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

VI SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credits
			Theory	Practical/Drawing	Duration	Theory/ Practical Marks	I.A. Marks	Total Marks	
1	15AE61	AERODYNAMICS-II	04		03	80	20	100	4
2	15AE62	GAS TURBINE TECHNOLOGY	04		03	80	20	100	4
3	15AE63	AIRCRAFT PERFORMANCE	04		03	80	20	100	4
4	15AE64	AIRCRAFT STRUCTURES-II	04		03	80	20	100	4
5	15AE65X	PROFESSIONAL ELECTIVE	03		03	80	20	100	3
6	15AE66X	OPEN ELECTIVE	03		03	80	20	100	3
7	15AEL67	AIRCRAFT PROPULSION LAB		1I+2P	03	80	20	100	2
8	15AEL68	AIRCRAFT STRUCTURES LAB		1I+2P	03	80	20	100	2
TOTAL			**22**	**06**	**24**	**640**	**160**	**800**	**26**

PROFESSIONAL ELECTIVE		OPEN ELECTIVE	
15AE651	FINITE ELEMENT METHOD	15AE661	UNMANNED AERIAL VEHICLES BASICS & APPLICATIONS
15AE652	EXPERIMENTAL AERODYNAMICS	15AE662	FUNDAMENTALS OF AERODYNAMIC THEORY
15AE653	SPACE MECHANICS	15AE663	ELEMENTS OF JET PROPULSION SYSTEMS
15AE654	EXPERIMENTAL STRESS ANALYSIS	15AE664	MAINTENANCE, OVERHAUL & REPAIR OF AIRCRAFT SYSTEMS

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.

2. Professional Elective: Elective relevant to chosen specialization/ branch

3. OpenElective: Electives from other technical and/or emerging subject areas.

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

AERODYNAMICS - II

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

SEMESTER – VI

Subject Code	**15AE61**	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 concepts of compressible flow and shock phenomenon
2. Acquire the knowledge of oblique shock and expansion wave formation.
3. Appreciate the measurement in high speed flow.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **One Dimensional Compressible Flow:** Energy, Momentum, continuity and state equations, velocity of sound, Adiabatic steady state flow equations, Flow through converging, diverging passages, Performance under various back pressures. Numericals.	**10 Hours**	**L1, L2**
Module -2 **Normal Shock:** Prandtl Meyer equation and Rankine – Hugonoit relation, Normal shock equations: Property ratios in terms of upstream mach number, Numericals, Moving Normal Shock wave.	**10 Hours**	**L1, L2**
Module -3 **Oblique shocks and Expansion waves:** Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polars, flow past wedges and concave corners, strong, weak and detached shocks, Flow past convex corners, Prandtl –Meyer expansion function, Reflection and interaction of shocks and expansion, waves, Families of shocks. Flow with Friction and Heat transfer.	**10 Hours**	**L1, L2, L3**
Module -4 **Differential Equations of Motion for Steady Compressible Flows:** Basic potential equations for compressible flow. Linearisation of potential equation-small perturbation theory. Methods for solution of nonlinear potential equation –Introduction, Method of characteristics, Boundary conditions, Pressure coefficient expression, small perturbation equation for compressible flow - Prandtl, Glauret and Geothert's rules - Ackert's supersonic airfoil theory, Von-Karman rule for transonic flow, Lift, drag pitching moment and center of pressure of	**10 Hours**	**L1, L2,L3**

supersonic profiles.		
Module -5 **Measurements in High speed Flow:** Types of subsonic wind tunnels - Balances and measurements - Interference effects- transonic, Supersonic and hypersonic wind tunnels and characteristic features, their operation and performance - Shock tubes and shock tunnels - Free flight testing - Measurements of pressure, velocity and Mach number -Flow visualization methods of subsonic and supersonic flows.	**10 Hours**	**L1, L2,L3**

Course Outcomes: After studying this course, students will be able to:

1. Utilize the concepts of compressible flow and shock phenomenon
2. Apply knowledge of oblique shock and expansion wave formation.
3. Measure the parameters high speed flow.

Graduate Attributes :

- 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 2full 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, "Modern Compressible Flow", McGraw Hill,3rd edition,2012,ISBN-13: 978-1259027420.
2. Radhakrishnan, E., "Gas Dynamics", Prentice Hall of India,5th edition,2014,ISBN-13: 978-8120348394

Reference Books:

1. Ascher.H.Saphiro, "Dynamics and Thermodynamics of Compressible fluid flow", John Wiley & Sons,1st edition,1977,ISBN-13: 978-0471066910.
2. Yahya, S.M., "Fundamentals of Compressible flow", NEW AGE , 2009,ISBN-13: 978-8122426687.
3. H.W. Liepmann and A.Roshko, "Elements of Gas Dynamics", Dover Publications Inc,2003,ISBN-13: 978-0486419633.
4. Hodge B. K, Koenig K, Compressible Fluid Dynamics with Computer Application, 1st edition, Prentice Hall, New York(1995).
5. Clancy L. J., Aerodynamics, Shroff Publishers, 2006,ISBN-13: 978-8175980570.
6. Zucrow, M.J. and Anderson, J.D., "Elements of gas dynamics", McGraw - Hill Book Co., New York, 1989.

