

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION 2015-2016

Elements of Aeronautics [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	15AE32	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
CREDITS – 04			
Course objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. To know the history and basic principle of aviation 2. To understand the foundation of flight, aircraft structures, material aircraft propulsion 3. To develop an understanding stability of an aircraft along with its different systems 			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		10 Hours	L1, L2
<p>Introduction to Aircrafts History of aviation; Atmosphere and its properties; Classification of aircrafts; Basic components of an aircraft; structural members; aircraft axis system; aircraft motions; control surfaces and high lift devices; classification of aircraft; conventional design configurations; principle of operation of each major part; Helicopters, their parts and functions.</p> <p>Aircraft Structures and Materials: Introduction; general types of construction; monocoque, semi-monocoque and geodesic structures; typical wing and fuselage structure; metallic and non-metallic materials for aircraft application.</p>			
Module -2		10 Hours	L1, L2
<p>Basic principles of flight – significance of speed of sound; airspeed and groundspeed; standard atmosphere; Bernoulli's theorem and its application for generation of lift and measurement of airspeed; forces over wing section, aerofoil nomenclature, pressure distribution over a wing section. Lift and drag components – generation of lift and drag; lift curve, drag curve, types of drag, factors affecting lift and drag; centre of pressure and its significance; aerodynamic centre, aspect ratio, Mach number and supersonic flight effects; simple problems on lift and drag.</p>			
Module -3		10 Hours	L1, L2, L3
<p>Aircraft Propulsion: Aircraft power plants, classification based on power plant and location and principle of operation. Turboprop, turbojet and turbofan engines; ramjets and scramjets; performance characteristics. Aircraft power</p>			

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<p>plants – basic principles of piston, turboprop and jet engines; Brayton cycle and its application to gas turbine engines; use of propellers and jets for production of thrust; comparative merits and limitations of different types of propulsion engines; principle of thrust augmentation.</p>		
<p>Module -4</p> <p>Aircraft Stability : Forces on an aircraft in flight; static and dynamic stability; longitudinal, lateral and roll stability; necessary conditions for longitudinal stability; basics of aircraft control systems. Effect of flaps and slats on lift, control tabs, stalling, gliding, landing, turning, aircraft manoeuvres; stalling, gliding, turning. Simple problems on these. Performance of aircraft – power curves, maximum and minimum speeds for horizontal flight at a given altitude; effect of changes in engine power and altitude on performance; correct and incorrect angles of bank; aerobatics, inverted manoeuvre, manoeuvrability. Simple problems.</p>	10 Hours	L1, L2
<p>Module -5</p> <p>Aircraft Systems: Mechanical systems and their components; hydraulic and pneumatic systems; oxygen System; environmental Control System; fuel system. Electrical systems, flight deck and cockpit systems; navigation system, communication system.</p> <p>Aircraft systems (Mechanical) – hydraulic and pneumatic systems and their applications; environment control system; fuel system, oxygen system.</p> <p>Aircraft systems (Electrical) – flight control system, cockpit instrumentation and displays; communication systems; navigation systems; power generation systems – engine driven alternators, auxiliary power Module, ram air turbine; power conversion, distribution and management.</p>	10 Hours	L1, L2
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Appreciate and apply the basic principle of aviation 2. Apply the concepts of fundamentals of flight, basics of aircraft structures, aircraft propulsion and aircraft materials during the development of an aircraft 3. Comprehend the complexities involved during development of flight vehicles. 		
<p>Graduate Attributes (as per NBA):</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design / development of solutions • Interpretation of data 		
<p>Question paper pattern:</p>		

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- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. John D. Anderson, "*Introduction to Flight*", McGraw-Hill Education, 2011. ISBN 9780071086059.
2. Lalit Gupta and O P Sharma, "*Fundamentals of Flight Vol-I to Vol-IV*", Himalayan Books, 2006, ISBN: 706.

