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

B.E. AERONAUTICAL ENGINEERING

III SEMESTER

Sl. No	Subject Code	Title	Teaching Dept.	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Drawing	Duration	Theory / Practical Marks	I.A. Marks	Total Marks	
1	15MAT31	ENGIINEERING MATHEMATICS -III	Mathematics	04		03	80	20	100	4
2	15AE32	ELEMENTS OF AERONAUTICS		04		03	80	20	100	4
3	15AE33	AERO THERMODYNAMICS		04		03	80	20	100	4
4	15AE34	MECHANICS OF MATERIALS		04		03	80	20	100	4
5	15AE35	MECHANICS OF FLUIDS		04		03	80	20	100	4
6	15AE36 X	**ELECTIVE**		03		03	80	20	100	3
7	15AEL37A/ 15AEL37B	MEASUREMENT AND METROLOGY LAB/ MATERIAL TESTING LAB			1I+2P	03	80	20	100	2
8	15AEL38	MACHINE SHOP LAB			1I+2P	03	80	20	100	2
TOTAL				**23**	**6**	**24**	**640**	**160**	**800**	**27**

Elective			
15AE361	AIRCRAFT PRODUCTION TECHNOLOGY	15AE363	MEASUREMENT & METROLOGY
15AE362	AIRCRAFT MATERIALS	15AE364	HYDRAULICS & PNEUMATICS

1. Core subject: This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

2a. Foundation Course: The courses based upon the content that leads to Knowledge enhancement.

2b. Foundation Elective: Elective Foundation courses are value-based and are aimed at man-making education

3. Elective: This is the course, which can be chosen from the pool of papers. It may be supportive to the discipline/providing extended scope/Enabling an Exposure to some other discipline/domain/nurturing student proficiency skills**.**

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

IV SEMESTER

Sl. No	Subject Code	Title	Teaching Dept.	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks	Total Marks	
1	15MAT 41	ENGINEERING MATHEMATICS-IV	Mathematics	04		03	80	20	100	4
2	15AE42/15AS42	AERODYNAMICS - I		04		03	80	20	100	4
3	15AE43	AIRCRAFT PROPULSION		04		03	80	20	100	4
4	15AE44	MECHANISMS AND MACHINE THEORY		04		03	80	20	100	4
5	15AE 45/15AE45	AIRCRAFT MATERIAL SCIENCE		04		03	80	20	100	4
6	15AE46X	**ELECTIVE**		03		03	80	20	100	3
7	15AEL47A/ 15AEL47B	MATERIAL TESTING LAB/ MEASUREMENT AND METROLOGY LAB			1I+2P	03	80	20	100	2
8	15AEL48	COMPUTER AIDED AIRCRAFT DRAWING			1I+2P	03	80	20	100	2
TOTAL				**23**	**06**	**24**	**640**	**160**	**800**	**27**

Elective			
15AE461	TURBOMACHINES	15AE463	THEORY OF ELASTICITY
15AE462	EXPERIMENTAL STRESS ANALYSIS	15AE464	MANAGEMENT AND ENTREPRENEURSHIP

1. Core subject: This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

2a. Foundation Course: The courses based upon the content that leads to Knowledge enhancement.

2b. Foundation Elective: Elective Foundation courses are value-based and are aimed at man-making education

3. **Elective**: This is the course, which can be chosen from the pool of papers. It may be supportive to the discipline/Providing extended scope/ Enabling an Exposure to some other discipline/domain /nurturing student proficiency skills.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
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SCHEME OF TEACHING AND EXAMINATION 2015-2016

Semester III
Engineering Mathematics III

Course Code: **15MAT31**	**IA Marks: 20**
Hours/Week: 4 hours	**Exam Hours: 03**
Total Hours: 50	**Exam Marks: 80**

Course Learning Objectives

The objective of this course is to introduce students to the mostly used analytical and numerical methods in the different engineering fields by making them to learn the following topics

- Fourier Series
- Fourier transforms and Z-Transforms
- Statistical methods
- Numerical methods to solve algebraic and transcendental equations
- Vector integration and calculus of variation

Module 1 **10 hrs**

Fourier Series:

Periodic functions, Dirichlet's condition, Fourier Series of Periodic functions with period 2π and with arbitrary period 2c, Fourier series of even and odd functions, Half range Fourier Series, practical Harmonic analysis. Complex Fourier series.

Module 2 **10 hrs**

Fourier Transforms: Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse transform.

Z-transform: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping rule, Shifting rule, Initial value and final value theorems (without proof) and problems, Inverse z-transform. Applications of z-transforms to solve difference equations.

Module 3 **10 hrs**

Statistical Methods: Correlation and rank Correlation coefficients, Regression and Regression coefficients, lines of regression - problems **Curve fitting:** Curve fitting by the method of least squares, Fitting of the curves of the form, $y = ax + b, y = ax^2 + bx + c, y = ae^{bx}, y = ax^b$.. **Numerical Methods:** Numerical solution of algebraic and transcendental equations by: Regular-falsi method, Secant method, Newton - Raphson method and Graphical method.

Module 4 **10 hrs**

Finite differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences-Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula. Central Difference-Stirling's and Bessel's formulae (all formulae without proof)-Problems. **Numerical integration**: Simpson's 1/3, 3/8 rule, Weddle's rule (without proof) -Problems

Module 5 **10 hrs**

Vector integration:

Line integrals-definition and problems, surface and volume integrals-definition, Green's theorem in a plane, Stokes and Gauss-divergence theorem(without proof) and

problems.

Calculus of Variations: Variation of function and Functional, variational problems, Euler's equation, Geodesics, minimal surface of revolution, hanging chain, problems

Course outcomes:

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

- Know the use of periodic signals and Fourier series to analyze circuits
- Explain the general linear system theory for continuous-time signals and systems using the Fourier Transform
- Analyze discrete-time systems using convolution and the z-transform
- Use appropriate numerical methods to solve algebraic and transcendental equations and also to calculate a definite integral
- Use curl and divergence of a vector function in three dimensions, as well as apply the Green's Theorem, Divergence Theorem and Stokes' theorem in various applications
- Solve the simple problem of the calculus of variations

TEXT BOOKS:

1. B.S. Grewal – *"Higher Engineering Mathematics"*, Khanna Publishers, 42nd Edition, 2013
2. B.V.Ramana – *"Higher Engineering Mathematics"*, Tata Mc Graw-Hill, 2006

REFERENCE BOOKS

1. N P Bali and Manish Goyal, *"A text book of Engineering mathematics"* , Laxmi publications, latest edition.
2. Kreyszig, *"Advanced Engineering Mathematics"* - 9th edition, Wiley, 2013
3. H. K Dass and Er. Rajnish Verma , *"Higher Engineering Mathematics"*, S. Chand publishing, 1st edition, 2011.

