exam
8. **Text Books:**
    a. Fundamentals of metal cutting and Machine Tools, B. L. Juneja, G. S. Sekhon and Nitin Seth, New Age International Publishers 2nd Edition,2003
    b. All about Machine Tools, Heinrich Gerling, New Age International Publishers revised 2nd Edition, 2006
9. **Reference Books:**
    a. Fundamental of Machining and Machine Tools, Geoffrey Boothroyd and Winston A. Knight, CRC Taylor& Francis, Third Edition.
    b. Metal cutting principles, Milton C. Shaw, Oxford University Press, Second Edition,2005.

10. **Course Objectives:**

- To introduce students to different machine tools in order to produce components having different shapes and sizes.
- To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
- To develop the knowledge on mechanics of machining process and effect of various parameters on economics of machining.

11. Topics Covered

Lecture No	Topic	% of Portion	
		Module-wise	Cumulative
Module 1			
MACHINE TOOLS Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine, boring machine, broaching machine, shaping machine, planning machine, grinding machine [**Simple sketches showing major parts of the machines**].			
1	**Lathe :** Introduction, Classification of lathe machine with specification and construction details with simple sketches	20%	20%
2	**Drilling Machine** Introduction, Classification of drilling machine with specification and construction details with simple sketches		
3	**Milling Machine** Introduction, Classification of milling machine with specification and construction details with simple sketches		
4	**Shaping Machine** Introduction, Classification of shaping machine with specification and construction details with simple sketches		
5	**Boring Machine** Introduction, Classification of boring machine with specification and construction details with simple sketches		
6	**Broaching Machine** Introduction, Classification of broaching machine with specification and construction details with simple sketches		
7	**Planing Machine** Introduction, Classification of planning machine with specification and construction details with simple sketches		
8	**Grinding Machine** Introduction, Classification of grinding machine with specification and construction details with simple sketches		
9	**Video Presentation**		
10	**Lab visits**		
At the end of the unit, the students are able to: 1. Classification of machine tools 2. Construction and specifications of lathe, drilling machine, milling machine, boring machine, broaching machine, shaping machine, planning machine, grinding machine			
Module 2			
MACHINING PROCESSES Introduction, Types of motions in machining, turning and Boring, Shaping, Planning and Slotting, Thread cutting, Drilling and reaming, Milling, Broaching, Gear cutting and Grinding, Machining parameters and related quantities.			
11	Machining Processes: Introduction	20%	40%
12	Types of motions in machining, turning and boring		
13	Types of motions in shaping , planning and slotting		
14	Types of motions in threading , drilling and reaming		
15	Types of motions in milling and broaching		
16	Gear cutting and grinding		
17	Machining parameters in turning, boring and planning		
18	Machining parameters in threading, drilling and reaming		

19	Machining parameters in boring and planning		
20	Other related quantities		

At the end of the unit, the students are able to:

1. **U**nderstand the types of motions in all machining operations
2. Calculate all machining parameters

MODULE 3

CUTTING TOOL MATERIALS, GEOMETRY AND SURFACE FINISH

Introduction, desirable Properties and Characteristics of cutting tool materials, cutting tool geometry, cutting fluids and its applications, surface finish, effect of machining parameters on surface finish.
Machining equations for cutting operations: Turning, Shaping, Planning, slab milling, cylindrical grinding and internal grinding, Numerical

21	Cutting tool materials: Desirable properties and characteristics	20%	60%
22	Cutting tool geometry		
23	Cutting fluid and its application		
24	Surface finish parameters		
25	Effect of machining parameters on surface finish		
26	Machining equations for turning		
27	Machining equations for shaping and planning		
28	Machining equations for slab milling and grinding		
29	Machining equations for internal grinding		
30	Numerical problems		

At the end of the unit, the students are able to:

1. Identify the desirable properties and characteristics of cutting tool material.
2. Iidentify the cutting tool geometry
3. Application of cutting fluid and influence of machining parameters on it
4. Solve problem on machining time calculations for all machine tool operations

MODULE 4

MECHANICS OF MACHINING PROCESSES

Introduction, Chip formation, Orthogonal cutting, Merchants model for orthogonal cutting, Oblique cutting, Mechanics of turning process, Mechanics of drilling process, Mechanics of milling process, Numerical problems.