Reference Books:

1. A.C. Kermode, "*Flight without formulae*", Pearson Education India, 1989. ISBN: 9788131713891.
2. Nelson R.C., "*Flight stability and automatic control*", McGraw-Hill International Editions, 1998. ISBN 9780071158381.
3. Ian Moir, Allan Seabridge, "*Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration*", John Wiley & Sons, 2011. ISBN 978111965006.
4. Sutton G.P., "*Rocket Propulsion Elements*", John Wiley, New York, 8th Ed., 2011; ISBN: 1118174208, 9781118174203.

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Aerothermodynamics			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	15AE33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
CREDITS – 04			
Course objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand various concepts and definitions of thermodynamics. 2. Comprehend the I-law and II-law of thermodynamics. 3. Acquire the knowledge of various types of gas cycles 			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 Fundamental Concepts & Definitions: Thermodynamics 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 Modules, intensive and extensive properties. 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, fixed points and measurements. 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		10 Hours	L1, L2
Module -2 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, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat at constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as film and		10 Hours	L1, L2, L3

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evacuation of vessels with and without heat transfer.		
<p>Module -3</p> <p>Second 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. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. 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; Reversible and Irreversible processes; factors that make a process irreversible, reversible heat engines, Carnot cycle, Carnot principles.</p> <p>Entropy: Clasius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, change of entropy, principle of increase in entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.</p>	10 Hours	L1, L2
<p>Module -4</p> <p>Pure Substances & Ideal Gases: Mixture of ideal gases and real gases, ideal gas equation, compressibility factor use of charts. P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, Saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour 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.</p> <p>Thermodynamic relations Maxwells equations, Tds relations, ratio of heat capacities, evaluation of thermodynamic properties from an equation of state</p>	10 Hours	L1, L2, L3
<p>Module -5</p> <p>Gas Cycles: Efficiency of air standard cycles, Carnot, Otto, Diesel cycles, P-V & T-S diagram, calculation of efficiency; Carnot vapour power cycle, simple Rankine cycle, Analysis and performance of Rankine Cycle, Ideal and practical regenerative Rankine cycles – Reheat and Regenerative Cycles, Binary vapour cycle.</p>	10 Hours	L1, L2, L3
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Apply the concepts and definitions of thermodynamics. 2. Differentiate thermodynamic work and heat and apply I law and II law of thermodynamics to different process. 3. Apply the principles of various gas cycles 		

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Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions.
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. A Venkatesh, "*Basic Engineering Thermodynamics*", Universities Press, India, 2007, ISBN 13: 9788173715877
2. P K Nag, "*Basic and Applied Thermodynamics*", 2nd Ed., Tata McGraw Hill Pub. 2002, ISBN 13: 9780070151314

Reference Books:

1. Yunus A.Cenegal and Michael A.Boles, "*Thermodynamics: An Engineering Approach*", TataMcGraw Hill publications, 2002, ISBN 13: 9780071072540
2. J.B.Jones and G.A.Hawkins, John Wiley and Sons, "*Engineering Thermodynamics*", Wiley 1986, ISBN 13: 9780471812029
3. G.J.Van Wylen and R.E.Sonntag, "*Fundamentals of Classical Thermodynamics*", Wiley Eastern, Wiley, 1985, ISBN 13: 9780471800149
4. Y.V.C.Rao, "*An Introduction to Thermodynamics*", Wiley Eastern, 1993, ISBN 13: 9788173714610.
5. B.K Venkanna, Swati B. Wadavadagi "*Basic Thermodynamics*", PHI, New Delhi, 2010, ISBN 13: 978-8120341128.

