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

Sl No	Subject Code	Title	Teaching Dept.	Teaching Hours / week		Examination			
				Th.	Pr.	Duration	I.A Marks	Theory/ Practical	Total Marks
1	10AL51	Management and Entrepreneurship	@	04	--	03	25	100	125
2	10AE52	Introduction to Composite Materials	AE/ME	04	--	03	25	100	125
3	10AE53	Dynamics of Machines	AE/ME	04	--	03	25	100	125
4	10AE54	Aerodynamics – I	AE	04	--	03	25	100	125
5	10AE55	Aircraft Propulsion	AE	04	--	03	25	100	125
6	10AE56	Aircraft Structures – I	AE	04	--	03	25	100	125
7	10AEL57	Aerodynamics Lab	AE	--	03	03	25	50	75
8	10AEL58	Energy Conversion Lab	AE/ME	--	03	03	25	50	75
Total				24	09	24	200	700	900

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

@ - Indicates that teaching department can be any Engineering Department / Department of Management Studies

Management & Entrepreneurship

Sub Code:	**10AL51**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

Syllabus Same as Existing sub code 10AL51

Introduction to Composite Materials

Sub Code:	**10AE52**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **06 Hrs**

Introduction To Composite Materials:

Definition, classification and characteristics of composite materials – fibrous composites, laminated. Matrix materials

Unit 2. **06 Hrs**

Fiber Reinforced Plastic Processing:

Lay up and curing, fabricating process - open and closed mould process - hand lay up techniques structural laminate bag molding, production procedures for bag molding.

Unit 3. **08 Hrs**

Advanced Processing Techniquesand Application Of Composites:

Filament winding, pultrusion, pulforming, thermo - forming, injection, injection molding, liquid molding, blow molding, Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.

Unit 4. **06 Hrs**

Fabrication Of Composite Structures:

Cutting, machining, drilling, mechanical fasteners and adhesive bonding, joining, computer-aided design and manufacturing, tooling, fabrication equipment.

PART B

Unit 5. **06 Hrs**

Macro-Mechanical Behavior of a Lamina:

Stress-strain relation for an orthotropic lamina- Restriction on elastic constants-Strengths of an orthotropic lamina and Failure theories for an orthotropic lamina.

Unit 6. **06 Hrs**

Micro-Mechanical Behavior of a Lamina:

Determination of elastic constants-Rule of mixtures, transformation of coordinates, micro-mechanics based analysis and experimental determination of material constants.

Unit 7. **06 Hrs**

Macro-Mechanical Behavior of a Laminate:

Classical plate theory- Stress and strain variation in a laminate- Resultant forces and moments- A B & D matrices- Strength analysis of a laminate

Unit 8. **08 Hrs**

Metal Matrix Composites:

Reinforcement materials, types, characteristics and selection of base metals. Application ofMMC's.

Text Books:

1. Composites Science and Engineering, K.K Chawla, Springer Verlag, 1998
2. R M Jones, " Mechanics of Composite Materials", McGraw-Hill, New York, 1975

Reference:

1. Meing Schwaitz, "Composite materials hand book", McGraw Hill Book Company. 1984
2. Introduction to Composite materials, Hull and Clyne, Cambridge University Press, 2nd Edition, 1990.
3. Forming Metal handbook, 9th edition, ASM handbook, V15. 1988, P327 338.
4. Mechanics of composites by Artar Kaw, CRC Press. 2002.

Dynamics of Machinery

Sub Code:	**10AE53**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART-A

Unit 1. **06 Hrs**

Static Force Analysis: Static force analysis: Introduction: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, Free body diagrams, principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.

Unit 2. **06 Hrs**

Dynamic Force Analysis: D'Alembert's principle, Inertia force, inertia torque, Dynamic force analysis of four-bar mechanism and slider crank mechanism. Dynamically equivalent systems. Turning moment diagrams and flywheels, Fluctuation of Energy. Determination of size of flywheels.

Unit 3. **08 Hrs**

Friction and Belt Drives: Definitions: Types of friction: laws of friction, Friction in pivot and collar bearings. Belt drives: Flat belt drives, ratio of belt tensions, centrifugal tension, power transmitted.

Unit 4. **06 Hrs**

Balancing of Rotating Masses: Static and dynamic balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

PART-B

Unit 5. **08 Hrs**

Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder-inline engine primary & Secondary forces, V-type engine; Radial engine – Direct and reverse crank method.

Unit 6. **06 Hrs**

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power

Unit 7. **06 Hrs**

Gyroscope: Vectorial representation of angular motion, Gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aeroplane, stability of two wheelers and four wheelers.

Unit 8. **06 Hrs**

Analysis of CAMS: Analysis of Tangent cam with roller follower and Circular arc cam operating flat faced and roller followers, Undercutting in Cams.

Text Books:

1. Theory of Machines: Sadhu Singh, Pearson Education, 2nd edition, 2007.
2. Theory of Machines: Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2006.

Reference:

1. Theory of Machines by Thomas Bevan, CBS Publication 1984.
2. Design of Machinery by Robert L. Norton, McGraw Hill, 2001.
3. Mechanisms and Dynamics of Machinery by J. Srinivas, Scitech Publications, Chennai, 2002.
4. Dynamics of machinery by J. B. K. Das & P. L. S. Murthy.

Scheme of examination:

One Question to be set from each unit. 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.

Aerodynamics – I

Sub Code:	**10AE54**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART – A

Unit 1.

