VISVESWARAIAH TECHNOLOGICAL UNIVERSITY, BELGAUM
SCHEME OF TEACHING AND EXAMINATION

M.TECH. AERONAUTICAL ENGINEERING (MAE)

I Semester

Subject Code	Name of the Subject	Teaching hours / week				Marks for		Total Marks
		Lecture	Practical	Field work / Tutorial	Duration of Exam in Hours	I.A.	Exam	
10 MAE 11	Applied Mathematics	04	--	02	03	50	100	150
10 MAE 12	Finite Element Methods	04	02	--	03	50	100	150
10 MAE 13	Introduction to Aerospace Vehicles & Systems	04	02	--	03	50	100	150
10 MAE 14	Aerodynamics & Flight Mechanics	04	--	02	03	50	100	150
10 MAE 15X	**Elective - I**	04	--	02	03	50	100	150
10 MAE 16	Seminar	--	--	03	--	50	--	50
	Total :-	20	04	09		300	500	800

Elective - I	
10 MAE 151	Solid Mechanics
10 MAE 152	Introduction to Avionics
10 MAE 153	Computational Fluid Dynamics & Wind Tunnel Testing

Note: The Internal Assessment marks for the core subjects with 2 hours of Practical will have 30 marks for theory and 20 marks for practical work.

I SEMESTER

APPLIED MATHEMATICS

Subject Code	**: 08 MAE11**	IA Marks	: 50
No. of Lecture Hours/ Week	: 04	Exam Hours	: 03
Total no. of Lecture Hours.	: 52	Exam Marks	: 100

---

1. Review of Fourier series and Applications, Review of Laplace Transforms and Applications, Eigen values and Eigen vectors. Some Applications of Eigen value problems.

06 Hours

2 . Classification of second order linear partial differential equations, Canonical forms for hyperbolic, parabolic and elliptic equations, Homogeneous and Non Homogeneous equations with constant coefficients. Applications

06 Hours

3 . Vector Functions, General rules for differentiation, Velocity and Acceleration, Gradient of a scalar field, Directional Derivative, Properties of Gradient, Divergence of vector point function, Curl of a vector point function, Properties of Divergence and Curl. Applications

07 Hours

4. Integration of vector functions, Line integral, Circulation, Work done by a force, Surface integrals, Volume integrals, Divergence Theorem of Gauss, Green's Theorem in the plane, Stoke's Theorem, Problems on all the three theorems and Applications

06 Hours

5. Review of Complex analysis, Complex analysis applied to potential theory, Electrostatic fields, conformal mapping, Heat problems, Fluid flow, General properties of Harmonic functions, Complex Integration, Cauchy's Theorem, Cauchy's Integral Formula, Cauchy's Integral Formula for Derivatives, Taylor's and Laurent's series. Applications.

07 Hours

6. Singular point, Residue, Method of finding Resides, Residue Theorem, Contour Integration, Integration round the unit circle, Rectangular contour. Applications.

06 Hours

7. Numerical Solutions algebraic and transcendental equations: Newton –Raphson method, Iteration method, Aitken's method, Solution of linear simultaneous equations. Gauss elimination method, Invrse of a matrix , Gauss-Seidal method, Crout's method. Solution of Ordinary Diferential Equations: Taylor's Series method, Picard's method, Euler's method, Euler's Modified method, Runge-Kutta 4^{th} order method. Applications.

07 Hours

8. Finite differences, Interpolation, Newton's Forward & Backward Interpolation formulae, Lagrange's formula, Newton's Divided difference, Central difference formulae (all formulae with proof). Numerical Differentiation, Numerical Integration (all rules with proof). Applications.

07 Hours

TEXT BOOKS:

1. Erwin Kreyszing: "**Advanced Engineering Mathematics"-** John Wiley & Sons(Asia) Pvt. Ltd. 8th edition
2. H K Dass:"**Advanced Engineering Mathematics"-** S Chand and Company Ltd. 12th edition.
3. Bali and Iyengar: "**Engineering Mathematics"-** Laxmi Publications (P) Ltd. 6th edition.