31	Introduction to mechanics of machining	20%	80%
32	Mechanism of chip formation with types of chips formed		
33	Orthogonal metal cutting model		
34	Merchants model for orthogonal cutting		
35	Oblique cutting		
36	Mechanics of turning process		
37	Mechanics of drilling process		
38	Mechanics of milling process		
39	Numerical problems		
40	Numerical Problems		

At the end of the unit, the students are able to:

1. *Understand the mechanics of machining*
2. Understand the mechanisms of chip formation along with types of chips

3. Explain and derive merchant's model for orthogonal cutting.
4. Explain and derive oblique cutting
5. Explain mechanics of turning, milling and drilling along with problem solving

MODULE 5

TOOL WEAR, TOOL LIFE

Introduction, tool wear mechanism, tool wear equations, tool life equations, effect of process parameters on tool life, machinability, Numerical problems

ECONOMICS OF MACHNING PROCESSES:

Introduction, choice of feed, choice of cutting speed, tool life for minimum cost and minimum production time, machining at maximum efficiency, Numerical problems

41	Introduction to tool wear and life	20%	100%
42	Tool wear mechanisms		
43	Derivations of tool wear equations		
44	Tool life equations and effect of process parameters on tool life		
45	Introduction to machining parameters		
46	Choice of feed, speed and depth of cut for minimum cost of production		
47	Choice of feed, speed and depth of cut for minimum production time		
48	Choice of feed, speed and depth of cut for maximum machining efficiency		
49	Problems		
50	Problems		

At the end of the unit, the students are able to:

1. *Explain benchmarking and QMS*.
2. Explain QFD & FMEA.
3. Explain about product liability.

Course Outcomes (COs):

17ME35 B.1: Explain the construction & specification of various machine tools.
17ME35 B.2: Describe various machining processes pertaining to relative motions between tool & work piece.
17ME35 B .3: Discuss different cutting tool materials, tool nomenclature & surface finish.
17ME35 B.4: Apply mechanics of machining process to evaluate machining time.
17ME35 B.5: Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

Person (s) who prepared this description and date of preparation:

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August, 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 17ME36B, Mechanical Measurements and Metrology
2. **Course** **:** Core
3. **Contact Hours** **:** 50
4. **Type of Course** **:** Theory
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 40, Final – 60
7. **Course Assessment Methods** **:** Internal Assessment Tests, Assignments and University Exam
8. **Text Books:**
    1. Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
    2. Engineering Metrology, R.K. Jain, Khanna Publishers, Delhi, 2009.
9. **Reference Books:**
    1. Engineering Metrology and Measurements, Bentley, Pearson Education.
    2. Theory and Design for Mechanical Measurements,III edition, Richard S Figliola, Donald E Beasley, WILEY India Publishers.
    3. Engineering Metrology, Gupta I.C., DhanpatRai Publications.
    4. Deoblin's Measurement system, Ernest Deoblin, Dhaneshmanick, McGraw –Hill.
    5. Engineering Metrology and Measurements,N.V.Raghavendra and L.Krishnamurthy, Oxford University Press.

Course Objectives:

1. Understand metrology, its advancements & measuring instruments,
2. Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and gear measurement & comparators.
3. Equip with knowledge of limits, fits, tolerances and gauging.
4. Acquire knowledge of measurement systems and methods with emphasis on different transducers, intermediate modifying and terminating devices.
5. Understand the measurement of Force, Torque, Pressure, Temperature and Strain.

10. Topics Covered

Lecture No	Topic	% of Portion	
		Module-wise	Cumulative
Module 1 – Introduction to Metrology			
The objective of this unit is to 1. Learn the objectives of Metrology and standards of length 2. Understand the concept of calibration 3. Learn the method of solving the problems on slip gauges 4. Measure the angle using various angle measuring devices			
1	Definition, objectives and concept of metrology, Need of inspection,	20%	20%
2	Principles, process, methods of measurement,		
3	Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement		
4	System of measurement, Material Standard, Wavelength Standards,		
5	Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars (Numericals), standardization		
6	**Linear Measurement and angular measurements:** Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge,		
7	adjustable slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, problems on building of slip gauges (M87, M112).		
8	Measurement of angles- sine bar, sine center, angle gauges		
9	optical instruments for angular measurements		
10	Auto collimator-applications for measuring straightness and squareness.		
At the end of the unit, the students are able to: 1. Define metrology with objectives 2. Classify standards of length 3. Solve numerical on slip gauges and end bars			
Module -2 System of Limits, Fits, Tolerance and Gauging			
The objective of this unit is to 1. Understand the concepts of limits fits and tolerances 2. Acquire knowledge of various types of gauges 3. Understand the method of solving problems related to limits fits and tolerances 4. Understand the working principle of comparators			
11	System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly,		
12	limits of size, Indian standards, concept of limits of size and tolerances,		
13	definition of fits, hole basis system, shaft basis system, types of fits and their designation (IS 919-1963),		
14	geometric tolerance, position-tolerances. Classification of gauges, brief concept of design of gauges (Taylor's principles),		
15	Geometrical tolerance, Positional tolerance, Hole basis and shaft basis of systems		
16	Classification of gauges, Brief concept of design of gauges (Taylor's		