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

GAS TURBINE TECHNOLOGY

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

Subject Code	**15AE62**	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. Comprehend the types of engines and its applications.
2. Understand the materials required for engine manufacturing.
3. Acquire the knowledge of engine performance and testing.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1 **Types,Variation&Applications:** Typesofenginesshowingarrangementofparts.Operatingparameters.Energy distributionofturbojet,turbopropandturbofanengines.Comparisonofthrustandspecificfuelconsumption.Thrust,pressureandvelocitydiagrams. **EngineParts:** Compressorassembly,typesofburners:advantagesanddisadvantages.Influenceofdesignfactorsonburnerperformance.Effectofoperatingvariablesonburner performance.Performancerequirementsofcombustionchambers.Construction ofnozzles.Impulseturbine andreactionturbine.Exhaustsystem,sound suppression. Thrustreversal:types,design&systems.Methodsof thrust augmentation,afterburnersystem	**10 Hours**	**L1, L2**
Module -2 **MaterialsandManufacturing:** Criteriaforselectionofmaterials.Heatrangesofmetals,hightemperaturestrength. surfacefinishing.Powdermetallurgy.UseofcompositesandCeramics.SuperalloysforTurbines. **Systems:** Fuelsystemsandcomponents.SensorsandControls.FADECinterfacewithengine. Typicalfuelsystem.Oilsystemcomponents.Typicaloilsystem.Startingsystems. Typicalstartingcharacteristics.Variousgasturbinestarters	**10 Hours**	**L1, L2**
Module -3 **EnginePerformance:** Design&off-designPerformance.Surgemarginrequirements,surgemarginstackup.Transientperformance.Qualitativecharacteristicsquantities.Transient workinglines.Startingprocess&WindmillingofEngines.Thrustenginestart envelope. Startingtorqueandspeedrequirements Calculationsfordesignand off-design performancefromgiventest data– (case studyforasingleshaftJet Engine).Engineperformancemonitoring	**10 Hours**	**L1, L2, L3**
Module -4	**10**	**L1,**

Compressor: CompressorMAP.Surgemargin,Inletdistortions. Testingand PerformanceEvaluation. **Combustor:**Combustor MAP,Pressureloss, combustionlightuptest.TestingandPerformanceEvaluation.**Turbines:**TurbineMAP.Turbin eTestingandPerformanceEvaluation.**Inletduct&nozzles:**Ram pressurerecoveryofinletduct.Propellingnozzles,afterburner,maximummass flowconditions. TestingandPerformanceEvaluation	**Hou rs**	**L2**
Module -5 **EngineTesting:** ProofofConcepts:DesignEvaluationtests. StructuralIntegrity.Environmental IngestionCapability.PreliminaryFlightRatingTest,QualificationTest,AcceptanceTest.Reliabi lityfigureofmerit.DurabilityandLifeAssessmentTests,Reliability Tests.Enginetestingwithsimulatedinletdistortionsand,surgetest.Estimating engine-operatinglimits.Methodsofdisplacingequilibriumlines. **Typesofenginetesting's:**NormallyAspiratedTesting,OpenAirTestBed,Ram AirTesting,Altitude Testing,Altitudetestfacility,FlyingTestBed, Ground TestingofEngineInstalledinAircraft,Flighttesting.Jetthrustmeasurements in flight. MeasurementsandInstrumentation.Data Acquisitionsystem, MeasurementofShaftspeed,Torque,Thrust,Pressure,Temperature,Vibration, Stress,Temperatureofturbinebladingetc.Engineperformancetrends:Massand CUSUMplots.AccuracyandUncertaintyinMeasurements.Uncertaintyanalysis. PerformanceReductionMethodology.	**10 Hou rs**	**L1, L2**

Course Outcomes:

After studying this course, students will be able to:

1. Select the suitable materials for engine manufacturing.
2. Evaluate the performance of the engine.
3. Test the engine using several types of engine testing methods.

Graduate Attributes :

- 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 2full 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. IrwinE.Treager,**'**GasTurbineEngineTechnology',McGraw Hill Education,3rd edition,2013,ISBN-13: 978-1259064876
2. P.PWalshandP.Peletcher,'GasTurbinePerformance'BlackwellScience,1998,ISBN0632047843.