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

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 **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. **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.	**10 Hours**	**L1, L2**
Module -2 **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.	**10 Hours**	**L1, L2**
Module -3 **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 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	**10 Hours**	**L1, L2, L3**

different types of propulsion engines; principle of thrust augmentation.		
Module -4 **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 stats 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.	**10 Hours**	**L1, L2**
Module -5 **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. **Aircraft systems (Mechanical)** – hydraulic and pneumatic systems and their applications; environment control system; fuel system, oxygen system. **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.	**10 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

1. Appreciate and apply the basic principle of aviation
2. Apply the concepts of fundaments 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.

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. 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; ISBH: 1118174208, 9781118174203.

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

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

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 evacuation of vessels with and without heat transfer.	**10 Hours**	**L1, L2, L3**

Module -3 **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. **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.	**10 Hours**	**L1, L2**
Module -4 **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. **Thermodynamic relations** Maxwells equations, Tds relations, ratio of heat capacities, evaluation of thermodynamic properties from an equation of state	**10 Hours**	**L1, L2, L3**
Module -5 **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.	**10 Hours**	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

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

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.

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

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

Course objectives: This course will enable students to

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
Module -1 **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. **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.	**10 Hours**	**L1, L2**
Module -2 **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. **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.	**10 Hours**	**L1, L2. L3**
Module -3 **Torsion:** Torsion of circular cylinders , Torsion combined with axial force and bending moments, Torsion of bars with arbitrary cross-sections, Torsion of a thin rectangular cross-section, Torsion of thin-	**10 Hours**	**L1, L2, L3**

walled open sections. **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.		
Module -4 **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. **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.	**10 Hours**	**L1, L2, L3, L4**
Module -5 **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. **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.	**10 Hours**	**L1, L2, L3**
Course outcomes: After studying this course, students will be able to: 1. Apply the basic concepts of strength of materials. 2. Compute stress, strain under different loadings. 3. Distinguish the different failure theories .		
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. 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

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

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

Course objectives: This course will enable students to

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
Module -1 **Basic Considerations:** Introduction, Dimensions- Modules and physical quantities, Continuum view of gases and liquids, Pressure and Temperature scales, Physical properties of fluids. **Fluid Statics:** Pressure distribution in a static fluid, Pressure and its measurement, hydrostatic forces on plane and curved surfaces, buoyancy, illustration by examples.	**10 Hours**	**L1, L2**
Module -2 **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. **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).	**10 Hours**	**L1, L2**
Module -3 **Fluid Dynamics:** Equations of motion: Euler's and Bernoulli's equation of motion for ideal and real fluids. Momentum equation, Fluid flow measurements. Numerical problems.	**10 Hours**	**L1, L2**

Dimensional analysis and similarity: Dimensional homogeneity, methods of dimensional analysis, model analysis, types of similarity and similitude. Dimensionless numbers. Model laws. Numerical problems.		
Module -4 **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.	**10 Hours**	**L1, L2, L3**
Module -5 **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.	**10 Hours**	**L1, L2, L3. L4**
Course outcomes: After studying this course, students will be able to: 1. Evaluate the effect of fluid properties. 2. Apply the governing laws of fluid flow. 3. Classify different types of fluid flows.		
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. Bansal, R.K, "*Fluid Mechanics and Hydraulics Machines*", Laxmi Publications (P) Ltd., New Delhi 2015, ISBN-13: 978-8131808153. 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

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

Aircraft Production Technology

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III
Elective

Subject Code	**15AE361**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the processes of casting, forging and extrusion,
2. Understand different metal cutting and joining processes.
3. Acquire knowledge on limits, fits and tolerances

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Casting Processes** Melting, refining and alloying, classification of casting processes – green sand, centrifugal cast, pressure cast, continuous casting; advantages and limitations; Sand moulding, Pressure die-casting process.	**6 Hours**	**L1, L2**
Module -2 **Forging and Extrusion Processes** Classification of forging processes, forging machines and equipments, expressions for forging pressure and load in open and die forging, flow lines, microstructure; Types of extrusions, equipments and moulds, deformation, microstructure and defects, products.	**6 Hours**	**L1, L2**
Module -3 **Metal Cutting** Machine tools and cutting tools; review of engine lathe parts and functions, single point cutting tool – nomenclature; orthogonal and oblique cutting, mechanism of chip formation, types of chips, merchants analysis, tool wear and tool failure, effect of machining parameters, tool life, heat generation, cutting fluids, machinability index;	**8 Hours**	**L1, L2, L3, L4**
Module -4 **Milling & Grinding Machines** Classification and construction features of milling machine, milling cutter nomenclature, milling operations, simple and compound differential and angular indexing; **Grinding Machines –** Types of abrasives, classification of grinding machines – internal, external,	**10 Hours**	**L1, L2**

surface, centerless, **Limits, Fits and Tolerances** Definition of tolerance, principle of interchangeability and selective assembly, dimensioning – geometrical and form tolerances, types of tolerances, types of fits – hole and shaft basis, gauges for measurement.		
Module -5 **Sheet Metal Processes** Rolling process, classification of sheet metals, processes – shearing, punching, blanking, bending, machines – manual, hydraulic, electric, turret punch, laser cutting, sheet metal calculations, layouts and case studies **Welding & Joining Technologies** Different types of joining technologies for metals – welding, brazing, soldering; selection of material for welding, process parameters and its effect on microstructure and weld quality; defects in welding	**10 Hours**	**L1, L2, L3. L4**

Course outcomes:

After studying this course, students will be able to:

1. Apply the processes of casting, forging and extrusion,
2. Distinguish different metal cutting and joining processes .
3. Apply the concepts of limits, fits and tolerances

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. Roy A Lindberg, "*Manufacturing Process and Materials of Manufacture*", Prentice Hall of India, 4th Edn. 1990, ISBN 13: 9788120306639.
2. P N Rao, "*Manufacturing Technology*", Tata McGraw Hill, 2008, ISBN 13: 9781259062575.

Reference Books:

1. S.K.Hajra Choudhury, "*Elements of Workshop Technology*", Media Promoters, 2009, ISBN-13:

978-0906216019.
2. G.Boothroyd "*Fundamental of Metal Machining*", McGraw Hill, 2005, ISBN 13: 9780070064980.