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Mechanics of Materials			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	15AE34	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
CREDITS – 04			
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Comprehend the basic concepts of strength of materials. 2. Acquire the knowledge of stress, strain under different loadings. 3. Understand the different failure theory. 			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
<p>Module -1</p> <p>Basic equations of linear elasticity: The concept of stress, Analysis of the state of stress at a point, Equilibrium equations, The state of plane stress, The concept of strain, Analysis of the state of strain at a point, Plane strain and plane stress in polar coordinates, Problem featuring cylindrical symmetry.</p> <p>Constitutive behaviour of materials: Constitutive laws for isotropic materials, Allowable stress, Yielding under combined loading, Material selection for structural performance, Composite materials, Constitutive laws for anisotropic materials, Strength of a transversely isotropic lamina. Engineering structural analysis: Solution approaches, Bar under constant axial force, Pressure vessels.</p>		10 Hours	L1, L2
<p>Module -2</p> <p>Euler-Bernoulli beam theory: The Euler-Bernoulli assumptions, Implications of the Euler-Bernoulli assumptions, Stress resultants Beams subjected to axial loads, Beams subjected to transverse loads, Beams subjected to combined axial and transverse loads.</p> <p>Three-dimensional beam theory: Kinematic description, Sectional constitutive law, Sectional equilibrium equations, Governing equations, Decoupling the three-dimensional problem, The principal centroidal axes of bending. The neutral axis, Evaluation of sectional stiffness.</p>		10 Hours	L1, L2, L3
<p>Module -3</p> <p>Torsion: Torsion of circular cylinders , Torsion combined with axial force and bending moments, Torsion of bars with arbitrary cross-</p>		10 Hours	L1, L2, L3

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<p>sections, Torsion of a thin rectangular cross-section, Torsion of thin-walled open sections.</p> <p>Thin-walled beams: Basic equations for thin-walled beams, Bending of thin-walled beams, Shearing of thin-walled beams. The shear centre. Torsion of thin-walled beams, Coupled bending-torsion problems Warping of thin-walled beams under torsion. Equivalence of the shear and twist centres, Non-uniform torsion, Structural idealization.</p>		
<p>Module -4</p> <p>Virtual work principles: Introduction, Equilibrium and work fundamentals, Principle of virtual work, Principle of virtual work applied to mechanical systems, Principle of virtual work applied to truss structures. Principle of complementary virtual work, internal virtual work in beams and solids.</p> <p>Energy methods: Conservative forces, Principle of minimum total potential energy, Strain energy in springs, Strain energy in beams, Strain energy in solids, Applications to trusses, Development of a finite element formulation for trusses, Principle of minimum complementary, Energy theorems, Reciprocity theorems, Saint-Venant's principle.</p>	10 Hours	L1, L2, L3, L4
<p>Module -5</p> <p>Yielding: Yielding under combined loading, Applications of yield criteria to structural, Application to bars, trusses and beams. Buckling of beams: Rigid bar with root torsion spring, buckling of beams, buckling of sandwich beams. Shearing deformations in beams, Shear deformable beams: an energy approach.</p> <p>Kirchhoff plate theory: Governing equations of Kirchhoff plate theory, The bending problem, Anisotropic plates, Solution techniques for rectangular plates, Circular, Energy formulation of Kirchhoff plate theory, Buckling of plates.</p>	10 Hours	L1, L2, L3
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Apply the basic concepts of strength of materials. 2. Compute stress, strain under different loadings. 3. Distinguish the different failure theories . 		
<p>Graduate Attributes (as per NBA):</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design / development of solutions • Interpretation of data. 		
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. 		

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- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. S.S. Bhavaikatii, "*Strength of Materials*", Vikas Publications House, New Delhi, 2012, ISBN-13: 978-8125927914.
2. Timoshenko and Young "*Elements of Strength of Materials*", East-West Press, 1976, ISBN 10: 8176710199.

Reference Books:

1. Beer.F.P. and Johnston.R, "*Mechanics of Materials*", McGraw Hill Publishers, 2006, ISBN-13: 978-0073380285.
2. S.Ramamrutham, R Narayanan, "*Strength of Materials*", Dhanapath Rai Publishing Company, New Delhi, 2012, ISBN 13: 9789384378264
3. Bao Shihua, Gong Yaoqing "*Structural Mechanics*" Wuhan University of Technology Press, 2005, ISBN: 7562924074 9787562924074
4. T.H.G Megson "*Introduction to Aircraft Structural Analysis*", Butterworth-Heinemann Publications, 2007, ISBN 13: 9781856179324