Reference Books:

1. AdvanceAero-EngineTesting,AGARD-59Publication
2.MIL–5007E,'MilitarySpecifications:Engine,Aircraft,Turbo Jet&Turbofan;GeneralSpecificationforAdvanceAeroEnginetesting',15thOct1973.
3. JPHolman,'ExperimentalmethodsforEngineers',TataMcGraw Hill,7th edition,2007,ISBN-13: 978-0070647763
4. A SRangawala,Turbomachinerydynamics-Designandoperations, McGraw–Hill, 2005,ISBN-13: 978-0071453691.
5. MichaelJ.Kores,andThomas W.Wild**,**'AircraftPowerPlant',

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GLENCOE Aviation Technology Series, 7th Edition, Tata McGraw Hill Publishing Co. Ltd. 2002

AIRCRAFT PERFORMANCE

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

SEMESTER – VI

Subject Code	**15AE63**	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 aircraft performance in steady unaccelerated and accelerated flight.
2. Understand the airplane performance parameters.
3. Acquire the knowledge on aircraft maneuver performance.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **The Equations of Motion Steady Unaccelerated Flight** Introduction, Four forces of flight, General equation of motion, Power available and power required curves. Thrust available and thrust required curves. Conditions for power required and thrust required minimum. Thrust available and maximum velocity, Power available and maximum velocity, Altitude effects on power available and power required; thrust available and thrust required.	**10 Hours**	**L1, L2**
Module -2 **Steady Performance – Level Flight, Climb & Glide** Performance: Equation of motion for Rate of climb- graphical and analytical approach -Absolute ceiling, Service ceiling, Time to climb – graphical and analytical approach , climb performance graph (hodograph diagram); maximum climb angle and rate of climb Gliding flight, Range during glide, minimum rate of sink and shallowest angle of glide.	**10 Hours**	**L1, L2**
Module -3 **Fundamental Airplane Performance Parameters** The fundamental Parameters: Thrust – to – weight ratio, Wing loading, Drag polar, and lift-to – drag ratio. Minimum velocity. Aerodynamic relations associated with lift-to-drag ratio. **Range And Endurance:** Propeller driven Airplane: Physical consideration, Quantitative formulation, Breguet equation for Range and Endurance, Conditions for maximum range and endurance. Jet Airplane: Physical consideration, Quantitative formulation, Equation for Range and Endurance, Conditions for maximum range and endurance, Effect	**10 Hours**	**L1, L2, L3**

of head wind tail wind.		
Module -4 **Aircraft Performance in Accelerated Flight** **Take-off Performance**: Calculation of Ground roll, Calculation of distance while airborne to clear obstacle, Balanced field length **Landing Performance and Accelerated Climb:** Calculation of approach distance, Calculation of flare distance, Calculation of ground roll, ground effects. Acceleration in climb.	**10 Hours**	**L1, L2, L3**
Module -5 **Maneuver Performance** Turning performance: Level turn, load factor, Constraints on load factor, Minimum turn radius, Maximum turn rate. Pull-up and Pull-down maneuvers: (Turning rate, turn radius). Limiting case for large load factor.The V-n diagram. Limitations of pull up and push over	**10 Hours**	**L1, L2, L3**

Course Outcomes:

After studying this course, students will be able to:

1. Apply the basic airplane performance parameters.
2. Differentiate the aircraft performance in steady unaccelerated and accelerated flight.
3. Explain the aircraft maneuver performance.

Graduate Attributes :

- 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 2full 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, Jr.**" Aircraft Performance and Design", McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 1999.
2. **John D. Anderson, Jr.**, "Introduction to flight" McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 2000.

Reference Books:

1. **Perkins, C.D., and Hage, R.E.**, "Airplane Performance stability and Control", John Wiley SonInc, New York, 1988.

2. **Barnes W. McCormick,** ` Aerodynamics, Aeronautics, and Flight Mechanics`, John Wiley& Sons, Inc. 1995.

AIRCRAFT STRUCTURES - II

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

Subject Code	**15AE64**	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80

CREDITS – 04

Course objective: This course will enable students to

1. Understand the concepts of open and closed thin walled beams.
2. Acquire the knowledge of buckling of plates, joints and fittings.
3. Comprehend the stress analysis on wings and fuselage.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Bending ,and shear- Open and Closed Thin Walled Beams** Symmetrical bending,unsymmetrical bending, direct stress distribution due to bending,position of the neutral axis, load intensity, shear force, and bending moment relationships, deflection due to bending, calculation of section properties, approximation for thin-walled sections. **Shear of beams**- General stress, strain, and displacement relationship for open and single-cell closed section thin-walled beams, shear of open section beams, shear centre, shear of closed section beams. Torsion of close section beam, and displacement associated with the Bredt-Batho shear flow. Torsion of open section beam.	**10 Hours**	**L1, L2**
Module -2 **Combined Open and Closed Section Beams, and Structural Idealisation** Bending, shear, torsion. Structural idealisation-Principle, Idealisation of a panel, effect of idealisation on the analysis of open and closed section beams. Bending of open and closed section idealised beams, shear of open section and closed section idealised beams. Deflection of open and closed section idealised beams.	**10 Hours**	**L1, L2**
Module -3 **Buckling of Plates, Joints and Fittings** Buckling of Isotropic flat plates in compression, ultimate compressive strength of Isotropic flat sheet, plastic buckling of flat sheet, columns subjected to local crippling failure, Needham & Gerard method for determining crippling stress, curved sheets in compression, elastic buckling of curved rectangular plates. Pure tension field beams, angle of	**10 Hours**	**L1, L2, L3**