REFERENCE BOOKS:

1. C. Ray Wylie and Louis C Barret**: "Advanced Engineering".** Mathematics Tata McGraw Hill Publishing Co. Ltd. 6th edition.
2. Michael D Greenberg**: "Advanced Engineering Mathematics"-** Pearsons India Ltd. 2nd edition.
3. B S Grewal: "**Higher Engineering Mathematics"-** 12th edition.

FINTE ELEMENT METHOD

Subject Code	**: 08 MAE -12**	IA Marks	: 50
No. of Lecture Hours/ Week	: 04	Exam Hours	: 03
Total no. of Lecture Hours.	: 52	Exam Marks	: 100

---

1 Introduction to Finite Element Method : Engineering Analysis, History, Advantages, Classification, Basic steps, Convergence criteria, Role of finite element analysis in computer-aided design., Mathematical Preliminaries, Differential equations formulations, Variational formulations, weighted residual methods

06 Hours

2. One-Dimensional Elements-Analysis of Bars and Trusses: Basic Equations and Potential Energy Functional, 1-0 Bar Element, Admissible displacement function, Strain matrix, Stress recovery, Element equations, Stiffness matrix, Consistent nodal force vector: Body force, Initial strain, Assembly Procedure, Boundary and Constraint Conditions, Single point constraint, Multi-point constraint, 2-D Bar Element, Shape functions for Higher Order Elements

08 Hours

3. Two-Dimensional Elements-Analysis of Plane Elasticity Problems: Three-Noded Triangular Element (TRIA 3), Four-Nodded Quadrilateral Element (QUAD 4), Shape functions for Higher Order Elements (TRIA 6, QUAD 8)

07 Hours

4. Axi-symmetric Solid Elements-Analysis of Bodies of Revolution under axi-symmetric loading: Axisymmetric Triangular and Quadrilateral Ring Elements. Shape functions for Higher Order Elements

06 Hours

5. Three-Dimensional Elements-Applications to Solid Mechanics Problems: Basic Equations and Potential Energy Functional, Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family. Shape functions for Higher Order Elements

08 Hours

6. Beam Elements-Analysis of Beams and Frames: 1–D Beam Element, 2–D Beam Element, Problems.

05 Hours

7. Heat Transfer *I* Fluid Flow: Steady state heat transfer, 1 D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1 D heat transfer in thin fins. Basic differential equation for fluid flow in pipes, around solid bodies, porous media.

06 Hours

8. Dynamic Considerations: Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, axisymmetric triangular element, quadrilatateral element, beam element. Lumped mass matrix, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.

06 Hours

TEXT BOOKS:

1. Chandrupatla T. R., "**Finite Elements in engineering"-** 2nd Edition, PHI, 2007.
2. Lakshminarayana H. V., "**Finite Elements Analysis** – **Procedures in Engineering**"-Universities Press, 2004

REFERENCE BOOKS:

1. Rao S. S. "**Finite Elements Method in Engineering"**- 4th Edition, Elsevier, 2006
2. P.Seshu, "**Textbook of Finite Element Analysis"**-PHI, 2004.
3. J.N.Reddy,"**FiniteElementMethod"** , McGraw -Hill International Edition.
4. Bathe K. J**. "Finite Elements Procedures"**- PHI.
5. Cook R. D., et al., "**Concepts and Application of Finite Elements Analysis"**- 4th Edition, Wiley & Sons, 2003.

INTRODUCTION TO AEROSPACE VEHICLES AND SYSTEMS

Sub Code	**08 MAE 13**	IA Marks	: 50
No. of Lecture Hours/week	: 04	Exam Hours	: 03
Total Lecture Hours	: 52	Exam Marks	: 100

1. General introduction to aeronautics, configurations of various types of aircraft **: Fixed wing aircraft:** Light aircraft, Fighter aircraft, passenger aircraft, and Cargo aircraft. Rotary wing aircraft: Light helicopter, Large passenger and cargo helicopter.

06 Hours

2. Exploded view of various types of aircraft, identification of various structural parts, materials used and their functions: various systems, equipments and their functions Exploded view of various types of helicopters, identification of various structural parts and materials used, and their functions; various systems, equipments and their functions

07 Hours

3. Satellite Missions and introduction to orbital dynamics, Different types of satellites and their applications, Spacecraft configurations: structures, Systems and subsystems identifications and functions of each, Spacecraft environment.