Review of Basic Fluid Mechanics **4 Hrs**

Continuity, momentum and energy equation, units and dimensions, inviscid and viscous flows, compressibility, Mach number regimes.

Unit 2.

Description of Fluid Motion **6 Hrs.**

Euler and Lagrangian descriptions, control volume approach to continuity and momentum equations, pathlines, streamlines and streaklines, angular velocity, vorticity, circulation, stream function, velocity potential and relationship between them.

Unit 3.

Airfoil Characteristics **6 Hrs.**

Fundamental aerodynamic variables, airfoil section geometry and wing planform geometry, aerodynamic forces and moments, centre of pressure, pressure coefficient, calculation of airfoil lift and drag from measured surface pressure distributions, typical airfoil aerodynamic characteristics at low speeds.

Unit 4.

Two-Dimensional Inviscid Incompressible Flows **10 Hrs**

Bernoulli's equation, pitot-tube measurement of airspeed, condition on velocity for incompressible flow, Eulers equations of motion, Governing equations for irrotational, incompressible flow, Laplace equation and boundary conditions. Two-dimensional source, sink and doublet flows, non-lifting flow over a two-dimensional circular cylinder and vortex flow.

PART - B

Unit 5. **06 Hrs**

Flow Over Circular Cylinders

Non-lifting flow over a two-dimensional circular cylinder, Lifting flow over a two-dimensionalcircular cylinder, Kutta-Joukowski theorem and generation of lift, D'Alembert's paradox.

Unit 6. **06 Hrs**

Incompressible Flow Over Airfoils

Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Classical thin airfoil theory for symmetric and cambered airfoils.

Unit 7.

Introduction to Viscous Flows **06 Hrs**

Navier-Stokes equations, boundary layer concept, displacement, momentum thickness and wall skin friction, viscous flow over two-dimensional streamlined and bluff bodies and drag characteristics, aspects of boundary layer separation and airfoil stall.

Unit 8.

Introduction to Aerodynamic Testing **08 Hrs**

Principles of wind tunnel flow simulation, open and closed circuit wind tunnels, and Major features of low speed, transonic and supersonic wind tunnels, smoke and tuft flow visualization techniques, Pressure and Aerodynamic load measurements on a model, total drag determination of two-dimensional bodies using wake survey at low speeds.

Text Books

1. Anderson, Jr. J.D. "Fundamentals of Aerodynamics", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007. (Special Indian Edition).

2. Houghton E.L and Carpenter P.W. "Aerodynamics for Engineering Students, CBS Publications and Distributors, 1993. (4^{th} Edition).

References :

1. Pope A. and Harper, J J.,"Low Speed Wind Tunnel testing", John Wiley Inc. New York, 1966
2. Anderson, Jr. J.D. "Introduction to Flight", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007. (Special Indian Edition).
3. Schlichting, H. "Boundary Layer Theory" Mc Graw Hill, New York, 2004
4. Duncan WJ, Thom AS and Young AD., "Mechanics of Fluids", Second Edition, Edward Arnold Printers Ltd, London, 1981
5. Pope A. and Goin, KL. "High Speed Wind Tunnel Testing", John Wiley & Sons Inc. New York, 1965

Scheme of examination:

One Question to be set from each unit. 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 Propulsion

Sub Code:	**10AE55**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1.

Introduction **06 Hrs**

Introduction: Review of thermodynamic principles, Principles of aircraft propulsion, Types of power plants, Basics of heat transfer; conduction, convection, radiation, diffusion mass transfer basic concepts and governing equations.

Unit 2.

Fundamentals of Gas Turbine Engines **07 Hrs**

Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics.

Unit 3.

Subsonic and Supersonic Inlets for Jet Engines **07 Hrs**

Internal flow and Stall in subsonic inlets – Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and eternal deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration – Models of inlet operation.

Unit 4.

Combustion Chambers and Nozzles

06 Hrs

Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders – .Theory of flow in isentropic nozzles – Convergent nozzles and nozzle choking – Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under – expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust reversal.

PART B

Unit 5.

Compressors **07 Hrs**

Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of prewhirl – Rotation stall – Elementary theory of axial flow compressor – Velocity triangles – degree of reaction – Three dimensional – Air angle distributions for free vortex and constant reaction designs – Compressor blade design – Centrifugal and Axial compressor performance characteristics.

Unit 6.

Intoduction to Turbines: 07 Hrs

Types of turbines-Operating Priciple-Design consideration – Velocity triangles – degree of reaction -performance parameters – Basics of blade design principles

Unit 7.

Ramjet Propulsion: 06 Hrs

Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet engine – Ramjet performance – Sample ramjet design calculations – Introduction to scramjet – Preliminary concepts in supersonic combustion – Integral ram- rocket

Unit 8.

Fundamentals of Rocket Propulsion 06 Hrs

Types and Classification of rockets Operating principle – Specific impulse of a rocket – Rocket nozzle classification – Rocket performance considerations

Text Books

1. V. Ganesan, " Gas Turbine", Tata McGraw Hill Pub. Co. Ltd., 1996
2. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.

References

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman,
2. 1989.
3. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
4. "Rolls Royce Jet Engine" – Third Edition – 1983.
5. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 1999.
6. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edn., 1993.
7. Heat & mass transfer by Domkundwar

Scheme of examination:

One Question to be set from each unit. 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 Structures – I

Sub Code:	**10AE56**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1.

Loads On Aircraft **06 Hrs**

Structural nomenclature – Types of loads – load factor – Aerodynamics loads – Symmetric manoeuvre loads – Velocity diagram – Function of structural components.

