Proposed Scheme and Syllabus from academic year 2010-11
Aeronautical Engineering
VII Semester

Sl No	Subject Code	Title	Teaching Dept.	Teaching Hours / week		Examination			
				Th.	Pr.	Dura-tion	I.A Marks	Theory/ Practical	Total Marks
1	10AE71	Control Engineering	AE/ME	04	--	03	25	100	125
2	10AE72	Aircraft Structures-II	AE	04	--	03	25	100	125
3	10AE73	Aircraft Stability and Control	AE	04	--	03	25	100	125
4	10AE74	Gas Turbine Technology	AE	04	--	03	25	100	125
5	10AE75*	*Electives II – (Group B)	AE	04	--	03	25	100	125
6	10AE76*	*Electives III –(Group C)	AE	04	--	03	25	100	125
7	10AEL77	Design, Modeling and Analysis Laboratory	AE	--	03	03	25	50	75
8	10AEL78	Simulation Laboratory	AE	--	03	03	25	50	75
Total				24	06	24	200	700	900

Note: One question has to be set for every 6 to 8 hours of teaching.

Subject Code	* Elective II (Group B)	Subject Code	* Elective III (Group C)
10AE751	Optimisation Techniques	10AE761	Experimental Stress analysis
10AE752	Computational Fluid Dynamics	10AE762	Helicopter Dynamics
10AE753	Aircraft Maintenance, Repair and Overhaul	10AE763	Space Mechanics and Launch Vehicles
10AE754	Statistical Quality Control	10AE764	Smart Materials
10AE755	Theory of plates and shells	10AE765	Agile Manufacturing
10AE756	Nondestructive Testing	10AE766	Robotics
10AE757	Mechatronics and Microprocessor	10AE767	Industrial and Experimental Aerodynamics
10AE758	Total Quality Management	10AE768	Micro and Smart Systems Technology

* Students shall register for one subject from each Group B and C Electives

Control Engineering

Sub Code:	**10AE71**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus is same as existing Sub code 10ME82

Aircraft Structures - II

Sub Code:	**10AE72**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction to Aircraft Structural Design:

Structural layout of the Airplane and components, Structural design V-n diagram,loads acting on major components such as wing, fuselage, tails, landing gear etc.,Concept of allowable stress and margin of safety.

Unit 2. **06 Hrs**

Unsymmetrical Bending:

Bending stresses in beams of unsymmetrical sections – Bending of symmetric sections with skew loads

Unit 3. **06 Hrs**

Shear Flow in Open Sections:

Thin walled beams, Concept of shear flow, shear centre, Elastic axis. With one axis of symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections.

Unit 4. **08 Hrs**

Shear Flow in Closed Sections:

Bredt – Batho formula, Single and multi – cell structures, Approximate methods, Shear flow in single & multi-cell structures under torsion. Shear flow in single and multi-cell under bending with walls effective and ineffective.

PART B

Unit 5. **06 Hrs**

Buckling of Plates:

Rectangular sheets under compression, Local buckling stress of thin walled sections, Crippling stresses by Needham's and Gerard's methods, Thin walled column strength. Sheet – stiffener panels. Effective width, inter rivet and sheet wrinkling failures.

Unit 6. **08 Hrs**

Stress Analysis in Wing And Fuselage:

Procedure – Shear and bending moment distribution for semi cantilever and other types of wings and fuselage, thin webbed beam. With parallel and non parallel flanges, Shear resistant web beams, Tension field web beams (Wagner's).

Unit 7. **06 Hrs**

Design of Aircraft Structure:

Design criteria – Safety Factor – Design life criteria – Analysis method – Life Assessment procedures – Design Principle – Future Airworthiness Requirements– Two bay crack criteria – Widespread Fatigue damage.

Unit 8. **06 Hrs**

Joints and Fittings And Introduction to Post Buckling:

General theory for the design of fittings, Estimation of fitting design loads, design of riveted, bolted and welding joints, post buckling of structures, concept of effective width.

Text Books:

1. Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold,1995.

2. Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw–Hill, N.Y., 1993.

Reference:

1. Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, 1985.

2. Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw-Hill, 1993.

3. D Williams & Edward Arnold, An Introduction to the Theory of Aircraft Structures

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B

Aircraft Stability and Control

Sub Code:	**10AE73**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Static Longitudinal Stability:

Historical perspective, Aerodynamic Nomenclature, Equilibrium conditions, Definition of static stability, Definition of longitudinal static stability, stability criteria, Contribution of airframe components: Wing contribution, Tail contribution, Fuselage contribution, Power effects-Propeller airplane and Jet airplane

Unit 2. **07 Hrs**

Static Longitudinal Stability and Control-Stick Fixed

Introduction, Trim condition. Static margin. stick fixed neutral points. Longitudinal control, Elevator power, Elevator angle versus equilibrium lift coefficient, Elevator required for landing, Restriction on forward C.G. range,

Unit 3. **07 Hrs**

Static Longitudinal Stability and Control-Stick Free

Introduction, Hinge moment parameters, Control surface floating characteristics and aerodynamic balance, Estimation of hinge moment parameters, The trim tabs, Stick-free Neutral point, Stick force gradient in unaccelerated flight, Restriction on aft C.G.

Unit 4. **06 Hrs**

Static Directional Stability and Control

Introduction, Definition of directional stability, Static directional stability rudder fixed, Contribution of airframe components, Directional control. Rudder power, Stick-free directional stability, Requirements for directional control, Rudder lock, Dorsal fin. One engine inoperative condition.. Weather cocking effect.

PART B

Unit 5. **06 Hrs**

Static Lateral Stability And Control

Introduction, definition of Roll stability. Estimation of dihedral effect., Effect of wing sweep, flaps, and power, Lateral control, Estimation of lateral control power, Aileron control forces, Balancing the aileron. Coupling between rolling and yawing moments. Adverse yaw effects. Aileron reversal.

Unit 6. **07 Hrs**

Dynamic Longitudinal Stability

Definition of Dynamic longitudinal stability: types of modes of motion: long or phugoid motion, short period motion. Airplane Equations of longitudinal motion, Derivation of rigid body equations of motion, Orientation and position of the airplane, gravitational and thrust forces, Small disturbance theory.

Unit 7. **07 Hrs**

Estimation of Dynamic Derivatives:

Aerodynamic force and moment representation, Derivatives due to change in forward speed, Derivatives due to the pitching velocity, Derivatives due to the time rate of change of angle of attack, Derivatives due to rolling rate, Derivatives due to yawing rate

Unit 8. **06 Hrs**

Dynamic Lateral and Directional Stability

Routh's criteria. Factors affecting period and damping of oscillations. Effect of wind shear. Flying qualities in pitch. Cooper-Harper Scale. Response to aileron step-function, side-slip excursion. Dutch roll and Spiral instability. Auto- rotation and spin. Stability derivatives for lateral and directional dynamics. Roll-Pitch-Yaw Inertial coupling.

Text Books:

1. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2007.
2. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988.

References

1. Bernard Etkin, " Dynamics of Flight Stability and Control", John Wiley & Sons, Second Edition, 1982.
2. Bandu N. Pamadi, ` Performance, Stability, Dynamics and Control of Airplanes`, AIAA 2nd Edition Series, 2004.
3. Barnes W. McCormick, ` Aerodynamics, Aeronautics, and Flight Mechanics`, John Wiley & Sons, Inc. 1995.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B

Gas Turbine Technology

Sub Code:	**10AE74**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART-A

Unit 1. **06 Hrs**

Types, Variation & Applications

Types of engines showing arrangement of parts. Operating parameters. Energy distribution of turbojet, turboprop and turbofan engines. Comparison of thrust and specific fuel consumption. Thrust, pressure and velocity diagrams.

Unit 2. **07 Hrs**

Engine Parts

Compressor assembly, types of burners: advantages and disadvantages. Influence of design factors on burner performance. Effect of operating variables on burner performance. Performance requirements of combustion chambers. Construction of nozzles. Impulse turbine and reaction turbine. Exhaust system, sound suppression. Thrust reversal: types, design & systems. Methods of thrust augmentation, afterburner system.