07 Hours

4. Sounding Rockets, Different types of satellite launch vehicles, General description about Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV) and Geo-synchronous Satellite Launch Vehicle (GSLV), Staging of rockets, Brief introduction about space shuttle

06 Hours

5. Introduction to aircraft specifications and standards for both Military and Civil aircraft, Airworthiness certification aspects aircraft and airborne sores

06 Hours

6. Introduction to aerospace industries – Components and systems manufactures, Service industries, Research and Development organizations and Academic institutions in India and worldwide.

06 Hours

7. Introduction to flight-testing: Purpose and Scope of Flight Testing; introduction to general flying and handling characteristics of aircraft. Flight test plans and procedures, Preparation, pilot briefing, Flight test data acquisition, analysis and interpretation.

08 Hours

8. Introduction to Airport Engineering, Development of air transportation and airdromes, Aircraft characteristics, airport layout and terminologies

06 Hours

TEXT BOOKS:

1. Chenna Keshu S and Ganapathy K K:"**Aircraft Production Technology and Management"-** Interline Publishing, Bangalore 1993
2. Anderson J D: "**Introduction to Flight"-** McGraw Hill, 1987.

REFERENCE BOOKS:

1. ISRO Course"**Material on Satellite Architecture".**
2. Khanna, Arora and SS. Jain, "**Airport Planning and Design New Chand and Brothers".**
3. Ralph D Kimberlin: "**Flight Testing of Fixed wing Aircraft"-** AIAA Education Series, 2003
4. J. Gordon Leishman:"**Principles of Helicopter Aerodynamics**"- Cambridge Aerospace series, 2000
5. Kermode A C: "**Mechanics of Flight"-** Pearson Education Low Price Edition, 2005.
6. Horonjeff R and McKelvey F X, "**Planning and Design of Airports"** McGraw Hill, Inc.
7. Jane's All The World Aircraft

AERODYNAMICS & FLIGHT MECHANICS

Sub Code	**: 08 MAE14**	IA Marks	: 50
No. of Lecture Hours/week	: 04	Exam Hours	: 03
Total Lecture Hours	: 52	Exam Marks	: 100

1. Introduction: History of Flight. Aerodynamics: Some introductory thoughts: Properties of fluids; Characteristics of the atmosphere; Types of fluid flows; Motion of a fluid element Aircraft components and their functions. Lift, drag and moment. Types of Drag. Streamlined and Bluff bodies.

06Hours

2. Some Fundamental Principles and equations- Conservation laws of mass, momentum and energy; inviscid flows; potential flows; vortex motion. Aerodynamics of airfoils: Airfoils Classifications, and Characteristics. Angle of attack. Aspect ratio. Symmetric and cambered etc.

07Hours

3. Incompressible flows over airfoils: Reynolds and Mach numbers. Introduction to viscous flows. Classical thin airfoil theory: Incompressible flow over finite wings. Lift and Drag. Multi-element airfoils. Flow over flat plate and airfoils. Boundary layer transition and turbulent flows.

06 Hours

4. Aerodynamics of Finite wing – fuselage system and aerodynamics of control surfaces. High angle of attack aerodynamics. Introduction to delta wing. High speed Aerodynamics: Small perturbation theory, supersonic airfoils, wave drag, Prandtl-Glauret rule, Shock expansion theory, Swept wing, introduction to delta wing.

07 Hours

5. Flight Mechanics: Aviation history**.** Principles of Flight. Aircraft aerodynamics; Drag and Thrust**.** Steady and level Flight. Variation of Thrust, Drag, Power available, and Power required with speed and altitude. Minimum drag, minimum power, Maximum and minimum level flight speeds.

06 Hours

6. Flight Mechanics: Steady Performance: Range and Endurance of jet and piston prop airplanes Airplane Steady Performance**:** General equation of motion, Steady level flight performance, Steady Climbing, Gliding Flights ; Minimum rate of sink and range in a glide.