	Principle)		
17	Wear allowance on gauges, Problems on gauge design,Types of gauges and gauge material		
18	**Comparators:** Functional requirements, classification, mechanical-Johnson Mikrokator	20%	40%
19	sigma comparators, dial indicator, electricalprinciples, , LVDT, Pneumatic- back pressure gauges,		
20	solex comparators and optical comparators- Zeiss ultra-optimeter		
At the end of the unit, the students are able to: 1. Define the limits, fits and tolerances 2. Solve the problems on limits, fits, tolerances and gauges 3. Explain the working of comparators			
Module -3 Measurement of screw thread and gear: The objective of this unit is to 1. Learn the terminology of screw thread and gear			
21	Terminology of screw threads, measurement of major diameter, minor diameter,		
22	pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods,		
23	best size wire. Screw thread gauges, Tool maker's microscope.		
24	Gear tooth terminology, tooth thickness measurement using constant chord method,		
25	addendum comparator method and base tangent method, measurement of pitch, concentricity,	20%	60%
26	run out, and involute profile. Gear roll tester for composite error.		
27	**Advances in metrology:** Basic concepts of lasers, advantages of lasers,		
28	laser interferometers, types, applications.		
29	Basic concepts of Coordinate Measuring Machines-		
30	constructional features, applications.		
At the end of the unit, the students are able to: 1. Explain methods of measurement of parameters of screw thread and gear			
Module-4 – Measurement systems and basic concepts of measurement methods: The objective of this unit is to 1. Learn measurement system and classification			
31	Definition, significance of measurement, generalized measurement system,		
32	definitions and concept of accuracy, precision, calibration, threshold,		
33	sensitivity, hysteresis, repeatability, linearity, loading effect		
34	system response-time delay. Errors in measurement,		
35	classification of errors. Transducers, transfer efficiency,	20%	80%
36	primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.		
37	**Intermediate modifying and terminating devices:** Mechanical systems,		
38	inherent problems, electrical intermediate modifying devices,		
39	input circuitry, ballast circuit, electronic amplifiers. Terminating devices,		

40	Cathode ray oscilloscope, Oscillographs		
At the end of the unit, the students are able to: 1. Classify the measurement system 2. Explain working of intermediate modifying and terminating devices			
Module- 5 Force, Torque and Pressure Measurement: The objective of this unit is to 1. Learn various force, torque, pressure measurement techniques			
41	Direct methods and indirect method, force measuring inst. Torque measuring inst.,	20%	100%
42	Types of dynamometers, Absorption dynamometer,		
43	Prony brake and rope brake dynamometer, and power measuring instruments. P		
44	Pressure measurement, principle, use of elastic members,		
45	Bridgeman gauge, McLeod gauge, Pirani gauge.		
46	Measurement of strain and temperature: Theory of strain gauges, types, electrical resistance strain gauge,		
47	preparation and mounting of strain gauges, gauge factor,		
48	Methods of strain measurement. Temperature Compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque,		
49	Strain gauge based load cells and torque sensors.		
50	Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer		
At the end of the unit, the students are able to: 1. Explain the working principle of force, pressure and torque measurement methods			

11. Course Outcomes (COs):

Upon the completion of the course the students will be able to:

17ME36B.1	**Define** metrology and **apply** concept of metrology to engineering applications
17ME36B.2	**Illustrate** the fundamentals of Limits, Fits and Tolerances including the gauge design
17ME36B.3	**Describe** various industrial metrological instruments for measuring linear, angular, screw thread and gear profiles
17ME36B.4	**Classify** and **analyze** the generalized measurement system
17ME36B.5	**Apply** the fundamental principles to understand working methodology of various force, torque and pressure measuring instruments
17ME36B.6	**Illustrate** the methods used for the measurement of strain and temperature

12. Person (s) who prepared this description and date of preparation:

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August 2018

KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 17MEL37B, Metrology and Measurement Lab
2. **Course** **:** Core
3. **Contact Hours** **:** 14
4. **Type of Course** **:** Practical's
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 40, Final – 60
7. **Course Assessment Methods** **:** Continuous evaluation of experiments
8. **Text Books:**
    1. Beckwith, Marangoni and Lien hard: "Mechanical Measurements", Pearson, 5th Ed., 2001
    2. R. K. Jain: "Engineering Metrology", Khanna Publication. 1994

9. **COURSE OBJECTIVES:**
    1. To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
    2. To illustrate the use of various measuring tools measuring techniques.
    3. To understand calibration techniques of various measuring devices.