Unit 3. **06 Hrs**

Materials and Manufacturing

Criteria for selection of materials. Heat ranges of metals, high temperature strength. surface finishing. Powder metallurgy. Use of composites and Ceramics. Superalloys for Turbines.

Unit 4. **07 Hrs**

Systems

Fuel systems and components. Sensors and Controls. FADEC interface with engine. Typical fuel system. Oil system components. Typical oil system. Starting systems. Typical starting characteristics. Various gas turbine starters.

PART – B

Unit 5. **06 Hrs**

Engine Performance

Design & off-design Performance. Surge margin requirements, surge margin stack up. Transient performance. Qualitative characteristics quantities. Transient working lines. Starting process & Wind milling of Engines. Thrust engine start envelope. Starting torque and speed requirements Calculations for design and off-design performance from given test data – (case study for a single shaft Jet Engine). Engine performance monitoring.

Unit 6. **07 Hrs**

Component Level Testing

Compressor: Compressor MAP. Surge margin, Inlet distortions. Testing and Performance Evaluation. **Combustor:** Combustor MAP, Pressure loss, combustion light up test. Testing and

Performance Evaluation. **Turbines:** Turbine MAP. Turbine Testing and Performance Evaluation. **Inlet duct & nozzles:** Ram pressure recovery of inlet duct. Propelling nozzles, after burner, maximum mass flow conditions. Testing and Performance Evaluation.

Unit 7. **07 Hrs**

Engine Testing

Proof of Concepts: Design Evaluation tests. Structural Integrity. Environmental Ingestion Capability. Preliminary Flight Rating Test, Qualification Test, Acceptance Test. Reliability figure of merit. Durability and Life Assessment Tests, Reliability Tests. Engine testing with simulated inlet distortions and, surge test. Estimating engine-operating limits. Methods of displacing equilibrium lines.

Types of engine testings: Normally Aspirated Testing, Open Air Test Bed ,Ram Air Testing, Altitude Testing, Altitude test facility, Flying Test Bed, Ground Testing of Engine Installed in Aircraft, Flight testing. Jet thrust measurements in flight. Test procedure: Test Schedule Preparation, Test Log Sheets, Test Documents. Type approval.

Unit 8. **06 Hrs**

Test Cells

Factors for design of engine test beds. Test bed calibration. Steps in test bed cross calibration.Measurements and Instrumentation. Data Acquisition system, Measurement of Shaft speed, Torque, Thrust, Pressure, Temperature, Vibration, Stress, Temperature of turbine blading etc. Engine performance trends: Mass and CUSUM plots. Accuracy and Uncertainty in Measurements. Uncertainty analysis. Performance Reduction Methodology.

Text Books:

1. Irwin E. Treager, `Gas Turbine Engine Technology` , GLENCOE Aviation Technology Series, 7th Edition, Tata McGraw Hill Publishing Co.Ltd. Print 2003.
2. P.P Walsh and P. Peletcher, 'Gas Turbine Performance' Blackwell Science, 1998, ISBN 0632047843.
3. Michael J. Kores , and Thomas W. Wild**,**` Aircraft Power Plant`, GLENCOE Aviation Technology Series, 7th Edition, Tata McGraw Hill Publishing Co.Ltd. 2002.

Reference Books:

1. Advance Aero-Engine Testing, AGARD-59 Publication
2. MIL –5007 E , `Military Specifications: Engine , Aircraft, Turbo Jet & Turbofan ; General Specification for Advance Aero Engine testing`, 15th Oct 1973.
3. J P Holman,` Experimental methods for Engineers`, Tata McGraw –Hill Publishing Co. Ltd . ,2007.
4. A S Rangawala-Turbomachinery dynamics-Design and operations, McGraw –Hill Publishing Co. Ltd . ,2007.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B

Optimisation Techniques

Sub Code:	**10AE751**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Non-linear programming. Mathematical fundamentals. Numerical evaluation of gradient.

Unit 2. **06 Hrs**

Unconstrianed Optimisation

One dimensional, single variable optimization. Maximum of a function. Unimodal-Fibonacci method. Polynomial based methods.

Unit 3. **07 Hrs**

Unconstrained Minimisation

Multivariable functions. Necessary and sufficient conditions for optimality. Convexity. Steepest Descent Method -Convergence Characteristics. Conjugate Gradient Method. Linear programming -Simplex Method.

Unit 4. **07 Hrs**

Constrained Minimisation

Non-linear programming. Gradient based methods. Rosens`s gradient, Zoutendijk`s method, Generalised reduced gradient, Sequential quadratic programming. Sufficient condition for optimality.

PART B

Unit 5. **06 Hrs**

Direct Search Methods

Direct search methods for nonlinear optimization. Cyclic coordinate search. Hooke and Jeeves Pattern search method. Generic algorithm.

Unit 6. **06 Hrs**

Discrete And Dynamic Programming

Integer and discrete programming. Branch and bound algorithm for mixed integers. General definition of dynamic programming problem. Problem modeling and computer implementation. Shortest path problem.

Unit 7. **07 Hrs**

Optimisation Application

Transportation problem. Transportation simplex method. Network problems. Maximum flow in net works. General definition of dynamic programming. Problem modeling and computer implementation.

Unit 8. **07 Hrs**

Finite Element Based Optimisation

Parameter optimization using gradient methods -Derivative calculation. Shape optimisation. Topology optimisation of continuum structures.

Text Books:

1. Ashok D Belegundu and Tirupathi R . Chandrupatla, `Optimisation Concepts and Applications in Engineering`, Pearson Education, In C.,1991.

Reference Books:

1. Fletcher, R., `Practical Methods of Optimisation`, Wiley, New York ,2nd Edition, 1987.
2. Dennis J.E. and Schnabel, R. B., `Numerical Methods for Unconstrained Optimisation and Nonlinear Equations`, Prentice Hall, Engle Wood Cliffs, New Jersey, 1983.
3. S.S. Rao, ` Optimisation -Theory and Application`, Wiley Eastern Ltd., 5th Edition.1990.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B

Computational Fluid Dynamics

Sub Code:	**10AE752**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Insight into power and philosophy of CFD. CFD ideas to understand. CFD application. Need for parallel computers for CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity.

Unit 2. **07 Hrs**

Governing Equations

Continuity, Momentum and Energy equations; derivation in various forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of the governing equations particularly suited for CFD work: Shock fitting and Shock capturing methods. Generic form of equations.

Unit 3. **06 Hrs**

Mathematical Behavior of Partial Differential Equations:

Classification of partial differential equations. Cramer rule and Eigen value method. Hyperbolic, parabolic and elliptic forms of equations. Impact on physical and computational fluid dynamics; case studies: steady inviscid supersonic flow; unsteady invisid flow; steady boundary layer flow; and unsteady thermal conduction.

Unit 4. **07 Hrs**

Discretization

Essence of discretization. Taylor series approach for the construction of finite-difference quotients. Higher order difference quotients. Up-wind differencing. Midpoint leap frog method. Reflection boundary condition. Difference equations. Explicit and Implicit approach: definition and contrasts. Errors and analysis of stability. Error propagation. Stability properties of Explicit and Implicit methods.

PART B

Unit 5. **07 Hrs**

Grid Generation

Body –fitted coordinate system. Need for grid generation. Essential properties of grids. Types of grids (O-type, C-type and H- type). Various grid generation techniques - Algebraic, and Numerical grid generation. Elliptic grid generation. Structured, Un-structured grids, Adaptive grids, Grid collapse. Multi-Grid methods .Grid accuracies.

Unit 6. **06 Hrs**

Appropriate Transformation

General transformation of equations. Metrics and Jacobians. Generic form of the governing flow equations with strong conservative form in the transformed space. Transformation of continuity equation from physical plane into computational plane; application of Grids stretching .

Unit 7. **06 Hrs**

Finite Volume Techniques

Finite Volume Discretization - Cell Centered Formulation. High resolution finite volume upwind Scheme. Runge - Kutta Time Stepping . Multi - Time –Step Integration scheme. Cell Vertex Formulation. Numerical dispersion.