07 Hours

7. Flight Mechanics: Accelerated Performance: Turn performance; Bank angle, load factor, pull-up & pull-down manouver; accelerated climbing V-n diagram, . Estimation of take-off and landing distances. Balanced Field Length

07 Hours

8. Stability and control: Definition of stability, equilibrium, definition of static and dynamic stability; Static Longitudinal Stability and Control ; Lateral and directional Stability and Control. Dynamic Stability

06 Hours

TEXT BOOKS:

1. John D. Anderson, Jr.: "**Fundamentals of Aerodynamics"-** Third edition, McGraw-Hill publications, 2001
2. Anderson J.D, "**Introduction to Flight"-** McGraw Hill, 1987

REFERENCE BOOKS:

1. Perkins, C.D., and Hage, R.E.: "**Airplane Performance, stability and Control"-** John Wiley & Sons Inc, New York, 1988
2. E L Houghton and PW Carpenter, "**Aerodynamics for Engineering students"-** Fourth edition, Edward Arnold publications, 1993.
3. John D Anderson, Jr., "**Computational Fluid Dynamics the basics with Applications"-** McGraw-Hill publications, 1995.
4. McCormick B.W. "**Aerodynamics, Aeronautics and Flight Mechanics"-** John Wiley & Sons New York, 1979.
5. Kermode A.C. "**Flight without Formulae"-** McGraw Hill, 1985.
6. Anderson J.D., "**Foundation of Aerodynamics"-** McGraw Hill Book Co, New York,1985
7. Clancy L.J. "**Aerodynamics"-** Pitman, 1986.
8. Bertin J.J**. "Aerodynamics for Engineers"-** Prentice Hall, 1988.
9. Ojha S.K., "**Flight Performance of Aircraft"-** AIAA Education Series. Editor in Chief, J.S. Przemieniecki 1995.

SOLID MECHANICS

Sub Code	**08 MAE 151**	IA Marks	: 50
No. of Lecture Hours/week	: 04	Exam Hours	: 03
Total Lecture Hours	: 52	Exam Marks	: 100

*1. Introduction**: Definition and scope, Strength of materials vs. Theory of elasticity, Structural analysis and design, Types of forces, Definition of Determinate and Indeterminate structures. Stress, Strain. Concept of Vectors and Tensors.***

07 Hours

*2.Mechanical Properties Of Solids**: Macroscopic properties of materials, Tensile properties, Strain hardening and other properties, Idealised one-dimensional stress-strain laws, Fatigue and hysteresis.***

06 Hours

*3. Analysis of Stresses: **Definition and types of stresses, Principal stresses and Principal planes, Notation and Sign convention, Stress tensors, Equations of equilibrium, Transformation of stresses and Applications, Plane stresses, Mohr circle.***

06 Hours

4.Analysis Of Strains: Types of Strain, Strain displacement relation, Strain at a point and strain tensor and its properties. Small strain and linear elasticity, Strain transformation equations. Strain rosettes, St.Venant's Principle, Plane stress and plane strain.

07 Hours

5.Stress – Strain Relations: Genenalised Hooke's law, Plastic deformation, Yield criteria and theories of failure.

06 Hours

6.Torsion Of Circular & Non-Circular Sections: Basic assumptions, Torsion equation and exact methods for Torsion equations. Warping of non-circular sections, Prandtl solutions using stress functions, Membrane analogy, Torsion of thin hollow sections.

07 Hours

7.Beams And Bending: Shear force and Bending moment diagrams, Geometrical characteristic of cross-sections. Stresses due to bending and shear. Deflection of beams and design of beams

06 Hours

8. Columns: Stable and Unstable equilibrium, Stability of long column, End conditions and theoretical solutions, Effective length factors, Limitations of Euler formula, Columns with eccentric loading. Design of columns

07 Hours

TEXT BOOKS:

1. S.M.A. Kazimi, "**Solid Mechanics"-** Tata Mc Graw Hill, 1988
2. Shames, I.H., **"Introduction to Solid Mechanics"** Prentice Hall of India Pvt. Ltd, 1990.

REFERENCE BOOKS:

1. Timoshenko, S. **"Strength of Materials"-** Vol. I and II, Princeton D. Von Nostrand Co, 1990.
2. Megson, T.M.G., "**Aircraft Structures for Engineering Students**"- Edward Arnold, 1995.
3. Fenner, R.T., **"Mechanics of Solids"-**Blackwell Scientific Publications, 1989.