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

Aircraft Materials

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III
Elective

Subject Code	**15AE362**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Understand different materials with their properties and various heat treatment processes of aircraft materials and alloys
2. Understand the effects and protection against corrosion of aircraft materials .
3. Understand the characteristics and applications of aluminum alloys and composites

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Elements Of Material Science** Structure of solid materials - Atomic structure, crystal structure, Imperfections in crystals.	**8 Hours**	**L1, L2**
Module -2 **Mechanical Behavior of Engineering Materials** Linear and non-linear elastic properties - Mechanism of elastic and inelastic action - Yielding, strain hardening, fracture, Elastic after effect Bauchinger's effect - Notch effect, Testing and flaw detection of material and components	**8 Hours**	**L1, L2, L3**
Module -3 **Heat Treatment and Corrosion** Heat treatment of carbon steel, aluminum alloys, magnesium alloys and titanium alloys used in aircraft. Types of corrosions - Effect of corrosion on mechanical properties - Protection against corrosion - Corrosion resistant materials used in aircraft.	**8 Hours**	**L1, L2, L3, L4**
Module -4 **Aluminum Alloys and Composites** Introduction - Physical Metallurgy - Wrought Aluminum Alloys - Cast Aluminum Alloys - Production of Semi- fabricated forms - Aerospace Applications - Plastics and Rubber - Introduction to FRP, Glass and Carbon Composites - Fibres and Resins - Characteristics and applications	**8 Hours**	**L1, L2, L3, L4, L5**
Module -5	**8 Hours**	**L1, L2, L3**

Selection of Materials for Aircraft and Rockets Classification of aircraft materials - Materials used for aircraft components - Application of Composite materials - Super alloys, Indigenized alloys. Emerging trends in Aerospace materials		

Course outcomes:

After studying this course, students will be able to:

1. Have knowledge about the mechanical behavior of different aircraft materials and their applications.
2. Distinguish different materials with their properties and various heat treatment processes of aircraft materials and alloys
3. Apply aluminum alloys and composite materials appropriately.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. S.O.Kasap, Principles of Electronic Materials and Devices, Tata McGraw Hill Edition, New Delhi, 2002, ISBN : 9780072957914
2. Van Vlack, L.H., Material Science for Engineers, 6th edition, Addison Wesley, 1985, ISBN-13: 978-0201093148

Reference Books:

1. Martin, J.W., "Engineering Materials, Their Properties, and Applications ", Wykedham Publications (London) Ltd., 1987, ISBN-13: 978-1259007361
2. Titterton, G., "Aircraft Materials and Processes ", V Edition, Pitman Publishing Co., 1995, ISBN-13: 9788175980136

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

Measurement and Metrology

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III
Elective

Subject Code	**15AE363**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

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
Module -1 **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.	**8 Hours**	**L1, L2, L3**
Module -2 **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.	**8 Hours**	**L1, L2**
Module -3 **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 Comparators. Angular measurements, Bevel Protractor, Sine Principle	**8 Hours**	**L1, L2, L3**

and. use of Sine bars, Sine center, use of angle gauges, Clinometers, **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.		
Module -4 **Measurements and Measurement systems:** Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hystersis, 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.	**8 Hours**	**L1, L2, L3**
Module -5 **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. **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	**8 Hours**	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

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

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. 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. Alsutko, Jerry. D.Faulk "*Industrial Instrumentation*", Thompson Asia Pvt. Ltd.2002, ISBN-13: 978-0827361256

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

Hydraulics & Pneumatics

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III
Elective

Subject Code	**15AE364**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Acquire the knowledge of hydraulic power, actuators, motors and different control components and circuit design and analysis
2. Understand the maintenance of hydraulic systems and pneumatic control.
3. Learn the applications of different multi-cylinder systems.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction To Hydraulic Power** : Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. **Hydraulic Actuators and Motors:** Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.	**8 Hours**	**L1, L2, L3**
Module -2 **Control Components In Hydraulic Systems:** Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. **Hydraulic Circuit Design And Analysis:** Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.	**8 Hours**	**L1, L2, L3, L4**

Module -3 **Maintenance of Hydraulic Systems:** Hydraulic oils; Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting. **Introduction to Pneumatic Control:** Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod–less cylinders, types, working advantages. Rotary cylinder types construction and application. Design parameters, selection.	**8 Hours**	**L1, L2, L3**
Module -4 **Directional Control Valves:** Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the sue of logic gates. Pressure dependent controls types construction– practical applications. Time dependent controls – Principle, construction, practical applications.	**8 Hours**	**L1, L2, L3**
Module -5 **Multi-Cylinder Applications:** Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). Electro-Pneumatic control: Principles-signal input and out put pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout.	**8 Hours**	**L1, L2, L3, L4**

Course outcomes:

After studying this course, students will be able to:

1. Apply the knowledge of hydraulic power, actuators, motors and different control components and circuit design and analysis
2. Select appropriate hydraulic systems and pneumatic control.
3. Analyse the different multi-cylinder systems

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. Anthony Esposito**, "***Fluid Power with applications***",** Pearson; 7 edition (May 26, 2008), ISBN-13: 978-0135136904
2. Andrew Parr**, "***Pneumatics and Hydraulics***",** Butterworth-Heinemann; 3 edition 2011), ISBN-13: 978-0080966748**.**

Reference Books:

1. S.R. Majumdar, "Oil Hydraulic Systems - Principles and Maintenance", Tata Mc Graw Hill publishing company Ltd. 2002, ISBN-13: 978-0071406697
2. S.R. Majumdar, "Pneumatic Systems", Tata Mc Graw Hill publishing Co., 1995, ISBN 13: 9780074602317
3. **Pippenger, John H., Hicks, Tyler Gregory**, "Industrial Hydraulics", McGraw Hill, New York 1979, ISBN 13: 9780070501409

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

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

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**
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:

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:

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
- Interpretation of data.

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

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

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 metallograpic 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**
12. Magnetic Particle Inspection.	**L1, L2, L3**

13. Ultrasonic Inspection.	**L1, L2, L3**
14. Eddy Current Inspection	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

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.

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.

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

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

Course objectives: This course will enable students to

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**

Course outcomes:

After studying this course, students will be able to:

1. Demonstrate the operation of general purpose machine tools and manufacturing process.
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.