Unit 8. **07 Hrs**

CFD Application to Some Problems

Time and space marching. LAX-WENDROFF Technique . Relaxation technique. Point iterative mehod. Successive over-relaxation/under relaxation. Aspects of numerical dissipation and dispersion; artificial viscosity. The Alternating-Direction- (ADI) Implicit Technique. Approximate factorization scheme. Upwind schemes; Flux vector splitting.

Text Books:

1. John D Anderson Jr. Computational Fluid Dynamics,`The Basics with Applications`, McGraw Hill International Edn; 1995 .
2. Tapan K. Sengupta, `Fundamentals of Computational Fluid Dynamics`, Universities Press (India) Private Limited; 2005.

References:

1. F. Wendt (Editor), “Computational Fluid Dynamics - An Introduction”, Springer – Verlag, Berlin; 1992.
2. Charles Hirsch, “Numerical Computation of Internal and External Flows”, Vols. I and II. John Wiley & Sons, New York; 1988.
3. Jiyuan Tu, Guan Heng Yeoh, and Chaoqun Liu,` Computational Fluid Dynamics- A Practical Approach`, Elsevier Inc; 2008.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Aircraft Maintenance, Repair and Overhaul

Sub Code:	**10AE753**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **07 Hrs**

Welding In Aircraft Structural Components

Equipments used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing.

Unit 2. **06 Hrs**

Sheet Metal Repair And Maintenance

Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation – reverse technology.

Unit 3. **07 Hrs**

Plastics and Composites in Aircraft

Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes.

Unit 4. **06 Hrs**

Inspection And Repair Of Composite Components:

Inspection and Repair of composite components – Special precautions – Autoclaves.

PART B

Unit 5. **07 Hrs**

Aircraft Jacking, Assembly And Rigging

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

Unit 6. **07 Hrs**

Review of Hydraulic and Pneumatic System

Trouble shooting and maintenance practices – Service and inspection. – Inspection and maintenance of landing gear systems. – Inspection and maintenance of air-conditioning and pressurisation system, water and waste system. Installation and maintenance of Instruments – handling – Testing – Inspection.

Unit 7. **06 Hrs**

Inspection And Maintenance Of Auxilary Systems:

Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs)

Unit 8. **06 Hrs**

Safety Practices

Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Troubshooting - Theory and practices.

Text Book

1. KROES, WATKINS, DELP, “Aircraft Maintenance and Repair”, McGraw-Hill, New York,1992.

References

1. LARRY REITHMEIR, “Aircraft Repair Manual”, Palamar Books, Marquette, 1992
2. BRIMM D.J. BOGGES H.E., “Aircraft Maintenance”, Pitman Publishing corp. New York, 1940.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Statistical Quality Control

Sub Code:	**10AE754**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME668

Theory of Plates and Shells

Sub Code:	**10AE755**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Plate and Shell Structures in Aerospace Vehicles. Flexural rigidity of plates. Flexural rigidity of shells. Introduction to bending and buckling of plates and shells. Reinforced plates. Eccentrically compressed shells.

Unit 2. **07 Hrs**

Bending of Thin Plates -Stresses

Pure bending of plates. Isotropic and orthotropic flat plates. Flexural rigidity of plate. Bending of plates by distributed lateral load. Combined bending and tension or compression. Bending and twisting moments. Shear stress.

Unit 3. **06 Hrs**

Bending Of Thin Plates - Strain Energy

Slopes of deflection of surface. Different edge conditions: - built in edge, simply supported edge and, free edge. Combined bending and tension or compression of plates. Strain energy by: – bending of plates, bending by lateral loads, combined bending and tension or compression of plates.

Unit 4. **07 Hrs**

Buckling Of Thin Plates

Method of calculation of critical loads. Buckling of simply supported rectangular plates uniformly compressed in one direction. Buckling of uniformly compressed rectangular plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides. Critical values of compressive stress.

PART B

Unit 5. **07 Hrs**

Buckling of Reinforced Plates

Stability of plates reinforced by ribs. Simply supported rectangular plates with longitudinal ribs. General equation for critical compressive stress. Critical compressive stress for a plate stiffened by one rib. Study of the experimental value of buckling of plates.

Unit 6. **07 Hrs**

Bending of Thin Shells

Deformation of an element of a shell. Expression for components of normal stresses. Flexural rigidity of shell. Case of deformation with presence of shearing stresses.

Unit 7. **06 Hrs**

Strain Energy Of Deformation Of Shells:

Strain energy of deformation of shell:-bending and stretching of middle surface. Symmetrical deformation of a circular cylindrical shell. Differential equation for bending of strip.

Unit 8. **06 Hrs**

Buckling of Shells

Symmetrical buckling of cylindrical shell under the action of uniform axial compression :- differential equation , critical stress. Symmetrical buckling of cylindrical shell under the action of uniform axial pressure. Study of the experimental values of cylindrical shells in axial compression. Bent or eccentrically compressed shells.

Text Books:

1. Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw-Hill Book Co. 1986.
2. Timoshenko, S.P. Winowsky. S., and Kreger, "Theory of Plates and Shells", McGraw-Hill Book Co. 1990

References:

1. Flugge, W. "Stresses in Shells", Springer – Verlag, 1985.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Nondestructive Testing

Sub Code:	**10AE756**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1 **07 Hrs**

Introduction

An Overview. Factors influencing the Reliability of NDE. Defects in materials. Defects in composites. NDT methods used for evaluation of materials and composites.

Unit 2 **07 Hrs**

Radiographic Inspection

X – Ray radiography: Principles of X – ray radiography, equipment. Production of X -rays, absorption, scattering, X-ray film processing; industrial radiographic practice, micro-radiography

Gamma ray radiography: Radioactivity, gamma ray sources, film radiography, application, examples.

General radiographic procedures. Reading and Interpretation of Radiographs. Defects in welding.

Unit 3 **06 Hrs**

Ultrasonics

Principle of wave propagation. Ultrasonic equipment. Variables affecting an ultrasound test. Basic methods and general considerations. Testing of products. Ultrasonic testing of composites.

Unit 4. **06 Hrs**

Ultrasonic Inspection

Ultrasonic application for thickness measurement. Types of scanning, types of indication. Welding inspection, tube inspection, test standards, determination of elastic constants.

PART -B

Unit 5. **06 Hrs**

Liquid Penetrant Test

Basic concept. Test equipment. Test Parameters & Procedure. Safety precautions.

Unit 6. **07 Hrs**

Magnetic Particle Test

Methods of generating magnetic field. Demagnetization of materials. Magnetic particle test: Principles , Test Equipment and Procedure. Interpretation and evaluation.

Unit 7. **06 Hrs**

Eddy Current Test

Principles of eddy current. Factors affecting eddy currents. Test system and test arrangement. Standardization and calibration. Application and effectiveness.

Unit 8. **07 Hrs**

Some Other Methods `

Thermal Inspection: Principles, equipment, inspection methods, applications.

Optical Holography: Principles, applications, holographic recording interferometer techniques of inspection

Acoustic Emission Inspection: Principle, comparison with other NDT methods, applicability, acoustic emission waves and propagation. Instrumentation principles.

Text Book:

1. J Prasad and C G Krishnadas Nair, ` Non-Destructive Test and Evaluation of Materials`, Tata McGraw-Hill Publishing Co. Ltd., 2008.

Reference Books:

1. Metals Hand Book, Vol-17, 9th Edition, Non destructive evaluation & quality control, American society of metals. 2001
2. Baldev Raj, T. Jayakumar, M. Thavasimuthu, `Nondestructive Testing`, Narosa Publishing House, 1997.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Mechatronics and Microprocessor

Sub Code:	**10AE757**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME65.

Total Quality Management

Sub Code:	**10AE758**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME758

Elective III (Group C)

Experimental Stress Analysis

Sub Code:	**10AE761**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME761

Helicopter Dynamics

Sub Code:	**10AE762**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART- A

Unit 1. **06 Hrs**

Introduction to Helicopter

Definitions. Genealogical tree of aircraft. Comparison between fixed wing aircraft and helicopter. Some helicopter configurations, major parts, and their functions. Civil and Military applications of helicopters. High speed rotorcraft.