diagonal tension in web. **Joints and Fittings**- bolted or riveted joints, accuracy of fitting analysis, eccentrically loaded connections, welded joints, and concept of effective width.		
Module -4 **Stress Analysis in Wing Spars and Box beams** Tapered wing spar, open and closed section beams, beams having variable stringer areas, three- boom shell, torsion and shear, tapered wings, cut-outs in wings.	**10 Hours**	**L1, L2,L3**
Module -5 **Stress Analysis in Fuselage Frames** Bending, shear, torsion, cut-outs in fuselages, principles of stiffeners construction, fuselage frames, shear flow distribution.	**10 Hours**	**L1, L2,L3**

Course Outcomes: After studying this course, students will be able to:

1. Utilize the concepts of thin walled beams.
2. Calculate the buckling of plates.
3. Analysis the stress in wings and fuselage frames.

Graduate Attributes :

- 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 2full 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. Megson, T. M. G., Aircraft Structures for Engineering Students, Edward Arnold,1995.
2. Peery D J &Azar J J , Aircraft Structures, 2nd edition, McGraw Hill N.Y.,1993

Reference Books:

1. Brun E. H. , Analysis & Design of Flight Vehicles Structures, Tri-State offset Co,USA,1985.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
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FINITE ELEMENT METHOD

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

Subject Code	**15AE651**	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

Course Objectives: This course will enable students to

1. Understand the importance of discretisation of domain using different finite elements
2. Acquire the knowledge of different loading and boundary conditions
3. Understand the governing methods of finite element analysis

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction: Basic Concepts, Background Review:** Stresses and Equilibrium, Plane stress, Plane strain, Potential energy and Equilibrium. Rayleigh - Ritz Method, Galerkin's Method, Simple applications in structural Analysis. Construction or discrete models - sub domains and nodes - simple elements for the FEM - Simplex, complex and multiples elements Polynomial selection -illustrative examples Elements and shape functions and natural coordinates, Use of local and natural coordinates, compatibility and convergence requirements of shape functions.	**10 Hours**	**L1,L2**
Module -2 **Fundamentals of Finite Element Method:** Construction of shape functions for bar element and beam element, Bar elements, uniform bar elements, uniform section, mechanical and thermal loading, varying section, truss analysis, Frame element, Beam element, problems for various loadings and boundary conditions.	**06 Hours**	**L1,L2**
Module -3 **Analysis of Two and Three dimensional Elements:** Shape functions of Triangular, Rectangular and Quadrilateral elements, different types of higher order elements, constant and linear strain triangular elements, stiffness matrix Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family.	**08 Hours**	**L1, L2,L3**
Module -4 **Theory of Isoparametric Elements and Axisymmetric:** Isoparametric, sub parametric and super-parametric elements, characteristics of Isoparametric quadrilateral elements, structure of computer program for FEM analysis, description of different modules, pre and post processing, Axisymmetric formulation finite element modeling of triangular and quadrilateral element.	**08 Hours**	**L1, L2,L3**

Module -5 **Field Problems:** Heat transfer problems, Steady state fin problems, 1D heat conduction governing equation, Derivation of element matrices for two dimensional problems, Dynamic consideration- Formulation- Hamilton's principle, Element mass matrices.	**08 Hours**	**L1,L2,L3**

Course Outcomes:

After studying this course, students will be able to:

1. Apply discretisation technique for domain decomposition.
2. Evaluate the effects of different loading and boundary conditions
3. Analyze the governing equations of finite element analysis

Graduate Attributes :

- 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 2full 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. Chandrupatla T. R., "Finite Elements in engineering", PHI, 3rd edition, 2002, ISBN-13: 978-8120321069.
2. Bhavikatti, Finite element Analysis, New Age International,3rd edition,2015,ISBN-13: 978-8122436716

Reference Books:

1. Rajasekharan. S - "Finite element analysis in engineering design", Wheeler Publishers
2. Bathe. KJ , "Finite Element Procedures", PHI Pvt. Ltd., New Delhi,1996,ISBN-13: 978-8126529988
3. Zienkiewicz. O.C. - "The Finite Element Method", Elsevier,7th edition,2013,ISBN-13: 978-9351071587
4. Rao S. S., "Finite Elements Method in Engineering", Elsevier,5th edition, 2008,ISBN-13: 978-9380931555
5. C.S. Krishnamurthy - "Finite Element analysis - Theory and Programming", Tata McGraw Hill Co. Ltd, New Delhi,2nd edition,2011,ISBN-13: 978-0074622100.