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

Course Code: 15MAT41	**IA Marks: 20**
Hours/Week: 4 hours	**Exam Hours: 03**
Total Hours: 50	**Exam Marks: 80**

Course Learning Objectives:

The objective is to provide students with mathematics fundamental, necessary to formulate, solve and analyze engineering problems by making them to learn the following topics

- Numerical methods to solve ordinary differential equations
- Finite difference method to solve partial differential equations
- Complex analysis
- Sampling theory
- Joint probability distribution and stochastic process

Module 1 **10 Hrs**

Numerical Methods : Numerical solution of ordinary differential equations of first order and first degree, Picard's method, Taylor's series method, modified Euler's method, Runge - Kutta method of fourth order. Milne's and Adams-Bashforth predictor and corrector methods (No derivations of formulae).

Numerical solution of simultaneous first order ordinary differential equations, Picard's method, Runge-Kutta method of fourth order.

Module 2 **10 Hrs**

Numerical Methods :Numerical solution of second order ordinary differential equations, Picard's method, Runge-Kutta method and Milne's method

Special Functions: Bessel's functions- basic properties, recurrence relations, orthogonality and generating functions. Legendre's functions - Legendre's polynomial, Rodrigue's formula, problems.

Module 3 **10 hrs**

Complex Variables: Function of a complex variable, limits, continuity, differentiability,. Analytic functions-Cauchy-Riemann equations in Cartesian and polar forms. Properties and construction of analytic functions. Complex line integrals-Cauchy's theorem and Cauchy's integral formula, Residue, poles, Cauchy's Residue theorem with proof and problems.

Transformations: Conformal transformations, discussion of transformations:$w = z^2, w = e^z, w = z + (a^2/z)$ and bilinear transformations.

Module 4 **10 hrs**

Probability Distributions: Random variables(discrete and continuous), probability functions. Binomial distribution, Poisson distribution**,** geometric distribution, uniform distribution, Exponential and normal distributions, Problems.

Joint probability distribution: Joint Probability distribution for two variables, expectation, covariance, correlation coefficient.

Module 5 **10 hrs**

Sampling Theory: Sampling, Sampling distributions, standard error, test of hypothesis for

means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

Stochastic process
Stochastic process, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability.

Course outcomes:

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

1. Use appropriate numerical methods to solve first and second order ordinary differential equations.
2. Use Bessel's and Legendre's function which often arises when a problem possesses axial and spherical symmetry, such as in quantum mechanics, electromagnetic theory, hydrodynamics and heat conduction.
3. State and prove Cauchy's theorem and its consequences including Cauchy's integral formula, compute residues and apply the residue theorem to evaluate integrals.
4. Analyze, interpret, and evaluate scientific hypotheses and theories using rigorous statistical methods .

TEXT BOOKS:

1. B.V.Ramana "Higher Engineering Mathematics" Tata Mc Graw-Hill, 2006
2. B.S. Grewal – "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2013,

REFERENCE BOOKS

1. N P Bali and Manish Goyal, "A text book of Engineering mathematics" , Laxmi publications, latest edition.
2. Kreyszig, "Advanced Engineering Mathematics " - 9th edition, Wiley, 2013
3. H. K Dass and Er. Rajnish Verma ,"Higher Engineering Mathematics", S. Chand publishing, 1st edition, 2011.

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

Aerodynamics-I

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AE42**	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

1. Understand the basics of fluid mechanics as a prerequisite to Aerodynamics
2. Acquire knowledge on typical airfoil characteristics and two-dimensional flows over airfoil and study the incompressible over finite wings
3. Assimilate the understanding of application of finite wing theory and high lift systems

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Review of Basic Fluid Mechanics** Continuity, momentum and energy equation, Control volume approach to Continuity, momentum and energy equation, Types of flow, pathlines, streamlines, and streaklines, units and dimensions, inviscid and viscous flows, compressibility, Mach number regimes. Vorticity, Angular velocity, Stream function, velocity potential function, Circulation, Numericals, Mach cone and Mach angle, Speed of sound.	**10 Hours**	**L1, L2**
Module -2 **Airfoil Characteristics** Fundamental aerodynamic variables, Airfoil nomenclature, airfoil characteristics. wing planform geometry, aerodynamic forces and moments, centre of pressure, pressure coefficient, aerodynamic center, calculation of airfoil lift and drag from measured surface pressure distributions, typical airfoil aerodynamic characteristics at low speeds. Types of drag-Definitions.	**10 Hours**	**L1, L2**
Module -3 **Two Dimensional Flows & Incompressible Flow Over Airfoil** Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow . Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder. Kutta-Joukowski theorem and generation of Lift, D'Alembert's paradox, Numericals, **Incompressible flow over airfoils:** Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Classical thin airfoil theory for symmetric and cambered airfoils. Kutta-Joukowski theorem and generation of Lift, Numericals.	**10 Hours**	**L1, L2, L3, L4, L5**

Module -4 **Incompressible Flow Over Finite Wings** Biot-Savart law and Helmholtz's theorems, Vortex filament: Infinite and semi-infinite vortex filament, Induced velocity. Prandtl's classical lifting line theory: Downwash and induced drag. Elliptical and modified elliptical lift distribution. Lift distribution on wings. Limitations of Prandtl's lifting line theory. Extended lifting line theory-lifting surface theory, vortex lattice method for wings. Lift, drag and moment characteristics of complete airplane.	**10 Hours**	**L1, L2**
Module -5 **Applications of Finite Wing Theory & High Lift Systems** Simplified horse-shoe vortex model, formation flight, influence of downwash on tail plane, ground effects. Swept wings: Introduction to sweep effects, swept wings, pressure coefficient, typical aerodynamic characteristics, Subsonic and Supersonic leading edges. Introduction to high-lift systems, flaps, leading-edge slats and typical high – lift characteristics. critical Mach numbers, Lift and drag divergence, shock induced separation, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects. Introduction to Source panel & vortex latice method.	**10 Hours**	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

1. Evaluate typical airfoil characteristics and two-dimensional flows over airfoil
2. Compute and analyse the incompressible flow over finite wings
3. Apply finite wing theory and design high lift systems from the aerodynamics view point

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. Anderson J .D, "*Fundamental of Aerodynamics*", 5th edition, McGraw-Hill International Edition, New York **(**2011), ISBN-13: 978-0073398105.

2. E. L. Houghton, P.W. Carpenter, "Aerodynamics for Engineering Students", 5th edition, Elsevier, New York. (2010), ISBN-13: 978-0080966328

Reference Books:

1. Clancy L. J. "*Aerodynamics*", Sterling book house, New Delhi. (2006), ISBN 13: 9780582988804
2. Louis M. Milne-Thomson, "*Theoretical Aerodynamics*", Imported Edition, Dover Publications, USA (2011), ISBN 9780486619804.