Unit 2. **07 Hrs**

Hover And Vertical Flight

Momentum theory and its application. Hovering flight and ground effects. Forces acting during hovering flight. Disc loading and power loading. Thrust and power coefficients. Figure of merit for hover thrust efficiency. Rotor solidity and blade loading coefficient. Forces acting during vertical flight. Cockpit control for vertical flight. Vertical climb and descend - variation in induced velocities. Torque balance and directional control, turning flights.

Unit 3. **07 Hrs**

Forward Flight

Forces acting on helicopter in forward flight. Method of achieving translatory flight. Controlling cyclic pitch: Swash-plate system. Blade flapping, feathering. Schematics showing flapping, lead/lag and feathering motion of rotor blade. Drag hinges. Lateral tilt - with and without conning. Lateral and longitudinal asymmetry of lift in forward flight. Types of rotors - teetering design, articulated design,, the hinge less design and bearing less design. Cockpit control of rotor system (collective and cyclic pitch).

Unit 4. **06 Hrs**

Basic Helicopter Performance

Hovering and axial climb and descent performance. Forward flight performance - total power required, effect of gross weight, effect of density altitude, lift – drag ratios, speed for minimum power, speed for maximum range. Factors affecting the maximum attainable forward speed. Autorotation- autorotation in forward flight, autorotation index. Ground effects in hover, transition and near ground, at low speed and high speed flights.

PART B

Unit 5. **06 Hrs**

Rotor Airfoil Aerodynamics And Dynamic Stall

Rotor airfoil requirements - Reynolds number and Mach number influence. Airfoil shape criteria. Dynamic stall in rotor environment, flow topology. Effect of sweep angle on dynamic stall. Effect of aerofoil shape on dynamic stall.

Unit 6. **07 Hrs**

Helicopter Stabilty And Control

Introductory concepts of stability, control and trim- hover trim and forward flight trim. Static stability of helicopters: longitudinal, lateral – directional and, directional. Dynamic stability aspects. Flight controls and stability augmentation, Main rotor control and tail rotor control.

Unit 7. **07 Hrs**

Standards , Specifications And Testing Aspects

Scope of requirements. General and operational requirements. Military derivatives of civil rotorcraft. Structural strength and design for operations on specified surfaces. Rotorcraft vibration classification. Flight and Ground Handling Qualities – General requirements and definitions. Control characteristics, breakout forces. Levels of handling qualities. Flight Testing - General handling fight test requirements and, the basis of limitations.

Unit 8. **06 Hrs**

Conceptual Design Of Helicopters

Design requirements. Design of main rotor - rotor dia, tip speed, rotor solidity, blade twist and aerofoil selection. Fuselage design - fuselage drag, vertical drag and down loads, side forces. Empennage design.

Text Books:

1. John Fay, `The Helicopter, History, Piloting & How it Flies`, Sterling Book House 2007
2. Gordon Leisshman J, `Principles of Helicopter Aerodynamics`, Cambridge University Press, 2002

Reference Books:

1. Bramwell,`Helicopter Dynamics`.
2. Def Stan 00970, Vol. 2 Rotorcraft
3. Saunders, G H, `Dynamics of Helicopter Flight`, John Wiley & Sons, Inc, NY, 1975

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

SPACE MECHANICS AND LAUNCH VEHICALS

Sub Code:	**10AE763**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **07 Hrs**

Intoduction to Space Mechanics

Space vehicles/ platforms. Inertial and Earth fixed coordinate reference frames. Representation of vector (position, velocity and acceleration) in fixed and moving reference frames, Coordinate transformations, Euler transformations.

Unit 2. **06 Hrs**

Central Force Motion

Two body problem and one body problem. Kepler's laws of motion.

Unit 3. **07 Hrs**

Orbital Mechanics

Establishment of orbits, single impulse and two impulse orbital transfers, ballistic trajectory, orbital perturbations – general and special perturbation methods, Sun synchronous and Geo-synchronous orbits.

Unit 4. **06 Hrs**

Satellite Dynamics

Geosynchronous and geostationary satellites life time - satellite perturbations - Hohmann orbits - calculation of orbit parameters - Determination of satellite rectangular coordinates from orbital elements

PART B

Unit 5. **06 Hrs**

Introduction to Launch Vehicles

Introduction to launch vehicles.. Introduction to Solid, Liquid and Cryogenic rocket engines. Performance parameters. Comparison of liquid propellant, solid Propellant and hybrid rockets.

Unit 6. **07 Hrs**

Principles of Operation and Types of Rocket Engines

One dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields. Description of vertical, inclined and gravity turn trajectories. Simple approximations to burnout velocity

Unit 7. **06 Hrs**

Rocket Performance and Staging

Launch vehicle trajectories, two body problem and orbital elements. Staging of rockets

Unit 8.

Spacecraft **07 Hrs**

Preliminary concepts of space, spacecraft. Introduction to manned and unmanned space missions. Spacecraft power generation. Life support system for manned space missions.

Materials for spacecraft: Selections of materials for spacecraft - special requirements of materials to perform under adverse conditions - ablative materials. . Life time estimation for a satellite.

Text Books:

1. M. H. Kaplan: Modern Spacecraft Dynamics and Control, John Wiley and Sons, 1976.
2. W. T. Thomson: Introduction to Space Dynamics, Dover Publications, 1986
3. G P Sutton, Rocket Propulsion Elements John Wiley and Sons, 1993

Reference Books:

1. H.S. Siefert (Ed.), "Space Mechanics", John Wiley & Sons, 1969.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Smart Materials

Sub Code:	**10AE764**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing subject code 10ME764

Agile Manufacturing

Sub Code:	**10AE765**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing subject code 10ME765

Robotics

Sub Code:	**10AE766**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing subject code 10ME766

Industrial and Experimental Aerodynamics

Sub Code:	**10AE767**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Wind Energy Collectors

Horizontal axis and vertical axis machines. Power coefficient. Betz coefficient by momentum theory.

Unit 2. **07 Hrs**

Vehicle Aerodynamics

Power requirements and drag coefficients of automobiles. Effects of cut back angle. Aerodynamics of Trains and Hovercraft.

Unit 3. **06 Hrs**

Building Aerodynamics

Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, building codes, building ventilation and architectural aerodynamics.

Unit 4. **07 Hrs**

Flow Induced Vibrations

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

PART B

Unit 5. **07 Hrs**

Model Measurements

Balances :- design, installation and, calibration. Internal balances. Mounting of models, rigidity. Measurement of interference. Lift and drag measurements through various techniques. Testing procedures. Testing:- 3-D wings, controls, complete model, power effects, aero elasticity, dynamic stability. Testing with ground plane, testing wind mill generator. Testing for local loads. Testing of rotor. Testing engines, Jettison tests. Data reduction. Data correction.

Unit 6. **06 Hrs**

Wind Tunnel Boundary Corrections and Scale Effects

Effects of lateral boundaries. Method of images. Wall corrections. Effects of Buoyancy, Solid Blocking, Wake Blocking. General downwash correction. Lift interference correction. Corrections for reflection plane models. Scale effects on aerodynamic characteristics and stability derivatives.

Unit 7. **07 Hrs**

Near sonic And Transonic Testing

Near sonic tunnel design. Calibration of test section. Model support system. Tare and interference evaluation. Near transonic testing.

Unit 8. **06 Hrs**

Supersonic Wind Tunnel Testing

Types of supersonic tunnels: - continuous, intermittent (indraft ,and blowdown). Pressure-vacuum tunnels. Supersonic tunnel design features. Calibration of test section. Optical systems-Schlieren set-up. Starting loads.Hypersonic wind tunnels - General introduction.

Text Books:

1. Jewel B. Barlow, William H RAE, Jr. and Alan Pope**,** ` Low speed Wind Tunnel Testing`, John Wiley & Sons; 1999.
2. M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and road Vehicles", Plenum press, New york, 1978.
3. P.Sachs, "Winds forces in engineering", Pergamon Press, 1978.