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

EXPERIMENTAL AERODYNAMICS

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

Professional Elective

Subject Code	**15AE652**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

Course Objectives:
This course will enable students to
1. Understand the basics of experimental aerodynamics.
2. Understand the procedures for model measurements.
3. Acquire the knowledge of wind tunnel testing.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **WindEnergyCollectors:** Horizontalaxisandvertical axismachines.Powercoefficient.Betzcoefficient bymomentumtheory. **VehicleAerodynamics:** Powerrequirementsanddragcoefficientsof automobiles.Effectsof cutback angle.AerodynamicsofTrainsandHovercraft.	**8 Hours**	**L1, L2**
Module -2 **BuildingAerodynamics:** Pressuredistributionon lowrisebuildings,windforceson buildings. Environmentalwindsincityblocks,Specialproblemsoftallbuildings,building codes,buildingventilationandarchitecturalaerodynamics. **FlowInducedVibrations:** EffectsofReynoldsnumber onwakeformation ofbluffshapes,Vortexinduced vibrations,Gallopingandstall flutter.	**8 Hours**	**L1, L2**
Module -3 **ModelMeasurements:** Balances: design,installationand,calibration.Internalbalances.Mountingof models,rigidity.Measurementof interference.Liftanddragmeasurements throughvarioustechniques. Testingprocedures. Testing:-3-Dwings,controls, completemodel,powereffects,aeroelasticity, dynamicstability. Testingwith ground plane,testingwind millgenerator.Testingfor local loads. Testingof rotor.Testingengines,Jettisontests.Datareduction.Datacorrection	**8 Hours**	**L1, L2, L3**
Module -4 **WindTunnelBoundary CorrectionsandScaleEffects:** Effectsoflateralboundaries.Methodof images.Wallcorrections.Effectsof Buoyancy,Solid Blocking,Wake Blocking.Generaldownwashcorrection.Lift interference correction.Correctionsforreflectionplanemodels.Scaleeffectson aerodynamiccharacteristicsandstabilityderivatives	**8 Hours**	**L1, L2**
Module -5 **Nearsonic andTransonicTesting:** Nearsonictunneldesign.Calibrationoftestsection.Modelsupportsystem.Tareand	**8 Hours**	**L1, L2**

interferenceevaluation.Neartransonictesting. **SupersonicWindTunnelTesting:** Types of supersonictunnels:-continuous,intermittent(indraftandblowdown). Pressure-vacuumtunnels.Supersonictunneldesignfeatures.Calibrationoftest section.Opticalsystems- Schlierenset-up.Startingloads. Hypersonic wind tunnels-Generalintroduction		

Course Outcomes:

After studying this course, students will be able to:

1. Distinguish the building and vehicle aerodynamics.
2. Evaluate the boundary corrections and scale effects.
3. Classify the wind tunnel testing.

Graduate Attributes :

- 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 2full 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. JewelB.Barlow,WilliamH RAE,Jr.andAlanPope**,**'LowspeedWindTunnelTesting',JohnWiley&Sons,3rd edition,2010,ISBN-13: 978-8126525683
2. M.Sovran(Ed), "Aerodynamics and dragmechanismsofbluffbodies androadVehicles",Plenumpress,Newyork, 1978.

Reference Books:

1. P.Sachs,"Windsforcesinengineering", PergamonPress, 2nd edition,2013.
2. R.D.Blevins,"Flowinducedvibrations",VanNostrand,1990.
3. N.G.Calvent, "Wind Power Principles", Calvert Technical Press ,2nd edition,2004,ISBN-13: 978-0951362068

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

SPACE MECHANICS

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

SEMESTER – VI

Professional Elective

Subject Code	**15AE653**	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

Course Objectives: This course will enable students to

1. Understand the basicconceptsofspacemechanics andthe general N-body.
2. Studysatelliteinjectionandsatelliteorbitperturbations.
3. Acquire the knowledge of interplanetary and ballisticmissiletrajectories.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Space Environment:** Peculiarities of space environment and its description, effect of space environment on materials of spacecraft structure and astronauts, manned space missions, effect on satellite life time.	**08 Hours**	**L1, L2**
Module -2 **Basic Concepts and the General N-Body:** The solar system, reference frames and coordinate systems, terminology related to the celestial sphere and its associated concepts, Kepler's laws of planetary motion and proof of the laws, Newton's universal law of gravitation, the many body problem, Lagrange-Jacobi identity, the circular restricted three body problem, libration points, the general N-body problem, two body problem, relations between position and time.	**08 Hours**	**L1, L2**
Module -3 **Satellite Injection and Satellite Perturbations**: General aspects of satellite injection, satellite orbit transfer, various cases, orbit deviations due to injection errors, special and general perturbations, Cowell's method and Encke's method, method of variations of orbital elements, general perturbations approach.	**08 Hours**	**L1, L2, L3**
Module -4 **Interplanetary Trajectories**: Two-dimensional interplanetary trajectories, fast interplanetary trajectories, three dimensional interplanetary trajectories, launch of interplanetary spacecraft, trajectory estimation about the target planet, concept of sphere of influence, Lambert's theorem.	**08 Hours**	**L1, L2**
Module -5 **Ballistic Missile Trajectories:** Introduction to ballistic missile trajectories, boost phase, the ballistic phase, trajectory geometry, optimal flights , time of flight, re-entry phase, the position of impact point, influence coefficients.	**08 Hours**	**L1, L2**