Unit 2.

Materials for Aircraft Structures **06 Hrs**

Metallic and non-metallic materials, Use of Aluminium alloy, titanium, stainless steel and composite materials. Desirable properties for aircraft application

Unit 3

Mechanical Properties of Material **06 Hrs**

Stress – Strain - Tensile properties – Compression properties – Shear properties – Bearing properties – Creep and Stress properties – Fracture properties –Fatigue properties.

Unit 4 **08 Hrs**

Statically Determinate And Interdeterminate Structures

Analysis of plane truss – Method of joints – 3 D Truss - Plane frames, Composite beam - Clapeyron's Three Moment Equation - Moment Distribution Method**.**

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PART B

Unit 5.

Energy Methods **06 Hrs**

Strain Energy due to axial, bending and Torsional loads - Castigliano's theorem - Maxwell's Reciprocal theorem, Unit load method - application to beams, trusses, frames, rings, etc.

Unit 6.

Columns **06 Hrs**

Columns with various end conditions – Euler’s Column curve – Rankine’s formula - Column with initial curvature - Eccentric loading – South well plot – Beam column.

Unit 7.

Theory of Elasticity **08 Hrs**

Concept of stress and strain**,** derivation of Equilibrium equations, strain-displacement relation, compatibility conditions and boundary conditions. Plane stress and Plane strain problems in 2D elasticity and Airy's Stress function

Unit 8.

Failure Theory **06 Hrs**

Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum Strain energy theory – Application to aircraft Structural problems.

Text Book

1. Mechanics of Materials, Dr.BC Punmia, Ashoak Kumar Jain, Arun Kumar Jain, Lakshmi Publication
2. Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 1995.
3. Timoshenko and Goodier," Theory of Elasticity' Mc Graw Hill Co.

Reference

1. Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993.
2. Timoshenko, S., "Strength of Materials", Vol. I and II, Princeton D. Von Nostrand Co, 1990

Scheme of Examination:

One Question to be set from each unit. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least TWO questions from Part A and TWO questions from Part B.

Aerodynamics Laboratory

Sub Code:	**10AEL57**	**IA Marks:**	**25**
Hrs/ Week:	**03**	**Exam Hours:**	**03**
Total Hours:	**42**	**Exam Marks:**	**50**

LIST OF EXPERIMENTS

1. Calibration of a subsonic wind tunnel
2. Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.
3. Smoke flow visualization studies on a two dimensional airfoil at different angles of incidence at low speeds
4. Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.
5. Surface pressure distributions on a two-dimensional circular cylinder at low speeds and calculation of pressure drag.
6. Surface pressure distributions on a two-dimensional symmetric airfoil at zero incidences at low speeds.
7. Surface pressure distributions on a two-dimensional cambered airfoil at different angles of incidence and calculation of lift and pressure drag.
8. Calculation of total drag of a two-dimensional circular cylinder at low speeds using pitot-static probe wake survey.
9. Calculation of total drag of a two-dimensional cambered airfoil at low speeds at incidence using pitot-static probe wake survey.
10. Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and momentum thickness.

Energy conversion Laboratory

Sub Code:	**10AEL58**	**IA Marks:**	**25**
Hrs/ Week:	**03**	**Exam Hours:**	**03**
Total Hours:	**42**	**Exam Marks:**	**50**

PART – A

(Individual Experiments)

21 Hrs

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels
3. Determination of Viscosity of lubricating oil using Redwood, Saybolt Viscometer and Torsion viscometers.
4. Valve Timing/port opening diagram of an I.C. engine (4 stroke/ 2stroke).
5. Use of planimeter.

PART – B

(Group Experiments)

21 Hrs

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for
   (a) Four stroke Diesel Engine
   (b) Four stroke Petrol Engine
   (c) Multi-cylinder Diesel/Petrol Engine, (Morse test)
   (d) Two stroke Petrol Engine
   (e) Variable Compression Ratio I.C. Engine

Proposed Scheme and Syllabus from academic year 2010-11
Aeronautical Engineering
VI SEMESTER

Sl No	Subject Code	Title	Teaching Dept.	Teaching Hours / week		Examination			
				Th.	Pr.	Dura-tion	I.A Marks	Theory/ Practical	Total Marks
1	10AE61	Applied Gas Dynamics	AE/ME	04	--	03	25	100	125
2	10AE62	Aircraft Performance	AE	04	--	03	25	100	125
3	10AE63	Aerodynamics – II	AE	04	--	03	25	100	125
4	10AE64	Finite Element Analysis	AE/ME	04	--	03	25	100	125
5	10AE65	Theory of Vibrations	ME	04	--	03	25	100	125
6	10AE66*	* Elective - I: (Group A)	AE/ME/IEM	04	--	03	25	100	125
7	10AEL67	Structures Lab.	AE	--	03	03	25	50	75
8	10AEL68	Propulsion 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 I (Group A)**
10AE661	Numerical Methods
10AE662	Aircraft Materials
10AE663	Combustion
10AE664	Reliability Engineering
10AE665	Industrial Management
10AE666	Rockets and Missiles

*** Students shall register for one subject from Group A Electives**

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

Applied Gas Dynamics

Sub Code:	**10AE61**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1. **07 Hrs**

Basics of Compressible Flow

Basics of thermodynamics-definition and basic relation, Energy Equation- For flow and non-flow process, adiabatic energy equation, stagnation pressure, temperature, density, reference velocities, Bernoulli's equation, Effect of Mach number on Compressibility, Isentropic flow with variable area-Area ratio as a function of Mach number, Impulse function, Mass flow rate, Flow through nozzles and diffusers

Unit 2.