REFERENCE BOOKS:

1 R.D.Blevins, " Flow induced vibrations",Van Nostrand,1990.

2 N.G.Calvent, "Wind Power Principles", Charles Griffin & Co.,London,1979

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Micro and Smart Systems Technology

Sub Code:	**10AE768**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing subject code 10ME768

Design, Modeling and Analysis Laboratory

Sub Code: 10AEL77 **IA Marks: 25**
Hrs / Week: 03 **Exam Hours: 03**
Total Hours: 42 **Exam Marks: 50**

List of Experiments

Part-A **21 Hrs**

1. Modeling of Symmetric Aerofoil Geometry, And Generation of Body Fitting Mesh.
2. Modeling of Cambered Aerofoil Geometry, And Generation of Body Fitting Mesh.
3. Modeling of 2-D Incompressible and Inviscid Flow over an Aerofoil. Computations and Analysis for Velocity Vectors and Pressures Distributions.
4. Modeling of 2-D Incompressible and Viscous Flow over an Aerofoil. Computations and Analysis for Velocity Vectors and Pressures Distributions.
5. Geometric Modeling and Mesh Generation of 2-D Convergent-Divergent Nozzle and Analyses of Flow for Adiabatic Conditions.

Part-B **21 Hrs**

6. Structural Modeling of Sandwich Beam of Rectangular Cross-Section and Analyses for Stresses.
7. Structural Modeling of a Three Dimensional Wing.
8. Structural Modeling and Stress Analysis of a Fuselage Bulk Head.
9. Structural Modeling and Stress Analysis of a Simply Supported Rectangular Plate Uniformly Compressed In one Direction.
10. Structural Modeling and Stress Analysis of a Simply Supported Rectangular Plate Uniformly Compressed In one Direction with a Cut-Out in Center.

Scheme of Examination

ONE question From Part-A	20 Marks
ONE question From Part-B	20 Marks
VIVA Voce	10 Marks
Total	**50 Marks**

Simulation Laboratory

Sub Code: 10AEL78 **IA Marks: 25**
Hrs / Week: 03 **Exam Hours: 03**
Total Hours: 42 **Exam Marks: 50**

List of Experiments

PART A **21 Hrs**

1. Falling sphere with viscous drag – Investigate velocity versus time plot; & simulate the fall.
2. Frequency response for a spring-mass system; simulation of the oscillations.
3. Simulation of simple servo-mechanism feedback system in time domain.
4. Simulation of simple servo-mechanism feedback system in `s` domain.
5. Simulate with transfer functions the experiments (3) and (4) above.

21 Hrs

PART B

6. Digital simulation of Analog Computations.
7. Simulate a bomb drop from an aircraft on a moving tank for pure –pursuit motion.
8. Simulate an Air Speed Indicator to read air speeds for the pressures read from a Pitot-static tube, with compressibility corrections.
9. Simulate a runaway.
10. Simulate a point take-off from a runaway.

Scheme of Examination

ONE question From Part-A	20 Marks
ONE question From Part-B	20 Marks
VIVA Voce	10 Marks
Total	**50 Marks**

Proposed Scheme and Syllabus for academic year 2010-11
Aeronautical Engineering
VIII Semester

Sl No	Subject Code	Title	Teaching Dept.	Teaching Hours / week		Examination			
				Th.	Pr.	Dura-tion	I.A Marks	Theory/ Practical	Total Marks
1	10AE81	Flight Vehicle Design	AE	04	--	03	25	100	125
2	10AE82	Avionics	AE	04	--	03	25	100	125
3	10AE83*	*Electives IV- (Group D)	AE	04	--	03	25	100	125
4	10AE84*	*Electives V- (Group E)	AE	04	--	03	25	100	125
5	10AE85	Project Work	AE	--	03	--	100	100	200
6	10AE86	Seminar on Current Topics	AE	03	--	--	50	--	50
Total				19	03	12	250	500	750

Note: One question has to be set for every 6 to 8 hours of teaching.

Subject Code	* Elective IV (Group D)	Subject Code	* Elective V (Group E)
10AE831	Flight Testing	10AE841	Aircraft Safety Rules and Regulations
10AE832	Fracture Mechanics	10AE842	Guidance and Navigation
10AE833	Theory of Aeroelasticity	10AE843	Management Information Systems
10AE834	Hydraulics and Pneumatics	10AE844	Project Management
10AE835	Reliability and Maintenance Engineering	10AE845	Product Design and Manufacturing
10AE836	Boundary Layer Theory	10AE846	Artificial Intelligence
10AE837	Operation Research	10AE847	Computer Integrated Manufacturing
10AE838	Aerospace Quality Assurance	10AE848	Aircraft Systems and Instrumentation

* Students shall register for one subject each from Group D and E Electives.

Flight Vehicle Design

Sub Code:	**10AE81**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART-A

Unit 1. **06 Hrs**

Conceptual Aircraft Design

Operational specifications-mission requirements. Government standards and regulations (MIL Specs, JAR-23 and JAR-25). Design process, flow chart, survey of various types of airplanes, over-view of design process. Airplane configuration description. Take-off weight-Preliminary Estimate-Spread sheet approach.

Unit 2. **06 Hrs**

Preliminary Aerodynamic Design

Selection of wing loading. Initial Airplane layout. Three view drawings. Arrangement of surfaces, mass, moment and inertia properties & balance diagram. Wing loading effect on take-off, landing, climb, acceleration, range, combat, flight ceiling, glide rate. Spread sheets.

Unit 3. **07 Hrs**

Design Of Structural Components:Wing, Fuselage And Tail

Mainplane: Airfoil cross-section shape, taper ratio selection, sweep angle selection, wing drag estimation. Spread sheet for wing design. Fuselage: Volume consideration, quantitative shapes, air inlets, wing attachments. Aerodynamic considerations and drag estimation. Spread sheets. Tail arrangements: Horizontal and vertical tail sizing. Tail planform shapes. Airfoil selection type. Tail placement. Spread sheets for tail design.

Unit 4. **07 Hrs**

Power for Flight

Propulsion selection, thrust to weight ratio, number of engines, engine rating, turbo-jet engine sizing. Installed thrust corrections, spread sheets. Propeller propulsive systems. Propeller design for cruise, static thrust. Turboprop propulsion. Piston and turbo-prop sizing. Propeller spread sheets.

PART-B

Unit 5. **07 Hrs**

Performance Estimation

Take-off phases, minimum take-off specification, climb gradients. Balanced field length. Landing approach. Free roll and braking. Spread sheet for take-off and landing distance. Enhance lift considerations - passive lift enhancement, trailing edge flap configuration, lift and drag determination. Active lift enhancement, Drag polar. Power to climb and maneuver.

Unit 6. **07 Hrs**

Static Stability

Longitudinal stability, static margin and stabilization. Control surface sizing. Effect of static margin on performance. Lateral and directional static stability-contribution of airframe components. Aileron sizing, rudder area sizing. Longitudinal maneuverability.

Unit 7. **06 Hrs**

Design Aspects of Sub-Systems

Air-conditioning and pressurisation, ice protection systems. Electric power system. Hydraulic systems, fuel system. Landing gear.

Unit 8. **06 Hrs**

Design Aspects: Avionics, Controls and Weapon Systems.

Communication system, Navigation system, Radar, Flight control system, Weapon systems, and weapon system interface.

Text Books:

1. Tomas C Corke., “Design of Aircraft,” Person Education, LPE, 2003.
2. John P Fielding, Introduction to Aircraft Design Cambridge University Press, 1999

Reference:

1. Darrol Stinton D.," The Design of the Aeroplane", Black Well Science, 2nd Edition, 2001
2. Daniel P. Raymer, "Aircraft Design: A Conceptual approach", AIAA Education Services, 1992.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Avionics

Sub Code:	**10AE82**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **07 Hrs**

Power Distribution Sytem

Bus Bar, split bus bar system, special purpose cables. Electrical diagram and identification scheme. Circuit controlling devices. Power utilisation-typical application to avionics. Need for Avionics in civil and military aircraft.