COMPUTATIONAL FLUID DYNAMICS AND WIND TUNNEL TESTING

Sub Code	**: 08 MAE 152**	IA Marks	: 50
No. of Lecture Hours/week	: 04	Exam Hours	: 03
Total Lecture Hours	: 52	Exam Marks	: 100

Computational Fluid Dynamics:

1. Introduction and philosophy of computational fluid dynamics

06 Hours

2. Governing equations of fluid dynamics: their derivation, discussion on their physical meaning and formulation

07 Hours

3. Studies on the Partial Differential Equations and their impact on CTD Discrimination.

06 Hours

4. **Grid generation and sensitivity studies**: Typical examples and applications- Explicit, Implicit, & Unwinding Schemes; relaxation,& successive over relaxation process, Numerical dissipation & dispersion. Artificial viscosity. Discussions on advanced topics and future of CFD

07 Hours

Wind Tunnel Testing:

5. Introduction to the purpose of wind tunnel testing and types of wind tunnels

06 Hours

6. Wind tunnel design considerations for different types of wind tunnels

06 Hours

7.Instrumentation and calibration of the test section. Force, Moment and Pressure measuring devices.

06Hours

)

8. Model design and fabrication considerations for tunnel testing, Generation of test plans and procedures, Testing and data acquisition and reduction applying corrections. Non-aeronautical use of wind tunnels

08 Hours

TEXT BOOKS:

1. John D Anderson Jr**.** "**Computational Fluid Dynamics, The basics with Applications".**
2. Alan Pope and William H RAE Jr. "**Low Speed Wind Tunnel Testing".**
3. Alan Pope and Kennith L Goin, "**High Speed Wind Tunnel Testing".**

INTRODUCTION TO AVIONICS

Sub Code	**08 MAE 153**	IA Marks	: 50
No. of Lecture Hours/week	: 04	Exam Hours	: 03

Total Lecture Hours	: 52	Exam Marks	: 100

1.Introduction: Importance and role of avionics, avionic environment, Regulatory and advisory agencies

02 Hours

Displays And Man-Machine Interaction: Head up displays, helmet mount displays, discussion of HUDs vs HMDs, Head down displays, data fusion, intelligent displays management, Displays technology, control and data entry, instrument placement

05 Hours

2.Aircraft Sensor Systems And Indicators: Aircraft state sensors: Air data information and its use, Air data sensors and air data systems, air stream direction detection; **Inertial reference systems:** Gyros and accelerometers, attitude derivation. RMI, HIS, ADI; **Outside world sensor systems:** Radar systems, Infrared systems

07 Hours

3.Navigation Systems: Principles of navigation, Terrestrial en route navigation and landing aids, Inertial Navigation, Aided Inertial Navigation systems and Kalman filters, GPS-global positioning system, terrain reference navigation

06 Hours

4.Surveillance Systems: Air traffic control, Primary radar, Secondary radar, Replies, Various system modes, error checking, Transponders of ATCCRB & Mode S, Collision avoidance, Lightning detection, Weather radar.

06 Hours

5.Airborne Communications Systems: VHF AM Communications, VHF Communications hardware, High frequency communications, ACARS, SELCAL, Digital Communications and Networking, VHF Digital communications, Data link Modes.

07 Hours

6.Onboard Communications: Microphones, Digital communications, Transmission lines, Digital data bus systems ARINC 426, MIL STD 1553, ARINC 629, Commercial standard digital bus, Fiber optic communication

07 Hours

7.Avionic Systems Integration: Data bus systems, integrated modular avionics, commercial off-the shelf (COTS)

06 Hours

8.Unmanned air vehicles: Importance of Unmanned air vehicles, UAV avionics

06 Hours

TEXT BOOKS:

1. Collinson RPG, "**Introduction to Avionics"-** Second Edition, Kluwer Academic Publishers, Chapman & Hall, 2003.
2. Albert Helfrick, "**Principals of Avionics"-** 2nd Edition, Avionics Communication Inc.

REFERENCE BOOKS:

1. Middleton, D.H., Ed., **"Avionics Systems, Longman Scientific and Technical"-** Longman Group UK Ltd., England, 1989.
2. Brain Kendal, **"Manual of Avionics"-** The English Book House, 3rd Edition, New Delhi, 1993.