Course Outcomes:

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

1. Apply the basicconceptsofspacemechanics andthe general N-body.
2. Explainsatelliteinjectionandsatelliteorbitperturbations.
3. Distinguish between interplanetary and ballisticmissiletrajectories.

Graduate Attributes :

- 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. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, W.H.Freeman&co,1984.
2. Thomson, Introduction to Space Dynamics, Dover Publications,Revised edition,2012.

Reference Books:

1. VandeKamp,P.,"ElementsofAstromechanics",Pitman,1979
2. Willian E. Wiesel, Space Flight Dynamics, Create Space Independent Publishing Platform, 3rd Edition ,2010,ISBN-13: 978-1452879598
3. George P. Sutton and Oscar Biblarz, Rocket Propulsion Elements,Wiley India Pvt Ltd,7th edition, 2010,ISBN-13: 978-8126525775.

EXPERIMENTAL STRESS ANALYSIS

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

Subject Code	**15AE654**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

Course Objectives: This course will enable students to

1. Understand the basics of measurements.
2. Study about the electrical resistance strain gauges.
3. Acquire the knowledge of NDT.

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Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Measurements:** Principlesofmeasurements,Accuracy,Sensitivityandrangeofmeasurements	**8 Hours**	**L1, L2**
Module -2 **Extensometers:** Mechanical,Optical,AcousticalandElectricalextensometersandtheiruses.Advantagesanddisadvantages	**8 Hours**	**L1, L2**
Module -3 **ElectricalResistanceStrainGauges:** Principleofoperationandrequirementsofelectricalstraingauges.Typesandtheiruses,Materialsforstraingauge.Calibrationandtemperaturecompensation,crosssensitivity,Rosette analysis.Wheatstonebridge andpotentiometer circuitsfor staticand dynamic strainmeasurements, strainindicators.	**8 Hours**	**L1, L2, L3**
Module -4 **PhotoElasticity:** Twodimensionalphotoelasticity,Conceptoflight, photoelasticeffects,stressopticlaw,Interpretationoffringepattern,Compensationandseparationtechniques,Photoelastic, materials.Introductiontothreedimensionalphotoelasticity.	**8 Hours**	**L1, L2**
Module -5 **Non destructive Testing:** FundamentalsofNDT.Radiography,ultrasonic,magneticparticleinspection,Fluorescentpenetranttechnique,Eddycurrenttesting,AcousticEmissionTechnique,Fundamentalsofbrittle coatingmethods,Introductionto Moiretechniques,Holography,ultrasonic C- Scan,Thermograph, Fiber-opticSensors.	**8 Hours**	**L1, L2**

Course Outcomes:
After studying this course, students will be able to:

1. Classify the types of extensometers.
2. Use the electrical resistance strain gauges.
3. Identify the different methods of NDT.

Graduate Attributes :

- 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 2full 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.Srinath,L.S.,Raghava,M.R.,Lingaiah,K.,Garagesha,G.,PantB.,andRamachandra,K.,"ExperimentalStressAnalysis",TataMcGraw-Hill,NewDelhi,1914.

2. Dally,J.W.,andRiley,W.F.,"ExperimentalStressAnalysis",McGraw-HillInc.,NewYork, 3rd revised edition, 1991,ISBN-13: 978-0071008259.

Reference Books:

1. Hetyenyi,M.,"HandbookofExperimentalStressAnalysis",JohnWiley ,NewYork,1972.
2. PollockA.A.,"AcousticEmissioninAcousticsandVibrationProgress",Ed.StephensR.W.B.,ChapmanandHall,1993.