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

Aircraft Propulsion

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AE43**	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

1. Understand the basic principle and theory of aircraft propulsion.
2. Understand the purpose of a centrifugal, axial compressors , axial and radial turbines
3. Acquire knowledge of importance of nozzles & inlets and combustion chamber

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction:** Review of thermodynamic principles, Principles of aircraft propulsion, Types of power plants, Working principles of internal combustion engine, Two – stroke and four – stroke piston engines, Gas- turbine engines, Cycle analysis of reciprocating engines and jet engines , advantages and disadvantages.	**10 Hours**	**L1, L2**
Module -2 **Propeller Theories & Jet propulsion** Types of propeller, Propeller thrust: momentum theory, Blade element theories, propeller blade design, propeller selection. **Jet Propulsion:** Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics.	**10 Hours**	**L1, L2, L3, L4**
Module -3 **Inlets & Nozzles** Internal flow and Stall in Subsonic inlets, Boundary layer separation. Major features of external flow near a subsonic inlet. Relation between minimum area ratio and eternal deceleration ratio. Diffuser performance. **Supersonic inlets:** Supersonic inlets, starting problem in supersonic inlets, Shock swallowing by area variation, External deceleration. Modes of inlet operation. **Nozzles:** Theory of flow in isentropic nozzles, Convergent nozzles and	**10 Hours**	**L1, L2**

nozzle choking, Nozzle throat conditions. Nozzle efficiency, Losses in nozzles. Over-expanded and under-expanded nozzles, Ejector and variable area nozzles, Thrust reversal.		
Module -4 **Gas Turbine Engine Compressors** **Centrifugal compressors:** Principle of operation of centrifugal compressors. Work done and pressure rise -Velocity diagrams, Diffuser vane design considerations. performance characteristics. Concept of Pre-whirl, Rotating stall. **Axial flow compressors:** Elementary theory of axial flow compressor, Velocity triangles, Degree of reaction, three dimensional flow. Air angle distribution for free vortex and constant reaction designs, Compressor blade design. Axial compressor performance characteristics.	**10 Hours**	**L1, L2, L3, L4**
Module -5 **Combustion chambers and Turbines** Classification of combustion chambers, important factors affecting combustion chamber design, Combustion process, Combustion chamber performance Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders **Axial Flow Turbines:** Introduction, Turbine stage, Multi-staging of turbine, Exit flow conditions, Turbine cooling, Heat transfer in turbine cooling. **Radial turbine**: Introduction, Thermodynamics of radial turbines, Losses and efficiency	**10 Hours**	**L1, L2, L3, L4**

Course outcomes:

After studying this course, students will be able to:

1. Apply the basic principle and theory of aircraft propulsion.
2. Explain the functions of centrifugal, axial compressors , axial and radial turbines
3. Analyse the performance of nozzles & inlets and combustion chamber

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. Bhaskar Roy, "*Aircraft propulsion*", Elsevier (2011), ISBN-13: 9788131214213
2. V. Ganesan, "*Gas Turbines*", Tata McGraw-Hill, 2010, New Delhi, India, ISBN: 0070681929, 9780070681927

Reference Books:

1. Hill, P.G. & Peterson, C.R., "*Mechanics & Thermodynamics of Propulsion*" Addison – Wesley Longman INC, 1999, ISBN-13: 978-0201146592.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H., "*Gas Turbine Theory*", Longman, 1989, ISBN 13: 9780582236325.
3. Irwin E. Treager, "*Gas Turbine Engine Technology*" GLENCOE Aviation Technology Series, 7th Edition, Tata McGraw Hill PublishingCo.Ltd. Print 2003, ISBN-13: 978-0028018287
4. S. M. Yahya(2010), "*Fundamentals of Compressible Flow with Aircraft and Rocket propulsion*", 4th Edition, New Age International Publications, New Delhi 2014, ISBN 13: 9788122426687.

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

Mechanisms and Machine Theory

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AE44**	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

1. Understand the theory of mechanisms including velocity, acceleration and static force analysis.
2. Acquire knowledge of spur gears, gear train, balancing of rotating and reciprocating masses.
3. Understand the concept of governors and gyroscope

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction to Mechanisms:** Types of constrained motion, Link and its types, joints and its types, kinematic pair and its types, degrees of freedom, Grubler's criterion, Types of kinematic chains and inversions: Inversions of Four bar chain: Beam engine, coupling rod of a locomotive, Watt's indicator mechanism. Inversions of Single Slider Crank Chain: Pendulum pump or Bull engine, Oscillating cylinder engine, Rotary internal combustion engine, Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism. Inversions of Double Slider Crank Chain: Elliptical trammels, Scotch yoke mechanism, Oldham's coupling. Straight line motion mechanisms: Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism and Ratchet and Pawl mechanism, Ackerman steering gear mechanism.	**10 Hours**	**L1, L2**
Module -2 **Velocity, Acceleration and static force analysis of Mechanisms (Graphical Methods):** Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons. **Static force analysis:** Introduction: Static equilibrium, Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams, principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.	**10 Hours**	**L1, L2, L3, L4**
Module -3 **Spur Gears and Gear Trains**	**10 Hours**	**L1, L2, L3, L4**

Spur Gears: Gear terminology, law of gearing, Path of contact, Arc of contact, Contact ratio of spur gear, Interference in involute gears, Methods of avoiding interference. **Gear Trains:** Simple gear trains, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Analysis of epicyclic gear train (Algebraic and tabular methods), torques in epicyclic trains.		
Module -4 **Balancing of Rotating and Reciprocating Masses** **Balancing of Rotating Masses:** Balancing of Several Masses Rotating in the Same Plane, Balancing of Several Masses Rotating in Different Planes (only Graphical Methods). **Balancing of Reciprocating Masses:** Primary and Secondary Unbalanced Forces of Reciprocating Masses, Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine, Balancing of Primary and secondary Forces of Multi-cylinder In-line Engines, Balancing of Radial Engines (only Graphical Methods)	**10 Hours**	**L1, L2, L3, L4**
Module -5 **Governors and Gyroscope** **Governors:** Types of governors; force analysis of Porter and Hartnell governors, Controlling force, stability, sensitiveness, isochronism, effort and power of Porter and Hartnell governors. **Gyroscopes:** Vectorial representation of angular motion, gyroscopic couple, effect of gyroscopic couple on plane disc and aeroplane	**10 Hours**	**L1, L2, L3, L4**

Course outcomes:

After studying this course, students will be able to:

1. Apply the theory of velocity, acceleration and static force analysis to design of mechanisms.
2. Design spur gears, gear train, balancing of rotating and reciprocating masses.
3. Apply governors and gyroscope

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. **Rattan S.S**, "*Theory of Machines*", Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009, ISBN: 007014477X, 9780070144774.
2. **J.J. Uicker, G.R. Pennock, J.E. Shigley.** "*Theory of Machines & Mechanisms*", OXFORD 3rd Ed. 2009, ISBN-13: 978-0195371239

Reference Books:

1. **R. S. Khurmi, J.K. Gupta,** "*Theory of Machines*", Eurasia Publishing House, 2008, ISBN 13: 9788121925242.
2. **Robert L Norton,** "*Design of Machinery*" by McGraw Hill, 2001, **ISBN-13:** 978-0077421717.
3. Ambekar, "*Mechanism and Machine theory*", PHI Learning Pvt. Ltd., 2007, ISBN 13: 9788120331341

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

Aircraft Material Science

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AE45**	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

1. Acquire knowledge on aircraft materials- metallic and non-metallic
2. Understand the properties of super alloys, ablative materials and high energy material.
3. Study material corrosion and prevention

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction to Aircraft Materials** General properties of materials, Definition of terms, Requirements of aircraft materials, Testing of aircraft materials, Inspection methods, Application and trends in usage in aircraft structures and engines, Selection of materials for use in aircraft. **Aircraft Metal Alloys** Aluminum alloys, Magnesium alloys, Titanium alloys, Plain carbon and Low carbon Steels, Corrosion and Heat resistant steels, Maraging steels, Copper alloys, Producibility and Surface treatments aspects for each of the above;	**10 Hours**	**L1, L2**
Module -2 **Super Alloys** General introduction to super alloys, Nickel based super alloys, Cobalt based super alloys, and Iron based super alloys, manufacturing processes associated with super alloys, Heat treatment and surface treatment of super alloys. **Composite Materials:** Definition and comparison of composites with conventional monolithic materials, Reinforcing fibers and Matrix materials, Fabrication of composites and quality control aspects, Carbon-Carbon Composites production, properties and applications, inter metallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminum, magnesium, titanium and nickel based composites for engines.	**10 Hours**	**L1, L2**
Module -3 **Polymers, Polymeric Materials & Plastics and Ceramics & Glass** Knowledge and identification of physical characteristics of commonly	**10 Hours**	**L1, L2**

used polymeric material: plastics and its categories, properties and applications; commonly used ceramic, glass and transparent plastics, properties and applications, adhesives and sealants and their applications in aircraft.		
Module -4 **Ablative Materials** Ablation process, ablative materials and applications in aerospace. **Aircraft Wood, Rubber, Fabrics & Dope And Paint:** Classification and properties of wood, Seasoning of wood, Aircraft woods, their properties and applications, Joining processes for wood, Plywood; Characteristics and definition of terminologies pertaining to aircraft fabrics and their applications, Purpose of doping and commonly used dopes; Purpose of painting, Types of aircraft paints, Aircraft painting process.	**10 Hours**	**L1, L2**
Module -5 **Corrosion and its Prevention** Knowledge of the various methods used for removal of corrosion from common aircraft metals and methods employed to prevent corrosion. **High Energy Materials:** Materials for rockets and missiles. Types of propellants and its general and desirable properties, insulating materials for cryogenic engines. Types of solid propellants: Mechanical characterization of solid propellants using uni-axial, strip-biaxial and tubular tests.	**10 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

1. Identify appropriate aircraft materials for a given application.
2. Explain the properties of super alloys, ablative materials and high energy material.
3. Understand material corrosion process and apply prevention technique.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. **Titterton G F** , "*Aircraft Material and Processes*", English Book Store, New Delhi, 1998, ISBN 13: 9788175980136
2. **H Buhl**, "*Advanced Aerospace Material*", Spring Berlin 1992, ISBN: 978-3-642-50161-6

Reference Books:

1. **C G Krishnadas Nair,** "*Handbook of Aircraft materials*", Interline publishers, Bangalore, 1993, ISBN 13: 9788172960032.
2. **Balram Gupta, S**, "*Aerospace material"* Vol. 1,2,3 ARDB, Chand & Co 1996, ISBN: 9788121922005
3. **Parker E R**, "*Materials for Missiles and Space*", John Wiley, McGraw-Hill, 1963,
4. 4.**Hill E T**, The "*Materials of Aircraft Construction*", Pitman London.

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

Turbomachines

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV
Elective

Subject Code	**15AE461**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the basics of turbomachines, the energy transfer and energy transformation in them.
2. Acquire the knowledge on design of centrifugal and axial turbomachines
3. Study hydraulic pumps and turbines.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction to turbomachines:** Classification and parts of a turbo machines; comparison with positive displacement machines; dimensionless parameters and their physical significance; specific speed; illustrative examples on dimensional analysis and model studies. **Energy transfer in turbomachines:** Basic Euler turbine equation and its alternate form; components of energy transfer; general expression for degree of reaction; construction of velocity triangles for different values of degree of reaction. .	**10 Hours**	**L1, L2**
Module -2 **Compression process:** Overall isentropic efficiency of compression; stage efficiency; comparison and relation between overall efficiency and stage efficiency; polytropic efficiency; pre heat factor. **Expansion process :** Overall isentropic efficiency for a turbine; stage efficiency for a turbine; comparison and relation between stage efficiency and overall efficiency, polytropic efficiency; reheat factor for expansion process.	**10 Hours**	**L1, L2, L3, L4**
Module -3 **Design and performance analysis of Centrifugal compressors:** Types, design parameters, flow analysis in impeller blades, volutes and diffusers, losses, slip factor, characteristic curves, surging, choking. Construction details. **Design and performance analysis of axial fans and compressors:**	**10 Hours**	**L1, L2, L3, L4**

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done, simple stage design problems, performance characteristics, instability in axial compressors. Construction details.		
Module -4 **Design and performance analysis of axial flow turbines:** Turbine stage, work done, degree of reaction, losses and efficiency, flow passage; subsonic, transonic and supersonic turbines, multi-staging of turbine; exit flow conditions; turbine cooling **Design and performance analysis of radial turbines:** Thermodynamics and aerodynamics of radial turbines; radial turbine characteristics; losses and efficiency; design of radial turbine.	**10 Hours**	**L1, L2, L3, L4**
Module -5 **Hydraulic pumps:** Centrifugal and axial pumps. Manometric head, suction head, delivery head; manometric efficiency, hydraulic efficiency, volumetric efficiency, overall efficiency; multi stage pumps. Characteristics of pumps. **Hydraulic turbines:** Classification; Module quantities; Pelton wheel, Francis turbine, Kaplan turbine and their velocity triangles. Draft tubes and their function. Characteristics of hydraulic turbines.	**10 Hours**	**L1, L2, L3, L4, L5**

Course outcomes:

After studying this course, students will be able to:

1. Compute the energy transfer and energy transformation in turbomachines.
2. Analyse the design of turbomachine blades.
3. Apply hydraulic pumps and turbines for specific requirements

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. S.M. Yahya, *"Turbines, Compressors & Fans"*, Tata-McGraw Hill Co., 2nd Edition (2002),

ISBN 13: 9780070707023.