Normal, Oblique Shocks and Expansion Waves **07 Hrs**

Governing Equations of Normal Shock Wave. Prandtl relation and Rankine - Hugoniot equation. Oblique shocks and corresponding relations. Shock polar & Hodograph plane. Supersonic flow over a wedge. Supersonic compression and supersonic expansion. Detached shocks. Mach reflection. Intersection of waves of same and opposite families.

Unit 3.

Fanno Flow **06Hrs**

Flow with friction in constant area duct. Fanno lines. Fanno equation. Definition of friction constant, Friction loss. Effect of wall friction on flow properties. Friction parameter. Local flow properties in terms of local Mach number.

Unit 4.

Rayleigh Flow **06 Hrs**

Flow with heating or cooling in ducts. Governing equations. Heating relations for a perfect gas. Slope of Rayleigh line. Entropy considerations. Maximum heat transfer.

PART B

Unit 5.

Differential Equations of Motion for Steady Compressible Flows **07 Hrs**

Basic potential equations for compressible flow. Linearisation of potential equation- small perturbation theory. Methods for solution of nonlinear potential equation -Introduction. Boundary conditions. Pressure coefficient expression.

Unit 6.

Similarity Rules **06 Hrs**

Two-dimensional linearized flow. Prandtl - Glauert rule and Gotherts rule. Von-Karman rule for transonic flow. Application to wings of finite span. Aerodynamic characteristics for actual and transformed bodies.

Unit 7.

Flow of Real Fluids. **06 Hrs**

Shock Wave – Boundary layer interaction. Experimental characteristics of airfoils in compressible flow. Nature of pressure distribution.

Unit 8.

Measurements in Compressible Flow **07 Hrs**

Types of Wind tunnel. Optical methods of flow visualization-shadow technique, Mach zender interferometer, Schileren technique. Wind tunnel Instrumentation and measurements-Pressure, Temperature, Flow rate, Hot-wire anemometer, Velocity measurements.

Text Books:

1. Rathakrishnan, E., “Gas Dynamics”, Prentice Hall of India.1995 edition.
2. Yahya, S.M., “Fundamentals of Compressible flow”, Wiley Eastern, 2003.

Reference Books:

1. John D Anderson, “Modern Compressible Flow”, Mc Graw Hill 1999.
2. Ascher.H.Saphiro, “Dynamics and Thermodynamics of Compressible fluid flow”, Ronald Press,1953.
3. H.W. Liepmann and A.Roshko, “Elements of Gas Dynamics”

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 Performance

Sub Code:	**10AE62**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1.

Introduction: 06 Hrs

The evolution of the airplane and the performance- a short history; The standard atmosphere; The Drag polar- source of aerodynamic force-lift, drag and moments ; aerodynamic coefficients- Variation of lift, drag and moment coefficient with angle of attack and Mach number Components of drag; Aerodynamic center; Equilibrium conditions; Variation of thrust, power and SFC with velocity and altitudes for air breathing engines..

Unit 2.

The Equations of Motion Steady Unaccelerated Flight: 07 Hrs

Introduction, Four forces of flight, General equation of motion, Power available and power required curves. Thrust available and thrust required curves. Conditions for power required and thrust required minimum. Thrust available and maximum velocity, Power available and maximum velocity, Altitude effects on power available and power required; thrust available and thrust required.

Unit 3.

Steady Performance – Level Flight, Climb & Glide: 07 Hrs

Equation of motion for steady level flight, Performance of airplane in level flight. Maximum speed in level flight. Climb Performance: Equation of motion for Rate of climb- graphical and analytical approach -Absolute ceiling, Service ceiling, Time to climb – graphical and analytical approach , climb performance graph (hodograph diagram); maximum climb angle and rate of climb Gliding flight, Range during glide, minimum rate of sink and shallowest angle of glide.

Unit 4.

Fundamental Airplane Performance Parameters: 06 Hrs

The fundamental Parameters: Thrust – to – weight ratio, Wing loading, Drag polar, and lift-to – drag ratio. Minimum velocity: Stall and High lift devices, Nature of stall – flow separation, High lift deices, Aerodynamic relations associated with lift-to-drag ratio.

PART B

Unit 5.

Range And Endurance: 07 Hrs

Propeller driven Airplane: Physical consideration, Quantitative formulation, Breguet equation for Range and Endurance, Conditions for maximum range and endurance.

Jet Airplane: Physical consideration, Quantitative formulation, Equation for Range and Endurance, Conditions for maximum range and endurance, Effect of head wind tail wind

Unit 6.

Aircraft Performance In Accelerated Flight **06 Hrs**

Take-off Performance: Calculation of Ground roll, Calculation of distance while airborne to clear obstacle, Balanced field length

Unit 7.

Landing Performance and Accelerated Climb: **06 Hrs**

Calculation of approach distance, Calculation of flare distance, Calculation of ground roll, ground effects. Acceleration in climb.

Unit 8.

Manouver Performance: **07 Hrs**

Turning performance: Level turn, load factor, Constraints on load factor, Minimum turn radius, Maximum turn rate. Pull-up and Pull-down maneuvers: (Turning rate, turn radius). Limiting case for large load factor. The V-n diagram. Limitations of pull up and push over.