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Mechanics of Fluid			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	15AE35	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
CREDITS – 04			
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Understand the basic fluid properties. 2. Understand the governing laws of fluid flow. 3. Acquire the knowledge of types of fluid flows. 			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
<p>Module -1</p> <p>Basic Considerations: Introduction, Dimensions- Modules and physical quantities, Continuum view of gases and liquids, Pressure and Temperature scales, Physical properties of fluids.</p> <p>Fluid Statics: Pressure distribution in a static fluid, Pressure and its measurement, hydrostatic forces on plane and curved surfaces, buoyancy, illustration by examples.</p>		10 Hours	L1, L2
<p>Module -2</p> <p>Fluids in motion: Methods of describing fluid motion, types of fluid flow, continuity equation in 3 dimensions, velocity potential function and stream function. Types of motion, Source sink, doublet , plotting of stream lines and potential lines Numerical problems.</p> <p>Fluid Kinematics: Kinematics of fluid motion and the constitutive equations, Integral (global) form of conservation equations (mass, momentum, energy) and applications, Differential form of conservation equations (continuity, Navier-Stokes equations, energy equation).</p>		10 Hours	L1, L2
<p>Module -3</p> <p>Fluid Dynamics: Equations of motion: Euler's and Bernoulli's equation of motion for ideal and real fluids. Momentum equation, Fluid flow measurements.</p>		10 Hours	L1, L2

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<p>Numerical problems.</p> <p>Dimensional analysis and similarity: Dimensional homogeneity, methods of dimensional analysis, model analysis, types of similarity and similitude. Dimensionless numbers. Model laws. Numerical problems.</p>		
<p>Module -4</p> <p>Flow past Immersed bodies: Introduction to boundary layer, boundary layer thickness, karman's integral momentum theory, drag on a flat plate for laminar and turbulent flow, Drag on immersed bodies. Expression for drag and lift. Kutta – joukowsky theorem; Fundamentals of aerofoil theory Numerical problems.</p>	10 Hours	L1, L2, L3
<p>Module -5</p> <p>Compressible flow and Boundary Layers theory: Steady, one-dimensional gas dynamics, Propagation of pressure waves in a compressible medium, velocity of sound , Mach number, Mach cone, Stagnation properties , Bernoulli's eqn for isentropic flow, normal shock waves . Numerical Problem; Laminar and turbulent boundary layers.</p>	10 Hours	L1, L2, L3. L4
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Evaluate the effect of fluid properties. 2. Apply the governing laws of fluid flow. 3. Classify different types of fluid flows. 		
<p>Graduate Attributes (as per NBA):</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design / development of solutions. • Interpretation of data. 		
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 16 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. <p>The students will have to answer 5 full questions, selecting one full question from each module.</p>		
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Bansal, R.K, “<i>Fluid Mechanics and Hydraulics Machines</i>”, Laxmi Publications (P) Ltd., New Delhi 2015, ISBN-13: 978-8131808153. 		

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2. Rathakrishnan. E, “*Fluid Mechanics*”, Prentice-Hall of India Pvt.Ltd, 2010, ISBN 13: 9788120331839.

Reference Books:

1. Yunus A. Cengel & John M Cimbala, Fluid Mechanics and Applications, McGraw Hill Education; 3rd edition, 2013, ISBN-13: 978-0073380322.
2. Ramamritham. S “*Hydraulic Fluid Mechanics and Fluid Machines*”, DhanpatRai& Sons, Delhi, 1988, ISBN 13: 9788187433804.
3. Kumar. K.L., “*Engineering Fluid Mechanics*” (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995, ISBN 13: 9788121901000.
4. Streeter. V. L., and Wylie, E.B., “*Fluid Mechanics*”, McGraw Hill, 1983, ISBN 13: 9780070665781