Unit 2. **06 Hrs**

Inertial Navigation System

Gyroscopic versus Inertial platform. Structure of stable platform. Inertial Navigation units. Inertial alignment. Inertial interface system. Importance of Compass swing.

Unit 3. **07 Hrs**

Electronic Flight Control System

Fly-by-wire system: - basic concept and features. Pitch and Roll rate: - command and response. Control Laws. Frequency response of a typical FBW actuator. Cooper Harper scale. Redundancy and failure survival. Common mode of failures and effects analysis.

Unit 4. **06 Hrs**

Electronic Flight Instrument Systems

Display -units, presentation, failure, and annunciation. Display of air data.

PART-B

Unit 5. **07 Hrs**

Introduction to Avionics Sub Systems and Electronic Circuits

Typical avionics subsystems. Amplifier, oscillator, aircraft communication system, transmitter, receiver, antenna.

Unit 6. **06 Hrs**

Principles of Digital Systems

Digital Computers – Microprocessors – Memories

Unit 7. **06 Hrs**

Flight Deck and Cockpits

Control and display technologies CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) - Civil cockpit and military cockpit : MFDS, HUD, MFK, HOTAS

Unit 8. **07 Hrs**

Avionics Systems Integration

Avionics equipment fit. Electrical data bus system. Communication Systems, Navigation systems, Flight control systems, Radar , Electronic Warfare, and fire control system. Avionics system architecture–Data buses MIL–STD 1553 B.

Text Books

1. R P G Collinson,` Introduction to Avionics Systems,` Kulwar Academic Publishers`, 2003
2. E H J Pallett,` Aircraft Electrical System,`. Pitman Publishers, 1976.

References

1 Middleton, D.H., Ed., `Avionics Systems`, Longman Scientific and Technical Longman Group UK Ltd., England, 1989.

2 Spitzer, C.R., `Digital Avionic Systems`, Prentice Hall, Englewood Cliffs, N.J., USA., 1987.

3. R.B. Underdown & Tony Palmer, `Navigation~, Black Well Publishing 2001

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Elective IV (Group D)

Flight Testing

Sub Code:	**10AE831**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Purpose and scope of flight testing, basic definition, types of flight tests, sequence of flight testing, planning the test program, governing regulations. Aircraft weight and center of gravity, flight testing tolerances. Method of reducing data uncertainty in flight test data -sources and magnitudes of error, avoiding and minimizing errors.

Unit 2. **07 Hrs**

Flight Test Instrumentation

Planning flight test instrumentation, sensing and transuding techniques. Measurement of linear and angular displacements, velocities and accelerations, vibration, force, temperature - onboard and ground based data acquisition system. Radio telemetry.

Unit 3. **07 Hrs**

Performance Flight Testing - Range, Endurance And Climb

Airspeed – in flight calibration. Level flight performance for propeller driven aircraft and for Jet aircraft - Techniques and data reduction. Range and endurance estimation of propeller and jet aircraft. Climb performance methods.

Unit 4. **06 Hrs**

Performance Flight Testing -Take-Off, Landing, Turning Flight

Turning performance limitations. Drag estimation. Take-off and landing -methods, procedures and data reduction.

PART B

Unit 5. **07 Hrs**

Stability And Control - Longitudal And Manoeuvring

Flight test Methods :-Static longitudinal stability ; Dynamic longitudinal stability. Data reduction. Maneuvering stability methods & data reduction.

Unit 6. **07 Hrs**

Stability And Control - Lateral & Directional

Flight Test methods: - Lateral and directional static stability; Lateral and directional dynamic stability. Regulations and data reduction.

Unit 7. **06 Hrs**

Flying Qualities

MIL and FAR regulations. Cooper-Harper scale. Pilot Rating . Flight test procedures.

Unit 8. **06 Hrs**

Hazardous Flight Testing

Stall and spin- regulations, test and recovery techniques. Dive testing for flutter, vibration and buffeting.

Text Books:

1. Ralph D Kimberlin, `Flight Testing of Fixed Wing Aircraft` ,AIAA educational Series,2003.

Reference Books:

1. ADARD, Flight Test Manual Vol. I to IV

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Fracture Mechanics

Sub Code:	**10AE832**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME832

Theory of Aeroelasticity

Sub Code:	**10AE833**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Aeroelasticity - definition and problems. Influence of aeroelastic phenomenon on design :- flutter, buffeting, dynamic loads problems, load distribution, divergence, control effectiveness & reversal. Critical flutter speeds versus wing sweep back. Effect of speed on control effectiveness.

Unit 2. **07 Hrs**

Deformation of Airplane Structures Under Static Loads

Deformation due to several forces. Influence coefficients. Properties of influence coefficients. Deformation under distributed forces. Influence functions. Properties of influence functions. Simplified elastic airplane. Deformation of airplane wing. Force and torque applied to wing. Integration by weighting matrices. Bending, torsional and shear stiffness curves.

Unit 3. **06 Hrs**

Static Aeroelastic Phenomena

Load distribution and divergence-wing torsional divergence (two-dimensional case, & finite wing case). Swept wing divergence. Prevention of Aeroelastic instabilities.

Unit 4. **07 Hrs**

Control Effectiveness and Reversal

Aileron effectiveness and reversal -2 dimensional case, and finite wing case. Strip theory. Aileron effectiveness in terms of wing -tip helix angle. Critical aileron reversal speed. Rate of change of local pitching moment coefficient with aileron angle.

PART B

Unit 5. **06 Hrs**

Deformation Of Airplane Structures Under Dynamic Loads

Differential and Integral forms of equations of motions of vibrations. Natural modes and frequencies of complex airplane structures - introduction. Dynamic response phenomenon - equations of disturbed motion of an elastic airplane.

Unit 6. **07 Hrs**

Dynamic Problems of Aeroelasticity

Flutter. Single-degree-of- freedom system. Determination of critical flutter speed. Aeroelastic modes. Wing bending and torsion flutter. Coupling of bending and torsion oscillations and destabilizing effects of geometric incidences. Stall flutter, Supersonic panel flutter, Buffeting and, Aileron buzz. Flutter prevention and control.

Unit 7. **07 Hrs**

Test Model Similarities

Dimensional concepts. Vibration model similarity laws. . Dimensionless form of equation of motion. Mode shapes and natural frequencies in dimensionless forms. Model scale factors.Flutter model similarity law. Scale factors. Structural simulation:-shape, mass and, stiffness.

Unit 8. **06 Hrs**

Testing Techniques

Measurement of structural flexibility. Measurements of natural frequencies and mode shapes. Polar plot of the damped response. Identification and measurement of normal modes. Steady state aeroelastic model testing. Dynamic aeroelastic model testing. Flight flutter testing.

Text Books:

1. Dowell, E. H., Crawley, E. F., Curtiss Jr., H. C., Peters, D. A., Scanlan, R. H., and Sisto, F., A Modern Course in Aeroelasticity, Kluwer Academic Publishers, 3rd Edition, 1995. (TL574.A37.M62)

2. Bisplinghoff, R., Ashley, H., and Halfman, R. L., Aeroelasticity, Dover, 1955. (TL570.B622)

Reference Books:

1. Fung, Y. C., An Introduction to the Theory of Aeroelasticity, 1955 (Dover, 1969).

2. Megson THG,` Aircraft structures for Engineering students`, Edward Arnold.

3. Bisplinghoff, R. and Ashley, H., Principles of Aeroelasticity, Dover, 1962. (TL570.B623)

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Hydraulics and Pneumatics

Sub Code:	**10AE834**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME74

Reliability and Maintenance Engineering

Sub Code:	**10AE835**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Definition. Performance, cost and reliability. Quality, reliability and safety. Probability and sampling. Probability concept. Discrete random variables. Binomial distribution. Multiple sampling methods. Continuous random variables.

Unit 2. **07 Hrs**

Quality & Its Measures

Quality & reliability. Taguchi methodology. Quality measure. The six Sigma Methodology.

Unit 3. **06 Hrs**

Data & Distributions

Non parametric methods. Histograms. Probability Plotting. Point and interval estimates. Normal and Lognormal Parameters.