2. D.G. Shephered, *"Principles of Turbo Machinery"*, The Macmillan Company (1964), ISBN-13: 978-0024096609.

Reference Books:

1. V.Kadambi and Manohar Prasad, *"An introduction to Energy conversion, Volume III, Turbo machinery "*, Wiley Eastern Ltd. (1977), ISBN: 9780852264539.

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

Experimental Stress Analysis

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV
Elective

Subject Code	**15AE462**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the basic principles of displacement, strain and stress in multi-axial loading systems.
2. Acquire knowledge of polarized light for photo elastic application for stress analysis and laser for holographic applications related to vibration.
3. Study the basics of different types of strain gages and their applications to static and dynamic strain measurements.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Two Dimensional Problems in Cartesian Coordinate system** – Fundamentals of stress and strain, stress – strain relationship, Elastic constant, plane stress, plane strain, differential equation of equilibrium Boundary conditions, Saint Venant's principle, compatibility equation, Airys stress function. Stress analysis of cantilever subjected to concentrated load at it's end and simply supported beam subjected to uniformly distributed load.	**10 Hours**	**L1, L2**
Module -2 **Two dimensional problem in polar coordinate systems** – General equations of equilibrium in polar coordinate compatibility equation, stress distribution about symmetric, axis, stress analysis of cylinder subjected to ~ internal and external pressure, Pure bending of curved beams, effect of hole on the stress distribution in plates, Stress analysis of rotating circular disk	**10 Hours**	**L1, L2, L3, L4**
Module -3 **Two Dimensional Photoelasticity** – Introduction to basic optics related to photoelasticity, stress option law, plane and circular Polaris cope arrangements, effect of stressed model in plane and circular polariscope, Isoclinic and Isochrmatics, stress trajectories, calibration of photoelastic material (determination of fringe constant). Various photoelastic materials and their properties, Casting of photoelastic models, Tardy's compensation technique, Separation techniques like, shear difference, oblique incidence and electrical analogy.	**10 Hours**	**L1, L2**
Module -4	**10 Hours**	**L1, L2, L3**

Introduction to 3-D photoelasticity – Phenomenon of Stress freezing, Method of stress freezing, slicing techniques, determination of material fringe constant at critical temperature. Scaling Model – Prototype relations. Birefringerent coating method – Reflection polariscope. Introduction to fringe sharpening and fringe multiplication..		
Module -5 **Strain gage technique for stress and strain analysis** – Introduction to electrical resistance strain gages, gage, factor, bridge circuit, bridge balance, output voltage of Wheatstone bridge, balancing of bridge, temperature compensation, various bridge configurations, bonding of strain gages to the specimen, determination of principle strains and stresses using strain rosettes. Environmental effects on performance of strain gages, Strain gages response to dynamic strains, Effect of lead wires. Introduction to Strain measurement on rotating components, Static and Dynamic Strain Measurement introduction to semiconductor gages, high temperature strain gages and self – temperature compensated gages. Introduction to Commercial strain indicators.	**10 Hours**	**L1, L2, L3, L4**

Course outcomes:

After studying this course, students will be able to:

1. Use photo elastic instruments for 2- and 3-dimensional stress analysis of static engineering components.
2. Implement laser holographic systems and strain measurement systems for identifying critical location and magnitude of strain and stress.
3. Identify appropriate stress measurement system to support engineering design.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. L.S. Srinath "*Experimental Stress Analysis*", Tata McGraw-Hill Publishing Company Limited, 1984, ISBN 13: 9780074519264
2. Dally, James W.; Riley, William F, "*Experimental stress Analysis*" McGraw-Hill Inc.,US, 1978, ISBN 13: 9780070152045

Reference Books:

1. James W. Dally, William F. Riley, "*Experimental Stress Analysis*", McGraw Hill Education; 3rd Revised edition edition (1 March 1991), **ISBN-13:** 978-0070152182
2. S.P. Timoshenko, "*Theory of Elasticity*", Mcgraw-Hill College; 3 edition (June 1970) ISBN-13: 978-0070647206
3. Sadhu Singh, "*Experimental Stress Analysis*", Khanna Publishers 2009, **ISBN-13:** 978-8174091826

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

Theory of Elasticity

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV
Elective

Subject Code	**15AE463**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the relationship among the displacement, strain and stress and materials properties
2. Acquire the knowledge of plane stress and plain stress problems for components subjected to bending, torsion and combined loading
3. Understand the principles of superposition in a multi-axial , multi-loading system.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Definition and Notation:** Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions. **Strain At A Point:** Compatibility Equations, Principal Strains, Generalised Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems.	**8 Hours**	**L1, L2, L3**
Module -2 **Two Dimensional Problems**: Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure.	**8 Hours**	**L1, L2, L3**
Module -3 **General Equations In Cylindrical Co-Ordinates:** Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration. **Stresses In an Infinite Plate** (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.	**8 Hours**	**L1, L2**
Module -4 **Torsion Of Circular, Elliptical And Triangular bars:** membrane analogy, torsion of thin open sections and thin tubes. Navier's theory, St. Venant's theory, Prandtl's theory on torsion, The semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. **Thermal Stresses:** Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs and in long circular cylinder, sphere.	**8 Hours**	**L1, L2**

Module -5 **Energy Method** Principle of virtual work - Strain energy in axial load, flexure, shear and torsion - Rayleigh Ritz Methods - Castigliano's theorem- Complementary strain energy	**8 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

1. Describe the relationship among the displacement, strain and stress and materials properties
2. Apply the knowledge of plane stress and plain stress problems for components subjected to bending, torsion and combined loading
3. Explain the principles of superposition in a multi-axial, multi-loading system.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. **L. S. Srinath**, **"***Advanced Mechanics of solids***"**, Tata Mc. Graw Hill, 2003, ISBN-13: 978-0070702608
2. **S. P. Timoshenko and J. N Gordier, "***Theory of Elasticity***"**, Mc. Graw Hill International, 3rd edition, 1972, ISBN-13: 978-0070647206

Reference Books:

1. **Sadhu Singh,** *"Theory of Elasticity"*, Khanna Publications, 1988, ISBN 13: 9788174090607
2. **Martin H Sadd, "***Elasticity, Theory, Applications & Numericals***"**, Elsevier. 2005, ISBN-13: 978-0124081369.
3. **Seetharamu & Govindaraju "***Applied Elasticity***"**, Interline Publishing, ISBN 13: 9788172960834
4. **C.T. WANG**, *"Applied Elasticity"***,** Mc. Graw Hill Book Co, 1953, ISBN 13: 9780070681255.