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Measurement and Metrology			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	15AE36	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
CREDITS – 04			
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Understand the standards of measurement, system of limits, fits, tolerances and gauging. 2. Understand the principles of measuring instruments 3. Acquire the knowledge on measurement and measurement systems. 			
Modules		Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
<p>Module -1</p> <p>Standards of measurement: Definition and Objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-81, M-112), Numerical problems on building of slip gauges.</p>		10 Hours	L1, L2, L3
<p>Module -2</p> <p>System of limits, Fits, Tolerances and gauging: Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963), geometrical tolerance, positional - tolerances, hole basis system, shaft basis of system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges -plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.</p>		10 Hours	L1, L2
<p>Module -3</p> <p>Comparators and Angular measurement: Introduction to Comparator, Characteristics, classification of comparators, mechanical comparators - Sigma Comparators, dial indicator, Optical Comparators - principles, Zeiss ultra optimeter, Electric and Electronic Comparators - principles, Pneumatic Comparators, back pressure gauges, Solex</p>		10 Hours	L1, L2, L3

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<p>Comparators. Angular measurements, Bevel Protractor, Sine Principle and. use of Sine bars, Sine center, use of angle gauges, Clinometers,</p> <p>Screw thread gear measurement: Terminology of screw threads, measurement of major diameter, minor diameter pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, Best size wire. Gear tooth vernier.</p>		
<p>Module -4</p> <p>Measurements and Measurement systems: Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, Classification of Errors. Transducers, Transfer efficiency, Primary and Secondary transducers, electrical, Mechanical, electronic transducers, advantages of each type transducers.</p>	10 Hours	L1, L2, L3
<p>Module -5</p> <p>Measurement of quantities: Principle, analytical balance, platform balance, proving ring, Torque measurement, Prony brake, hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, Mcloed gauge, Pirani Gauge.</p> <p>Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement</p>	10 Hours	L1, L2, L3
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Apply the standards of measurement, system of limits, fits, tolerances and gauging. 2. Identify and use appropriate measuring instruments. 3. Acquire the knowledge on measurement and measurement systems 		
<p>Graduate Attributes (as per NBA):</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design / development of solutions (partly). • Interpretation of data. 		
<p>Question paper pattern:</p> <ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question consists of 16 marks. • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. 		

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The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Beckwith Marangoni and Lienhard, John H. Lienhard V "*Mechanical Measurements*" , 6th Ed., 2006, ISBN-13: 978-0201847659.
2. R.K.Jain "*Engineering Metrology*", Khanna Publishers, 1994, ISBN 13: 9788174091536

Reference Books:

1. I.C.Gupta "*Engineering Metrology*" Dhanpat Rai Publications, Delhi, 2013, ISBN 13: 1234567144039.
2. Alstutko, Jerry. D.Faulk "*Industrial Instrumentation*", Thompson Asia Pvt. Ltd.2002, ISBN-13: 978-0827361256

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MEASUREMENTS AND METROLOGY LAB			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	15AEL37A	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	42	Exam Marks	80
CREDITS – 04			
Course objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Learn the concepts of mechanical measurements and metrology 2. Use the concept of accuracy, error and calibration 3. Use the basic metrological instruments 			
Modules			Revised Bloom's Taxonomy (RBT) Level
1. Calibration of Pressure Gauge			L1, L2, L3, L4
2. Calibration of Thermocouple			L1, L2, L3, L4
3. Calibration of LVDT			L1, L2, L3, L4
4. Calibration of Load cell			L1, L2, L3, L4
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.			L1, L2, L3, L4, L5
6. Comparison and measurements using vernier caliper and micrometer			L1, L2, L3, L4
7. Measurement of vibration parameters using vibration setup.			L1, L2, L3, L4
8. Measurements using Optical Projector / Toolmaker Microscope.			L1, L2, L3
9. Measurement of angle using Sine Center / Sine bar / bevel protractor			L1, L2, L3
10. Measurement of alignment using Autocollimator / Roller set			L1, L2, L3
11. Measurement of Screw thread Parameters using Two-wire or Three-wire method.			L1, L2, L3
12. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator			L1, L2, L3

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13. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer	L1, L2, L3
14. Calibration of Micrometer using slip gauges	L1, L2, L3
Course outcomes: After studying this course, students will be able to: <ol style="list-style-type: none">1. Identify and classify different measuring tools related to experiments.2. Identify, define, and explain accuracy, precision, and some additional terminology.3. Conduct, Analyze, interpret, and present measurement data from measurements experiments.	
Conduct of Practical Examination: <ol style="list-style-type: none">1. All laboratory experiments are to be included for practical examination.2. Students are allowed to pick one experiment from the lot.3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.	
Graduate Attributes (as per NBA): <ul style="list-style-type: none">• Engineering Knowledge.• Problem Analysis.• Design / development of solutions• Interpretation of data.	