Text Books:

1. John D. Anderson, Jr. " Aircraft Performance and Design", McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 1999

2. John D. Anderson, Jr., "Introduction to flight" McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 2000

References

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988.
2. 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

Aerodynamics – II

Sub Code:	**10AE63**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART – A

Unit 1.
Introduction To Two-Dimensional Panel Methods **06 Hrs.**
Non-lifting flows over arbitrary bodies, source panel method, lifting flows over arbitrary bodies, vortex panel method, some examples

Unit 2.
Incompressible Flows Over Finite Wings **08 Hrs.**
Downwash, Induced drag, vortex filament, the Biot-Savart Law, Prandtl's lifting line theory and its limitations, Elliptic lift distribution.

Unit 3.
Subsonic linearized flow over airfoils **06 Hrs.**
Full velocity potential equation, linearized velocity potential equation and boundary condition, Prandtl-Glauret compressibility correction.

Unit 4.
Effects Of Compressibility **06 Hrs.**
Basics of speed of sound, Mach waves, Normal shock waves, Oblique shock waves, Expansion fan, Prandtl – Meyer expansion, Critical Mach number; Drag-divergence Mach number, Sound Barrier, Transonic area rule,.

PART – B

Unit 5.
Applications Of Finite Wing Theory **06 Hrs.**
Simplified horse-shoe vortex model, formation flight, influence of downwash on tail plane, ground effects.

Unit 6.
Bodies Of Revolution **06 Hrs.**
Introduction to slender body theory, cylindrical coordinates, boundary conditions, pressure coefficient, Subsonic flow past a axially symmetric body at zero incidence and solution for a slender cone.

Unit 7.
Swept Wings And High-Lift Systems **06 Hrs.**
Introduction to sweep effects, swept wings, pressure coefficient, typical aerodynamic characteristics, Subsonic and Supersonic leading edges. Introduction to high-lift systems, flaps, leading-edge slats and typical high - lift characteristics.

Unit 8.

Viscous Flows **08 Hrs.**

Derivation of Navier-Stokes equation for two-dimensional flows, boundary approximations, laminar boundary equations and boundary conditions, Blasius solution, qualitative features of boundary layer flow under pressure gradients, Integral method, aspects of transition to turbulence, turbulent boundary layer properties over a flat plate at low speeds.

Text Books:

1. Anderson, Jr. J.D. "Fundamentals of Aerodynamics", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007. (Special Indian Edition).

2. H.W. Liepmann and A.Roshko, "Elements of Gas Dynamics"

3. Schlichting, H, "Boundary layer theory", McGraw Hill, New York 2004

Reference:

1. Bertin, John J., "Aerodynamics for Engineers". Pearson Education Inc., 2002.

2. White, F.M., " Fluid Mechanics", Mc Graw Hill Inc. New York, 1986

3. Houghton E.L and Carpenter P.W. "Aerodynamics for Engineering Students", CBS Publications and Distributors,8 1993. (4th Edition).

4. Anderson, Jr. J.D. "Introduction to Flight", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007. (Special Indian Edition).

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

Finite Element Analysis

Sub Code:	**10AE64**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1

Introduction: Basic Concepts, Background Review: 08 Hrs

Stresses and Equilibrium, Plane stress, Plane strain, Potential energy and Equilibrium. Rayleigh - Ritz Method, Galerkin's Method, Simple applications in structural Analysis. Construction or discrete models - sub domains and nodes - simple elements for the FEM - Simplex, complex and multiples elements Polynomial selection -illustrative examples

Unit 2

Fundamentals of Finite Element Method: 06 Hrs

Elements and shape functions and natural coordinates, Use of local and natural coordinates, compatibility and convergence requirements of shape functions, Construction of shape functions for bar element and beam element

Unit 3

Analysis of Discrete Elements: 06 Hrs

Bar elements, uniform bar elements, uniform section, mechanical and thermal loading, varying section, truss analysis, Frame element, Beam element, problems for various loadings and boundary conditions.

Unit 4

Analysis of Two dimensional Elements: 06 Hrs

Shape functions of Triangular, Rectangular and Quadrilateral elements, different types of higher order elements, constant and linear strain triangular elements, stiffness matrix

PART B

Unit 5

Analysis of Three dimensional elements: 06 Hrs

Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family.

Unit 6

Theory of Isoparametric Elements: 06 Hrs

Isoparametric, sub parametric and super-parametric elements, characteristics of Isoparametric quadrilateral elements, structure of computer program for FEM analysis, description of different modules, pre and post processing.

Unit 7

Axisymmetric solids subjected to axisymmetric loading: 06 Hrs

Axisymmetric formulation, finite element modeling of triangular and quadrilateral element

Unit 8

Field Problems: 08 Hrs

Heat transfer problems, Steady state fin problems, 1D heat conduction governing equation, Derivation of element matrices for two dimensional problems, Dynamic consideration-Formulation-Hamilton's principle, Element mass matrices.

Text Books:

1. Chandrupatla T. R., "Finite Elements in engineering"- 2nd Edition, PHI, 2007.
2. C.S. Krishnamurthy - "Finite Element analysis - Theory and Programming", Tata McGraw Hill Co. Ltd, New Delhi
3. Bhavikatti, Finite element Analysis, New Age International

Reference Books:

1. Rajasekharan. S - "Finite element analysis in engineering design", Wheeler Publishers
2. Bathe. KJ - "Finite Element Procedures", PHI Pvt. Ltd., New Delhi
4. Zienkiewicz. O.C. - "The Finite Element Method", Tata McGraw Hill Co. Ltd, New Delhi
5. Rao S. S. "Finite Elements Method in Engineering"- 4th Edition, Elsevier, 2006

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

Theory of Vibrations

Sub Code:	**10AE65**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1 **06 Hrs**

Introduction

Types of vibrations, S.H.M, principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems.