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

Management and Entrepreneurship

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – IV
Elective

Subject Code	**15AE464**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 04

Course objectives: This course will enable students to

1. Understand the concepts of management , organization and staffing
2. Understand the concepts of entrepreneurship
3. Learn about industry, institution and overall business.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Management** : Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of Management – Management as a Science, Art or Profession Management & Administration – Roles of Management, Levels of Management, Development of Management Thought – Early Management Approaches – Modern Management Approaches. PLANNING: Nature, importance and purpose of planning, process objectives – Types of plans (Meaning only) – Decision making – Importance of planning – steps in planning & planning premises – Hierarchy of plans.	**10 Hours**	**L1, L2**
Module -2 **Organizing and Staffing**: Nature and purpose of organization - Principles of organization – Types of organization - Departmentation – Committees – Centralization Vs decentralization of authority and responsibility – Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing – Process of Selection & Recruitment (in brief).	**10 Hours**	**L1, L2**
Module -3 **Directing & Controlling**: Meaning and nature of directing-Leadership styles, Motivation Theories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Coordination. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control.	**10 Hours**	**L1, L2**
Module -4 ENTREPRENEUR: Meaning of Entrepreneur, Functions of an Entrepreneur, Types, Intrapreneur – an emerging Class. Concept of Entrepreneurship – Evolution of Entrepreneurship, Development of Entrepreneurship; Role of entrepreneurs in Economic Development ; Entrepreneurship in India SMALL SCALE INDUSTRY : Definition; Characteristics; Need and	**10 Hours**	**L1, L2, L3**

rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start an SSI – Government policy towards SSI; Different Policies of S.S.I; Impact of Liberalization, Privatization, Globalization on S.S.I, Effect of WTO/GATT Supporting Agencies of Government for S.S.I, Meaning ; Ancillary Industry and Tiny Industry (Definition only)		
Module -5 **Institutional Support**: Different Schemes: TECKSOK, KIADB, KSSIDC, KSIMC, DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC. **Preparation of Project**: Meaning of project, project Identification, Project Selection, Project Report, Need and Significance of Report, Contents, formulation, Guidelines by Planning Commission for Project report, network Analysis, Errors of Project Report, Project Appraisal. Identification of Business Opportunities – Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.	**10 Hours**	**L1, L2**

Course outcomes:

After studying this course, students will be able to:

1. Use the concepts of management , organization and staffing
2. Utilise the concepts of entrepreneurship
3. Develop the skill to make an industry, an institution and a business.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- 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. **P.C Tripathi, P.N.Reddy,** "*Principles of Management*", Tata McGraw Hill, 4th Edition, 2010, ISBN: 9780071333337.
2. **Vasant Desai** "*Dynamics of Entrepreneurial Development & Management*", Himalaya Publishing House, 2011, ISBN 13: 9788183184113.
3. **Poornima M. Charantimath** "*Entrepreneurship Development-Small Business Enterprises*", Pearson Education, 2006 (2 & 4), ISBN 13: 9788131762264.

Reference Books:

1. **Robert Lusier** "*Management Fundamentals – Concepts, Application, Skill Development*", 5th edition, Thomson Publications, 2011, ISBN-13: 9781111577520

2. **S. S. Khanka** "Entrepreneurship Development", S Chand & Co., 2007, ISBN: 9788121918015
3. **Stephen Robbins**, "Management", Pearson Education / PHI – 17th Edition, 2003, ISBN-13: 978-0132163842

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

MATERIAL TESTING LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AEL47A**	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

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 metallograpic 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**
12. Magnetic Particle Inspection.	**L1, L2, L3**

13. Ultrasonic Inspection.	**L1, L2, L3**
14. Eddy Current Inspection	**L1, L2, L3**

Course outcomes:

After studying this course, students will be able to:

1. Apply the relations among materials and their properties.
2. Differentiate the formation, properties and significance of the alloys through different experiments.
3. Understand the different types, advantages and applications of various NDT methods

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.

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

MEASUREMENTS AND METROLOGY LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AEL47B**	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

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**
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:

1. Identify and classify different measuring tools related to experiments.
2. Identify, define, and explain accuracy, resolution, precision, and some additional terminology.
3. Conduct, Analyze, interpret, and present measurement data from measurements experiments.

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.

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

COMPUTER AIDED AIRCRAFT DRAWING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	**15AEL48**	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

1. Understand and interpret drawings of machine and aircraft components
2. Prepare assembly drawings either manually or by using standard CAD packages.
3. Familiarize with standard components and their assembly of an aircraft.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
1. Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections.	**L1, L2, L3, L6**
2. **Orthographic Views:** Conversion of pictorial views into orthographic projections. of **simple machine parts** with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.	**L1, L2, L3**
3.Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.	**L1, L2, L3**
4.Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.	**L1, L2, L3**
5.Keys & Joints: Parallel key, Taper key, Feather key, Gibhead key and Woodruff key	**L1, L2, L3**
6.Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.	**L1, L2, L3**
7. Couplings: Split Muff coupling, protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)	**L1, L2, L3**
8. Design of propeller and hub assembly	**L1, L2, L3**
9. Design of wing assembly	**L1, L2, L3**

10. Design of fuselage assembly	**L1, L2, L3**
11. Design of Engine Mounts	**L1, L2, L3**
12. Design of main rotor blade assembly of helicopter	**L1, L2, L3, L4, L5, L6**
13. Design of UAV assembly	**L1, L2, L3, L4, L5, L6**
14. Design of Landing Gear Assembly	**L1, L2, L3, L4, L5, L6**

Course outcomes:

After studying this course, students will be able to:

1. Distinguish drawings of machine and aircraft components
2. Identify assembly drawings either manually or by using standard CAD packages.
3. Practise with standard components and their assembly of an aircraft..

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.