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

UNMANNED AERIAL VEHICLES BASICS & APPLICATIONS

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

SEMESTER – VI

Open Elective

Subject Code	**15AE661**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

Course Objectives: This course will enable students to

1. Comprehend the basic aviation history and UAV systems.
2. Acquire the knowledge of basic aerodynamics, performance, stability and control.
3. Understand the propulsion, loads and structures.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Introduction** Aviation History and Overview of UAV systems, Classes and Missions of UAVs, Definitions and Terminology, UAV fundamentals , Examples of UAV systems-very small , small, Medium and Large UAV	**6 Hours**	**L1, L2**
Module -2 **The Air Vehicle** **Basic Aerodynamics:** Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, Induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag **Performance:** Overview, Climbing flight, Range and Endurance – for propeller-driven aircraft, range- a jet-driven aircraft, Guiding Flight	**6 Hours**	**L1, L2**
Module -3 **Stability and Control** Overview, Stability, longitudinal, lateral, dynamic stability, Aerodynamics control, pitch control, lateral control, Autopilots, sensor, controller, actuator, airframe control, inner and outer loops, Flight-Control Classification, Overall Modes of Operation, Sensors Supporting the Autopilot.	**8 Hours**	**L1, L2, L3**

Module -4 **Propulsion** Overview, Thrust Generation, Powered Lift, Sources of Power, The Two-Cycle Engine, The Rotary Engine, The Gas Turbine, Electric Motors, Sources of Electrical Power **Loads and Structures** Loads, Dynamic Loads, Materials, Sandwich Construction, Skin or Reinforcing Materials, Resin Materials, Core Materials, Construction Techniques	**10 Hours**	**L1, L2, L3**
Module -5 Mission Planning and Control, Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Tradeoffs	**10 Hours**	**L1, L2, L3**

Course Outcomes:
After studying this course, students will be able to:

1. Apply the basic concepts of UAV systems.
2. Explain the basic aerodynamics, performance, stability and control required for UAV.
3. Select the propulsion system and materials for structures.

Graduate Attributes :

- 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 2full 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. Paul GerinFahlstrom , Thomas James Gleason, INTRODUCTION TO UAV SYSTEMS, 4th Edition, Wiley Publication, 2012 John Wiley & Sons, Ltd
2. Landen Rosen, Unmanned Aerial Vehicle, Publisher : Alpha Editions ,ISBN13 : 9789385505034.

Reference Books:

1. Unmanned Aerial Vehicles: DOD's Acquisition Efforts, Publisher : Alpha Editions, ISBN13 : 9781297017544

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

FUNDAMENTALS OF AERODYNAMIC THEORY

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

SEMESTER – VI

Subject Code	**15AE662**	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

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.	**08 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.	**08 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.	**08 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'sclassical 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.	**08 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.	**08 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 2full 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.

ELEMENTS OF JET PROPULSION SYSTEMS

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

Subject Code	**15AE663**	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

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.	**08 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.	**08 Hours**	**L1, L2, L3**
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.	**08 Hours**	**L1, L2**

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 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.	**08 Hours**	**L1, L2, L3**
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	**08 Hours**	**L1, L2, L3**

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.

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Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2full 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.

MAINTENANCE, OVERHAUL &REPAIR OF AIRCRAFT SYSTEMS

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

SEMESTER – VI

Open Elective

Subject Code	**15AE664**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	40	Exam Marks	80

CREDITS – 03

Course objectives: This course will enable students to

1. Comprehend the fundamentals of maintenance and certification.
2. Acquire the knowledge of documentation for maintenance.
3. Understand the Aircraft Maintenance, safety and trouble shooting.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Fundamentals of Maintenance & Certification** Types of maintenance, Redesign, Failure rate pattern, Other	**6 Hours**	**L1, L2**

maintenance considerations. Aviation industry certification requirements, Type certificate (FAA form 8110.9), Airworthiness certificate (FAA form 8100-2), Aviation maintenance certifications, General, Airframe, Power plant, Avionics courses.		
Module -2 **Documentation for Maintenance** Manufacturers documentation, Airplane maintenance manual, Fault insulation manual, Illustrated parts catalogue, structural repair manual, wiring diagram manual, Master minimum equipment, Federal Aviation regulation (FAR), Advisory circulars, Airworthiness direction ATA document standards, Technical policies and procedure manuals (TPPM)	**6 Hours**	**L1, L2**
Module -3 **Aircraft Management Maintenance** Structure, Role of aviation management, Line supervisory management, Management areas of concern in an airlines, Manager of overhaul shops, Line maintenance control centre flight line (preflight & post flight), Aircraft Logbook,Maintenance crew skill requirements	**8 Hours**	**L1, L2, L3**
Module -4 **Hanger Maintenance (on Aircraft) & Material Support** Introduction, organisation of hanger maintenance, Non- routine item, parts availability, cannibalization, Types of shops- sheet metal shop, Aircraft interior shop, Engine shop, Avionics shop, ground support equipment, outsourcing of shop maintenance work, operation of overhaul shops, Material support, Material management inventory control, Support functions of material, Parts ordering, Storage, Issue, control and handling, Parts receiving quality control, calibration program, stock level adjustments, shelf life, exchanges, warranty & modifications of parts.	**10 Hours**	**L1, L2, L3**
Module -5 **Maintenance Safety & Trouble shooting** Safety regulations, occupational safety and health standards maintenance safety program, Airlines safety management, General safety rules, Accident & injury reporting, Hazardous materials storage and handling aircraft furnishing practices trouble shooting, Knowledge of malfunctions.	**10 Hours**	**L1, L2, L3**
Course outcomes: After studying this course, students will be able to: 1. Maintain the aircraft maintenance manual and logbook. 2. Do the quality control and calibration. 3. Incorporate the safety regulations and rules.		