Unit 2 **07 Hrs**

Undamped Free Vibrations

Single degree of freedom systems. Undamped free vibration,natural frequency of free vibration, Spring and Mass elements, effect of mass of spring, Compound Pendulum.

Unit 3 **07 Hrs**

Damped Free Vibrations

Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.

Unit 4 **06 Hrs**

Forced Vibration .

Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation, transmissibility ratio. due to harmonic exitation and support motion.

PART B

Unit 5 **06 Hrs**

Vibration Measuring Instruments & Whirling Of Shafts

Vibration of elastic bodies – Vibration of strings – Longitudinal, lateral and torsional Vibrations

Unit 6. **08 Hrs**

Systems With Two Degrees Of Freedom

Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Geared systems. Forced Oscillations-Harmonic excitation. Applications:
a) Vehicle suspension.
b) Dynamic vibration absorber.
c) Dynamics of reciprocating Engines.

Unit 7 **06 Hrs**

Continuous Systems
Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler's equation for beams.

Unit 8 **06 Hrs**

Numerical Methods For Multi-Degree Freedom Systems
Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle. Holzer's method, Stodola method.

Text Books:

1. Theory of Vibration with Applications: W.T. Thomson and Marie Dillon Dahleh, Pearson Education 5th edition, 2007.
2. Mechanical Vibrations: V.P. Singh, Dhanpat Rai & Company Pvt. Ltd., 3rd edition, 2006

Reference Books:

1. Mechanical Vibrations: S.S. Rao, Pearson Education Inc, 4th Edition, 2003.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. Theory & Practice of Mechanical vibrations: J.S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. Elements of Vibrations Analysis: Leonanrd Meirovitch, Tata McGraw Hill, Special Indian edition, 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

VI Semester

Electives: 06AE66*

* Elective - I: (Group A)

Sub Code	Title
10AE661	Numerical methods
10AE662	Aircraft materials
10AE663	Combustion
10AE664	Reliability Engineering
10AE665	Industrial Management
10AE666	Rockets and Missiles

Numerical Methods

Sub Code:	**10AE661**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1

Numerical Computation **06Hrs**

Motivation and Objectives/ Number Representation/ Machine Precision/ Round-of f Error/ Truncation Error/ Random Number Generation.

Unit 2

Linear Algebraic Systems **06 Hrs**

Motivation and Objectives/ Gauss-Jordan Elimination/Gaussian Elimination/LU Decomposition/ III- Conditioned Systems/ Iterative Methods.

Unit 3

Interpolation and Approximation **06 Hrs**

Lagrangian Polynomials - Divided differences Interpolating with a cubic spline - Newton's forward and backward difference formulas.

Unit 4

Eigen Values and Eigenvectors **08 Hrs**

Motivation and Objectives/ The characteristics Polynominal/ Power Methods / Jacobi’s Method/ Householder Transformation/ QR Method/ Danilevsky’s Method/ Polynominal Roots.

PART B

Unit 5

Numerical Differentiation and Integation **08 Hrs**

Derivative from difference tables - Divided differences and finite differences - Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules - Two and Three point Gaussian quadrature formulas - Double integrals using trapezoidal and Simpson's rules.

Unit 6

Curve Fitting **06 Hrs**

Motivation and objectives/ Interpolation/ Newton's Difference Formula/ Cubic Splines/ Least Square/ Two-Dimensional Interpolation.

Unit 7

Root Finding **06 Hrs**

Motivation and Objectives/ Bracketing methods/ Contraction Mapping Method/ Se cant Method/ Muller's Method/ Newton's Method/ Polynomial Roots/ Nonlinear Systems of Equations.

Unit 8

Optimization **06Hrs**

Motivation and Objectives/ Local and Global Minima/ Line Searches/ Steepest Descent Method/ Conjugate-Gradient Method/ Quasi-Newton Methods/ Penalty Functions/ Simulated Annealing.

Text Book:

1. Applied Numerical methods for Engineers Using Mat Lab and C-Robert Schilling and Sandra Harris, Thomson Learning, 2002.
2. Applied Numerical Analysis – Gerald and Wheatley, Pearson Education, 2002.

Reference Books:

1 Numerical Recipes in C – William Press et. Al., 2e, Cambridge University Press.

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 Materials

Sub Code:	**10AE662**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit – 1 **06 Hrs**

Introduction To Aircraft Materials:

General properties of materials, Definition of terms, Requirements of aircraft materials, Testing of aircraft materials, Inspection methods, Application and trends in usage in aircraft structures and engines, Introduction to smart materials and nanomaterials; Selection of materials for use in aircraft.

Unit – 2 **08 Hrs**

Aircraft Metal Alloys And Superalloys:

Aluminum alloys, Magnesium alloys, Titanium alloys, Plain carbon and Low carbon Steels, Corrosion and Heat resistant steels, Maraging steels, Copper alloys, Producibility and Surface treatments aspects for each of the above; General introduction to superalloys, Nickel based superalloys, Cobalt based superalloys, and Iron based superalloys, manufacturing processes associated with superalloys, Heat treatment and surface treatment of superalloys.