Unit 4. **07 Hrs**

Reliability & Rates of Failure

Reliability characterisation. Bath tub curve. MTBF concept. Constant failure rate model. Time dependent failure rates. Component failures and failure modes.

PART-B

Unit 5. **06 Hrs**

Reliability Testing

Reliability enhancement procedures. Reliability growth testing, Environmental stress testing. Nonparametric methods. Ungrouped data. Accelerated life testing.

Unit 6. **07 Hrs**

Redundancy

Introduction: Active and standby redundancy. Constant failure rate models. Redundancy limitations. Multiply redundant system. Case studies.

Unit 7. **07 Hrs**

Maintained Systems

Types of maintenance. Preventive maintenance, Idealised maintenance, Imperfect maintenance.Redundant components. Corrective maintenance. Maintainability. Repair: revealed failures. Testing & repair: unrevealed failures. Prediction of maintenance schedules. Modern trends in maintenance Philosophy like BITE, IRAN, HUM, TPM etc.

Unit 8. **06 Hrs**

System Safety Analysis

Product and equipment hazards. Human errors. Methods of analysis. Failure Modes and Effects Analysis. Fault tree construction. Direct evaluation of fault tree.

Text Book:

1 E.E. Lewis, `Introduction to Reliability Engineering`, John Wiley., 1994

Reference Books:

1 K.S. Trivedi, `Probability and statistics with Reliability`, Queuing and Computer Science Applications, PHI.

2 E Balagurswamy, `Reliability Engineering,` Tata McGraw Hill Publications.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Boundary Layer Theory

Sub Code:	**10AE836**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Preliminary Concepts

Some examples of viscous flow phenomena: - aerofoil, cylinder, circular pipe. Boundary conditions for viscous flow problems. The kinematics properties of viscous flow.

Unit 2. **07 Hrs**

Fundamental Equations of Viscous Flow

Conservation of mass, momentum and energy equations. Mathematical characterisation of basic equations. Dimensionless parameters in viscous flow.

Unit 3. **06 Hrs**

Solutions of Viscous Flow Equations

Classification of solutions. Couette flow, stability of Couette flow. Poiseuille steady flow through duct. Unsteady duct flow between plates with bottom injection and top suction. Plane stagnation flow- differential equation free of parameters.

Unit 4. **07 Hrs**

Introduction to Laminar Boundary Layer

Laminar boundary layer equations. Flat plate Integral analysis. Displacement thickness, Momentum and Energy thicknesses for two dimensional flows; Shape factor. Some insight into boundary layer approximations. Discussion of Navier Stokes equations. Concept of thermal boundary layer.

PART B

Unit 5. **06 Hrs**

Laminar Boundary Layer Equations

Dimensionless variables. Laminar boundary layer equations. Similarity solutions for steady two-dimensional flow. Blasius solution for flat- plate flow, wall shear stress. Flat plate heat transfer for constant wall temperature. Some examples of Falkner-Skan potential flows. Reynolds analogy as a function of pressure gradient.

Unit 6. **06 Hrs**

Transition to Turbulence

Stability of laminar flows - concept of small disturbance stability. Temporal instability and Spatial instability. Stability of Blasius and Falkner-Skan profiles. Effect of wall temperature. Transition to turbulence. Affecting parameters.

Unit 7. **07 Hrs**

Incompressible Turbulent Mean Flow

Physical and mathematical description of turbulence. Fluctuations and time averging. Turbulent flow in pipes and channels. Free turbulence: - jets, wakes and mixing layers.

Unit 8. **07 Hrs**

Instrumentation and Measurements:

Hot wire and Hot film anemometer for turbulence measurements. Schlieren methods for flow visualization. Pressure probes, Interferometer and Smoke method.

Text Books:

1. H. Schlichting, `Boundary Layer Theory`, McGraw- Hill, New York, 1979.
2. Frank White,` Viscous Fluid flow` - McGraw Hill, 1991.
3. J.P.Hollman and W.J. Gajda, Jr. 'Experimental methods for Engineers', 5th Edition McGraw- Hill , 1989

Reference Books:

2. Ronald L., Panton, `Incompressible fluid flow`, John Wiley & Sons, 1984.
3. Boundary Layer by T.R.Oke

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Operation Research

Sub Code:	**10AE837**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME73

Aerospace Quality Assurance

Sub Code:	**10AE838**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Quality Concepts

Concepts and definition, design specifications, manufacture in conformance with design applications, role of quality assurance during usage of aircraft.

Unit 2. **07 Hrs**

Quality Assurance during Overhaul

Quality assurance during overall / repair of aircraft and its aggregates, concession and deviations . Production permits.

Unit 3. **06 Hrs**

Quality Control

Units of measure, measuring actual performance. Continuous process regulation. Strategic quality management. Role of quality director. Quality culture.

Unit 4. **07 Hrs**

Probability Concepts

Concept of variation. Quantitative methods of summarizing data. Normal curve, Exponential Probability distribution. Weibull probability distribution. Poisson distribution. Binomial distribution. Scope for data analysis. Sample size. Regression analysis.

PART B

Unit 5. **06 Hrs**

Designing For Quality

Early warning concepts and design assurance. Designing for basic function requirements. Design for Time- Oriented performance. Designing for safety. Designing for maintainability.

Unit 6. **07 Hrs**

Manufacture & Reliability Prediction

Initial planning for qualities. Failure patterns. Predicting reliability during design. Exponential formula. Setting specification limits. Process quality audits. Self inspection.

Unit 7. **07 Hrs**

Inspection, Test & Measurements

Sampling risk. Analysis of some rule to thumb. Sampling plot. Evaluation of parameters affecting field performance. Acceptance sampling plan. Feed back . Field data.

Unit 8. **06 Hrs**

Quality Assurance

Zero defect analogy, FMECA, Fault Tree Analysis, bench marking, quality circles, quality audit. Quality standards ISO 9000, TQM, CMM, Six Sigma. Quality organizational set up in production / repair / operational set up.

Text Books:

1. J M Juran, Frank M Gryna, `Quality Planning and Analysis,` TMH Publications, 2005

Reference Books:

1. M Fox, `Quality Assurance Management`, McGraw Hill Publications
2. Oalela, `ISO 9000 A, Manual for TQM`, Parga man Publishers.
3. S C Keshu and K K Ganapathi, `Aircraft production technology and Management, ` Interline Publishers,1993

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Elective V (Group E)

Aircraft Safety Rules and Regulations

Sub Code:	**10AE841**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

C.A.R. Series 'A' – Procedure for Civil Air Worthiness Requirements and Responsibility Operators Vis-À-Vis Air Worthiness Directorate

Responsibilities of operators / owners- Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators.

Unit 2. **06 Hrs**

C.A.R. Series 'B' – Issue Approval of Cockpit Check List, Mel, Cdl:

Deficiency list (MEL & CDL); Preparation and use of cockpit checklist and emergency list.

Unit 3. **07 Hrs**

C.A.R. Series 'C' – Defect Recording, Monitoring, Investigation and Reporting

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.

Unit 4. **07 Hrs**

C.A.R. Series 'D' – And Aircraft Maintenance Programmes

Reliability Programmes (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO – Revision programme; Maintenance of fuel and oil uplift and consumption records – Light aircraft engines; Fixing routine maintenance periods and component TBOs – Initial & revisions.

PART B

Unit 5. **06 Hrs**

C.A.R. Series 'E' – Approval of Organizations

Approval of organizations in categories A, B, C, D, E, F, & G - Requirements of infrastructure at stations other than parent base.

Unit 6. **07 Hrs**

C.A.R. Series 'F' – Air Worthiness And Continued Air Worthiness:

Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

Unit 7. **06 Hrs**

C.A.R. Series 'L'&'M'

Issue of AME Licence, its classification and experience requirements, Mandatory Modifications / Inspections.

Unit 8. **07 Hrs**

C.A.R. Series 'T'&'X'

Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of tax permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

Text Books:

1. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)" – Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi 2000.

References:

1. "Aircraft Manual (India) Volume" – Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Guidance And Navigation

Sub Code:	**10AE842**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction

Concepts of navigation, guidance and control. Introduction to basic principles. Air data information.