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MATERIAL TESTING LAB			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	15AEL37B	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	42	Exam Marks	80
CREDITS – 04			
Course objectives: This course will enable students to			
<ol style="list-style-type: none"> 1. Understand the relations among materials and their properties. 2. Understand the formation, properties and significance of the alloys through different experiments. 3. Understand the types, advantages and applications of various NDT methods. 			
Modules			Revised Bloom's Taxonomy (RBT) Level
1. Hardness Testing – Vicker's, Brinell, Rockwel			L1, L2, L3
2. Tensile Test			L1, L2, L3, L4, L5
3. Flexural Test			L1, L2, L3, L4, L5
4. Torsional Test			L1, L2, L3
5. Impact Test			L1, L2, L3
6. Shear Test			L1, L2, L3
7. Fatigue Test			L1, L2, L3, L4, L5
8. Preparation of specimen for metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & metal matrix composites			L1, L2, L3
9. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.			L1, L2, L3
10. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.			L1, L2, L3
11. Visual Testing Technique, Dye penetration testing. To study the defects of Cast and Welded specimens.			L1, L2, L3

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12. Magnetic Particle Inspection.	L1, L2, L3
13. Ultrasonic Inspection.	L1, L2, L3
14. Eddy Current Inspection	L1, L2, L3
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Apply the relations among materials and their properties. 2. Differentiate the formation, properties and significance of the alloys through different experiments. 3. Differentiate the types, advantages and applications of various NDT methods. 	
<p>Conduct of Practical Examination:</p> <ol style="list-style-type: none"> 1. All laboratory experiments are to be included for practical examination. 2. Students are allowed to pick one experiment from the lot. 3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks. 4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. 	
<p>Graduate Attributes (as per NBA):</p> <ul style="list-style-type: none"> • Engineering Knowledge. • Problem Analysis. • Design / development of solutions (partly) • Interpretation of data. 	

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MACHINE SHOP LAB			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	14AEL38	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	42	Exam Marks	80
CREDITS – 04			
<p>Course objectives: This course will enable students to</p> <ol style="list-style-type: none"> 1. Practice general-purpose machine tools and manufacturing process. 2. Operate the special purpose machine tools 3. Prepare physical models using different manufacturing processes. 			
Modules			Revised Bloom's Taxonomy (RBT) Level
1. Introduction to Machining operations & tools (i.e. Lath machine & shaper machine etc.)			L1, L2
2. Machining and machining time estimation for plain turning, taper turning & step turning.			L1, L2, L3
3. Machining and machining time estimation for thread cutting			L1, L2, L3
4. Machining and machining time estimation for knurling			L1, L2, L3
5. Machining and machining time estimation for knurling operation			L1, L2, L3
6. Machining and machining time estimation for drilling operation			L1, L2, L3
7. Machining and machining time estimation for boring operation			L1, L2, L3
8. Machining and machining time estimation for internal thread cutting			L1, L2, L3
9. Machining and machining time estimation for external thread cutting			L1, L2, L3
10. Machining and machining time estimation for eccentric turning			L1, L2, L3
11. Machining of hexagon in shaping machine			L1, L2, L3
12. Machining of square in shaping machine			L1, L2, L3
13. Cutting of gear teeth using milling machine			L1, L2, L3
14. Grinding operations using grinding machine.			L1, L2, L3
<p>Course outcomes:</p> <p>After studying this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate the operation of general purpose machine tools and manufacturing process. 			

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2. Identify the special purpose machine tools for specific requirements
3. Develop physical models using different manufacturing processes.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly)
- Interpretation of data.

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