Unit – 3 **06 Hrs**

Composite Materials:

Definition and comparison of composites with conventional monolithic materials, Reinforcing fibers and Matrix materials, Fabrication of composites and quality control aspects, Carbon-Carbon Composites production, properties and applications, inter metallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminum, magnesium, titanium and nickel based composites for engines.

Unit – 4 **06 Hrs**

Polymers, Polymeric Materials & Plastics and Ceramics & Glass:

Knowledge and identification of physical characteristics of commonly used polymeric material: plastics and its categories, properties and applications; commonly used ceramic, glass and transparent plastics, properties and applications, adhesives and sealants and their applications in aircraft.

PART – B

Unit – 5 **06 Hrs**

Ablative and Super Conducting Materials:

Ablation process, ablative materials and applications in aerospace; Phenomenon of super conduction, super conducting materials and applications in aerospace.

Unit – 6 **07 Hrs**

Aircraft Wood, Rubber, Fabrics & Dope And Paint:

Classification and properties of wood, Seasoning of wood, Aircraft woods, their properties and applications, Joining processes for wood, Plywood; Characteristics and definition of terminologies pertaining to aircraft fabrics and their applications, Purpose of doping and commonly used dopes; Purpose of painting, Types of aircraft paints, Aircraft painting process.

Unit – 7 **06 Hrs**

Corrosion and Its Prevention:

Knowledge of the various methods used for removal of corrosion from common aircraft metals and methods employed to prevent corrosion.

Unit – 8 **07 Hrs**

High Energy Materials:

Materials for rockets and missiles. Types of propellants and its general and desirable properties, insulating materials for cryogenic engines. Types of solid propellants: Mechanical characterization of solid propellants using uni-axial, strip-biaxial and tubular tests.

Text Books:

1. Handbook of Aircraft materials Interline publishers, C G Krishnadas Nair, , Bangalore, 1993.

2. Aicraft Material and Processes, Titterton G F, , English Book Store, New Delhi, 1998

Reference:

1. Advanced Aerospace Material, H Buhl, Spring Berlin 1992

2. Aerospace material Vol. 1,2,3 ARDB, Balram Gupta, S Chand & Co 1996

3. Materials for Missiles and Space, Parker E R, John Wiley.

4. The Materials of Aircraft Construction, Hill E T, Pitman London.

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

Combustion

Sub Code:	**10AE663**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit – 1 **06 Hrs**

Review of Basic Concepts:

Laws of thermodynamics, simple thermo chemical equations, and heat of combustion, properties of real gases, Rankine-Hugoniot curves, ideas of deflagration and detonation.

Unit – 2 **06 Hrs**

Chemical Equilibrium And Kinetics:

Concept of chemical equilibrium, Elements of adiabatic flame temperature calculation, Chemical kinetics – rates and order of reactions, Reaction mechanism and chain reactions.

Unit – 3 **08 Hrs**

Premixed Flames:

Mechanistic description of premixed flames, Burning velocity and parametric dependences, Experimental methods of measuring burning velocity, One dimensional Conservation Equations, Simple one-dimensional thermal theory of flame, concepts of minimum ignition energy, quenching distance, stability limits and flame stabilization.

Unit – 4 **06 Hrs**

Diffusion Flames:

Differences between premixed and diffusion flames, gas diffusion flames in parallel flow – jet flames and Burke Schumann flames, Liquid droplet combustion.

PART – B

Unit – 5 **06 Hrs**

Combustion in Piston Engines:

Review of operation of reciprocating engines, Description of the combustion process in piston engines, Combustion efficiency and factors affecting it, detonation in reciprocating engines and preventive methods.

Unit – 6 **07 Hrs**

Combustion in Gas-Turbine Engines:

Description of different types of combustion chambers in gas-turbine engines, primary requirements of the combustor, Flow structure, recirculation and flame stabilization in main combustion chamber, afterburners.

Unit – 7 **07 Hrs**

Combustion in Rocket Engines:

Combustion of carbon particle, boundary layer combustion, basic principles of combustion solid propellants, extension of droplet combustion to liquid propellant rockets.

Unit – 8 **06 Hrs**

Emissions:

Flame radiation, pollutants - unburnt hydrocarbons, oxides of nitrogen and carbon monoxide, methods of reducing pollutants, Principle of exhaust gas analysis.

Text Books:

1. Introduction to Combustion by Stephen Turns.
2. Combustion fundamentals by Roger Strehlow

Reference Books:

1. Industrial Combustion by Charles E. Baukal.
2. Heat Transfer in Industrial Combustion by CE Baukal Jr
3. Combustion, Fossil Power Systems by G. Singer. 4th Ed. 1966 Ed Pub.
4. Fuels and Combustion, Sharma, S.P., and Chandra Mohan , Tata Me. Graw Hill Publishing Co.,Ltd., New Delhi, 1987.
5. Gas Turbine, Jet and Rocket Propulsion, Mathur, M.L., and Sharma, R.P., ,' Standard Publishers and Distributors, Delhi, 1988

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

Reliability Engineering

Sub Code:	**10AE664**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART A

Unit 1 **07 Hrs**

Introduction

Reliability concepts and definitions, probability distribution functions and their application in reliability Evaluation, Reliability Evaluation in Engineering systems using Markov Models

Unit 2 **07 Hrs**

Failure analysis

Causes of failure, concept of hazard failure models, Bath Tub curve, MTTF, MTBF

Unit 3 **06 Hrs**

Reliability Modeling

System reliability for various configurations and combinational aspects, Weibull analysis On reliability

Unit 4 **06 Hrs**

Reliability Studies:

Reliability improvement, redundancy, reliability-cost trade-off

PART B

Unit 5 **06 Hrs**

Maintainability and Availability concepts

System Safety analysis

Unit 6 **07 Hrs**

Maintenance concepts

Types of Maintenance, Modern trends in Maintenance Philosophy like BITE, **IRAN,** HUM, TPM etc.