10. TOPICS COVERED

Practical No.	Subject of Lecture	% of Portion	Cumulative
Part A Mechanical Measurements			
1	Calibration of pressure gauge	7	7
2	Calibration of thermocouple	7	14
3	Calibration of LVDT	7	21
4	Calibration of load	7	28
5	Determination of modulus of elasticity using strain gauge	7	35
Part B Metrology			
1	Measurement using tool makers microscope	8	43
2	Measurements of angle using sine center / sine bar /Bevel protractor	7	50
3	Measurement of alignment using autocollimator	7	57
4	Measurement of cutting tool forces using a) lathe tool dynamometer b) Drill tool Dynamometer	7	64
5	Measurement of screw thread parameters using two or three wide method	8	72
6	Measurement of surface roughness using Tally surf	7	79
7	measurement of gear tooth profile using gear tooth vernier caliper	7	86
8	Calibration of micrometer using ship gauges	7	93
9	Measurement using optical flats	7	100

11. COURSE OUTCOMES

- To calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer....
- To measure angle using sine center/sine bar/bevel protractor, alignment using autocollimator/roller set.
- To demonstrate measurements using optical projector/tool maker microscope, optical flats.
- To measure cutting tool forces using lathe/drill tool dynamometer...
- To measure screw thread parameters using two – wire or three – wire method, gear tooth profile using gear tooth Vernier caliper /gear tooth micrometer.
- To measure surface roughness using taly surf/mechanical comparator.

12. Person (s) who prepared this description and date of preparation:

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KLE DR. M. S. SHESHGIRI COLLEGE OF ENGINEERING AND TECHNOLOGY BELAGAVI

DEPARTMENT OF MECHANICAL ENGINEERING

1. **Course Code & Title** **:** 17MEL38B, Machine Shop
2. **Course** **:** Core
3. **Contact Hours** **:** 14
4. **Type of Course** **:** Practical's
5. **Class schedule** **:** 03 hours / Week
6. **Marks** **:** IA – 40, Final – 60
7. **Course Assessment Methods** **:** Continuous evaluation of experiments
8. **Text Books:**
    1. Fundamentals of metal cutting and Machine Tools B.L. Juneja, G.S. Sekhon and Nitin Seth, New Age International Publishers 2nd Edition, 2003
    2. All about Machine Tools, Heinrich Gerling, New Age International Publishers revised 2nd Edition, 2006

9. **COURSE OBJECTIVES:**

Students are expected-

1. To provide an insight to different machine tools, accessories and attachments
2. To train students into machining operations to enrich their practical skills
3. To inculcate team qualities and expose students to shop floor activities
4. To educate students about ethical, environmental and safety standards

10. TOPICS COVERED

Practical No.	Topics Covered	Percentage of portion	
		Practical wise	Cumulative
PART A			
1	JOB 1. facing, plain Turing, counter sink	60	7
2	JOB 1. step Turing, taper Turing		14
3	JOB 1. knurling, groove		21
4	JOB 1. external thread cutting		28
5	JOB 2. Facing ,Turing		35
6	JOB 2. boring, drilling		42
7	JOB 2. internal threading		49
8	JOB 3. Facing ,Turing		56
PART B			
10	keyways / slots on job 2	30	70
11	Gear cutting (preparation of blank)		77
12	Gear cutting		84
PART C			
13	Demonstration of formation of cutting parameters of single point cutting tool using bench grinder / tool & cutter grinder.	10	92
14	Demonstration of surface milling /slot milling		100

11. COURSE OUTCOMES

17MEL38B.1 To understand the working principles of machine elements such as Governors, Gyroscopes etc.,

17MEL38B.1 Perform turning, facing, knurling, thread cutting, tapering, eccentric turning and allied operations, keyways / slots, grooves etc. using shaper

17MEL38B.2 Perform gear tooth cutting using milling machine

17MEL38B.3 Understand the formation of cutting tool parameters of single point cutting tool using bench grinder / tool and cutter grinder, Surface Milling/Slot Milling

17MEL38B.4 Demonstrate precautions and safety norms followed in Machine Shop

17MEL38B.5 Exhibit interpersonal skills towards working in a team

12. Person (s) who prepared this description and date of preparation:

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August, 2018