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 2full 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. **Harry A Kinnison, Tariq Siddiqui,**McGraw Hill education (India) Private Ltd 2013)
2. **Krores Watkins,** DELP, 'Aircraft maintenance and repair', Mc Grew Hill New York 1992.

Reference Books:

1. **Larry Reithmer**" Aircraft Repair Manual" Palmar Books Marqutte 1992.
2. **Brimm DJ Bogges** HE aircrfat maintenance Pitman publishing corp, New York 1940.

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AIRCRAFT PROPULSION LAB

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

Subject Code	**15AEL67**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	42	Exam Marks	80

CREDITS – 02

Course Objectives: This course will enable students to

1. Understand how to do the heat transfer
2. Comprehend the cascade testing of axial compressor and axial turbine blade row.
3. Study the performance of propeller and jet engines.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
1. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)	**L1, L2, L3, L4**
2. Study of an aircraft jet engine (Includes study of assembly of sub systems, various components, their functions and operating principles)	**L1, L2, L3, L4**
3. Study of forced convective heat transfer over a flat plate.	**L1, L2, L3, L4**
4. Cascade testing of a model of axial compressor blade row.	**L1, L2, L3, L4**
5. Cascade testing of a model of axial Turbine blade row	**L1, L2, L3, L4, L5**
6. Study of performance of a propeller.	**L1, L2, L3, L4**
7. Determination of heat of combustion of aviation fuel.	**L1, L2, L3, L4**
8. Study of free and wall jet	**L1, L2, L3**
9. Measurement of burning velocity of a premixed flame.	**L1, L2, L3**
10. Study of the flame lift up and fall back phenomenon for varied Air/Fuel ratio.	**L1, L2, L3**
11. Measurement of nozzle flow.	**L1, L2, L3**
12. Performance studies on a scaled jet engine	**L1, L2, L3**

13. Study of free convective heat transfer over a flat plate	**L1, L2, L3**
14. Study of Fuel injection characteristics	**L1, L2, L3**

Course Outcomes:
After studying this course, students will be able to:

1. Analyze the cascade testing of axial compressor and axial turbine blade row.
2. Evaluate the performance of a jet engine.
3. Perform the measurement of a flame and nozzle flow.

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 :

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

AIRCRAFT STRUCTURES LAB

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

Subject Code	**15AEL68**	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Lecture Hours	42	Exam Marks	80

CREDITS – 02

Course Objectives: This course will enable students to

1. Learn about the simply supported beam, cantilever beam.
2. Understand the Maxwell's theorem and Poisson ration.
3. Acquire the knowledge about buckling load, shear failure and shear centre.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
1. Deflection of a Simply Supported Beam.	**L1, L2, L3, L4**

2. Deflection of a cantilever Beam	**L1, L2, L3, L4**
3. Beam with combined loading by using superposition theorem	**L1, L2, L3, L4**
4. Verification of Maxwell's Reciprocal Theorem.	**L1, L2, L3, L4**
5. Determination of Young's Modulus using strain gages.	**L1, L2, L3, L4, L5**
6. Poisson Ratio Determination	**L1, L2, L3, L4**
7. Buckling load of slender Eccentric Columns and Construction of Southwell Plot	**L1, L2, L3, L4**
8. Shear Failure of Bolted and Riveted Joints	**L1, L2, L3**
9. Bending Modulus of sandwich Beam	**L1, L2, L3**
10. Fault detection and de-lamination studies in composite plate	**L1, L2, L3**
11. Determination of fundamental frequency and spectrum analysis of a cantilever beam and harmonics.	**L1, L2, L3**
12. Vibration induced structural damage studies	**L1, L2, L3**
13. Determining of Shear centre location for open sections-unsymmetrical bending	**L1, L2, L3**
14. Determining of Shear centre location for closed sections	**L1, L2, L3**

Course Outcomes:

After studying this course, students will be able to:

1. Compute the deflection of simply supported beam and cantilever beam.
2. Verify the Maxwell's theorem.
3. Determine the buckling load, shear failure and shear centre.

Conduct of Practical Examination:

1. All laboratory experiments aretobeincludedforpracticalexamination.
2. Studentsare allowed to pick one experimentfrom the lot.
3. Strictlyfollow theinstructions 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 :

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

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SCHEME OF TEACHING AND EXAMINATION 2015-2016