Unit 2. **07 Hrs**

Radar Systems

Principle of working of radar. MTI and Pulse Doppler radar. Moving target detector. Limitation of MTI performance. MTI from a moving platform (AMTI)

Unit 3. **06 Hrs**

Tracking With Radar

Mono pulse tracking. Conical scan and sequential lobbing. Automatic tracking with surveillance radar (ADT)

Unit 4. **07 Hrs**

Other Guidance Systems

Gyros and stabilised platforms.Inertial guidance and Laser based guidance. Components of Inertial Navigation System. Imaging Infrared guidance. Satellite navigation. GPS.

PART B

Unit 5. **06 Hrs**

Transfer Functions

Input-output Transfer function. Basic altitude reference. Concepts of Open loop and Close Loop.

Unit 6. **07 Hrs**

Missile Control System

Guided missile concept. Roll stabilisation. Control of aerodynamic missile. Missile parameters for dynamic analysis. Missile autopilot schematics. Acceleration command and root locus.

Unit 7. **06 Hrs**

Missile Guidance

Proportional navigation guidance; command guidance. Comparison of guidance system performance. Bank to turn missile guidance

Unit 8. **07 Hrs**

Integrated Flight/Fire Control System

Director fire control system. Tracking control laws. Longitudinal flight control system. Lateral flight control system. Rate of change of Euler angle , Auto Pilot

Text Books:

1. Merrilh I. Skolnik,` Introduction to Radar Systems`, 3rd edition, Tata Mc Graw Hill , 2001.

2. John H Blakelock,` Automatic control of Aircraft & Missiles`, Wile –Inter Science Publication, 2nd edition, May 1990.

Reference Books:

1. R.B. Underdown & Tony Palmer, `Navigation`, Black Well Publishing; 2001.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

Management Information Systems

Sub Code:	**10AE843**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME756

Project Management

Sub Code:	**10AE844**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME667

Product Design and Manufacturing

Sub Code:	**10AE845**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART –A

UNIT-1

INTRODUCTION TO PRODUCT DESIGN: Asimow's model: Definition of product design, Design by Evolution, Design by Innovation, Essential Factors of Product design, Production-Consumption Cycle, Flow and value addition in the Production-Consumption Cycle, the Morphology of design(The seven phases), Primary design phases and flowcharting, role of allowance, process capability and tolerance in detailed design & assembly.

6 Hours

UNIT-2

PRODUCT DESIGN PRACTICE AND INDUSTRY: Introduction, product strategies, time to market, analysis of the product, The S's Standardization , Renard series, simplification, role of aesthetics in product design, functional design practice.

6 Hours

UNIT-3

REVIEW OF STRENGTH, STIFFNES AND RIGIDITY CONSIDERATIONS IN PRODUCT DESIGN:

Principal stress trajectories (force-flow lines), balanced design, criteria and objectives of design, material toughness: resilience designing for uniform strength, tension vis-à-vis compression. Review of production process: Introduction, primary processes, machining process, non-traditional machining processes.

7 Hours

UNIT-4

DESIGN FOR PRODUCTION- METAL PARTS:

Producibility requirements in the design of machine components, forging design, pressed components design, casting design, and design for machining ease, the role of process engineer, ease of location casting and special casting. Designing with plastic, rubber, ceramics and wood: approach to design with plastics bush bearings, gears in plastics, rubber parts, design recommendations for rubber parts, ceramic and glass parts.

7 Hours

PART –B

UNIT – 5

OPTMIZATION IN DESIGN: Introduction, Siddal's Classification of Design Approaches, Optimisation by Differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method Optimum Design.

6 Hours

UNIT – 6

ECONOMIC FACTOR INFLUENCING DESIGN: Product value, Design for safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic analysis, Profit and Competitiveness, Break – even Analysis, Economic pf a New Product Design.

6 Hours

UNIT – 7

HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESGN: Introduction, Human being as Applicator of forces, Anthropometry, Man as occupant of space, The Design of Controls, the design of displays, Man/Machine information exchange.

6 Hours

UNIT – 8

VALUE ENGINEERING AND PRODUCT DESIGN: Introduction, Historical perspective, what is value? Nature and measurement of value, Normal degree of value, Importance of value, The value analysis job plan, Creativity, Steps to problems –solving and value analysis, Value analysis Test, Value Engineering idea Generation Check – list Cost Reduction through value engineering case study on Tap Switch Control Assembly, material and Process selection in value Engineering.

Modern approaches to product design: Concurrent design and Quality Function Deployment (QFD)

8 Hours

TEXT BOOKS:

1. **Product Design and Manufacturing**, A.C. Chitale and R.C. Gupta, PHI 4th Edition, 2007
2. **Product Design & Development,** Karl T.Ulrich & Steven D, Epinger, Tata Mc Graw Hill, 3rd Edition, 2003

REFERENCE BOOKS:

1. **New Product Development,** Tim Jones Butterworth Heinmann, Oxford, mc 1997
2. **New Product Development,** Design & Analysis , Roland Engene Kinetovecz, Jon eiley & Sons, Inc, N.Y. 1990

Artificial Intelligence

Sub Code:	**10AE846**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME846

Computer Integrated Manufacturing

Sub Code:	**10AE847**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus same as existing Subject code 10ME61

Aircraft Systems And Instrumentation

Sub Code:	**10AE848**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Flight Control Systems

Primary and secondary flight controls. Flight control linkage system. Conventional Systems, Power assisted and fully powered flight controls. Power control unit – Mechanical, Electro-hydraulic. Advanced actuation concepts.

Unit 2. **07 Hrs**

Mechanical Systems

Hydraulic fluid. Hydraulic system and components. Study of typical workable system. Power packs. Hydraulic actuators. Pneumatic system and components. Use of bleed air. Emergency lowering of landing gear and braking. Shock absorbers - Retraction mechanism.

Unit 3. **07 Hrs**

Aircraft Fuel and Engine Systems

Characteristics of aircraft fuel system. Gravity feed and pressure feed. A generalized fuel system. Fuel pumps-classification. Fuel control unit. Engine starting sequence. Starting and Ignition systems. Engine oils and a typical lubricating system.

Unit 4. **06 Hrs**

Environmental Control and Emergency Systems

Air-conditioning system, vapour cycle system, deicing and anti-icing system. Fire detection-warning and suppression. Crew escape aids.

PART B

Unit 5. **06 Hrs**

Aircraft Instruments

Instruments displays, panels & layouts. Instrumentation grouping. Navigation instruments, Radio instruments. Hydraulic and Engine instruments

Unit 6. **07 Hrs**

Air Data Instruments

Basic air data system and probes. Mach meter, Air speed indicator, Vertical speed indicator. Barometric pressure sensing. Altimeter. Air data alerting system- angle of attack sensing, stall warning, Mach warning, altitude alerting system.

Unit 7. **07 Hrs**

Gyroscopic Flight Instruments

The gyroscope and its properties. Limitations of a free gyroscope. Drift. Gyroscopic flight. Instruments -Pneumatic, and Electric. Direction indicator, Turn and Bank Indicator.

Unit 8. **06 Hrs**

Engine Instruments

Study of various types of engine instruments- RPM, Pressure, Temperature, Fuel flow, Fuel quantity, and vibrations.

Text Books

1. Ian Moir and Allan Seabridge,` Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration`, AIAA Educational Series, 2001.
2. Pallet, E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific and Technical, Indian reprint 1996.
3. William A Neese, `Aircraft Hydraulic Systems`, Himalayan Books; 2007.

References

1. Lalit Gupta and O P Sharma,` Aircraft Systems (Fundamentals of Flight Vol. IV)`, Himalayan Books; 2006.
2. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.
3. R. W. Sloley and W. H. Coulthard,` The aircraft Engineers Handbook, No 4, INSTRUMENTS', Sterling Book House, 6th Edition, 2005.
4. S R Majumdar,` Pneumatic Systems`, Tata McGraw Hill Publishing Co.; 1995.

Scheme of Examination:

Four questions from Part A and Four questions from Part B to be set. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.