Unit 7 **06 Hrs**

Failure Investigation Process and Methodologies like FTA, FMEA

Unit 8 **07 Hrs**

Reliability and Quality Improvement techniques like, Bench Marking, JIT, Quality Circles, Quality Audit, TQM, Kaizan etc.

Text Book:

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

Reference Books:

1. Probability and statistics with Reliability, Queuing and Computer, K.S. Trivedi,
2. Science Applications, PHI.
3. Reliability Engineering, E Balagurswamy, 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

Industrial Management

Sub Code:	**10AE665**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART - A

Unit – 1 **06 Hrs**

Introduction: Historical perspective, contribution of Taylor, Henry Fayol, Gilbert, Charles Babbage, Henry Gantt to the evolution of management science in the Indian context. Ownership of Industries Proprietorship, partnership, joint stock companies, public and private undertakings, co-operative organizations

Unit – 2 **08 Hrs**

Quality Philosophy: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs legal aspects of quality implementing quality improvement). Definitions and aims of standardizations, techniques for standardization (Statistical Principles, Codification system, variety control and value Engineering).

Unit – 3 **06 Hrs**

Statistical Process Control: Chance and assignable causes, Statistical Basis of the Control Charts -basic principles, choices of control limits, significance of control limits, control limits, analysis of pattern on Variable attribute control charts (no numericals)

Unit – 4 **06 Hrs**

Work Study, Incentives, Health And Safety: Work study-Motion study and Method time study, principles of motion economy, charts and diagrams, Job evaluation systems, Multi skilling, Wage payment and plans, Incentive schemes, Training and Development, Safety Regulations and safe practices.

PART - B

Unit – 5 **06 Hrs**

Motivation And Behavior: Hawthorns studies and its findings Maslows theory X and Y theory, Immaturity theory motivation hygiene theory, Pretence of needs and satisfaction of needs, goal oriented behavior, integration of organizational goals and needs of employee.

Unit – 6 **06 Hrs**

Management And Behavioral Approach: Contribution of Elton Mayo and Skinner to behavior sciences. Skills of a manager at various levels in an organization and inter-related systems, understanding past behavior, predicting future behavior, directing, changing and controlling behavior.

Unit – 7 **07 Hrs**

Process Management: Definition of process management. Major process decisions-process choice, vertical integration, resource flexibility, customer involvement, capital intensity, relationships between decisions, service operation, economics of scoop and gaining focus. Designing process-process rearranging and process improvement

Unit – 8 **07 Hrs**

Management Of Technology: Meaning and role of technology-primary areas of technology management, management of technology and its role in improving business performance. Creating and applying technology-R and D stages and technology fusion. Technology strategy. Implementation guidelines.

Text Books:

1. **Principles of Management**, Koontz O Donnel,"Mc.Graw Hill Intl.Book Co.
2. **Statistical Quality Control:** E.L. Grant and R.S. Leavenworth, 7th edition, McGraw-Hill publisher

Reference Books:

1. **Essentials of management,** Koontz Weirich,TATA McGraw Hill Intl. Book Co., 7th Edition.
2. **Management of Organizational Behaviour,** Hersey Paul and Kenneth H," PHI.
3. **Operations management-strategy and analysis,**Lee J.Krajewski and Larry P. Ritzman, Fifth Edition Addison-Wiley.
4. **Organizational Behaviour,** Stephen P Robbins, 9th Edition, Pearson Education Publications, ISBN-81-7808-561-5 2002

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

Rockets and Missiles

Sub Code:	**10AE666**	**IA Marks:**	**25**
Hrs/ Week:	**04**	**Exam Hours:**	**03**
Total Hours:	**52**	**Exam Marks:**	**100**

PART-A

Unit-1 **06 Hrs**

Rockets Classification and Definitions, Rocket propulsion, nuclear rocket engine, electric rocket propulsion, other rocket propulsion concepts. Application of rocket propulsion. Total impulse, exhaust velocity, energy and efficiency, acceleration in multiple of earth gravity or thrust to vehicle weight ratio.

Unit-2 **06 Hrs**

Nozzle Theory and Flight Performance, Ideal rocket thrust and thrust coefficient, characteristics velocity and specific impulse. Principal losses in real nozzles. Nozzle alignment, Gravity free, drag free space flight, forces acting on a vehicle in atmospheric space flight.

Unit-3 **06 Hrs**

Rocket Propellant ; Propellant - Desirable Physical Properties. Liquid Oxidizers, Liquid mono propellants. Solid Propellant Classification. Propellant characteristics. Aging and useful life. Typical ingredients of composite solid propellants. Hybrid Rocket Propellant –Introduction, Application, Grain Configuration.

Unit-4 **08 Hrs**

Selection of Rocket Propulsion System. Idealized process for selecting propulsion system. Advantages and disadvantages of solid and liquid propellant rockets. Criteria for selection.

PART-B

Unit-5 **08 Hrs**

Missile Aerodynamics. Theory of bodies of revolution. Lift and moment of slender bodies of revolution. Pressure distribution and loading of slender bodies of revolution. Planar W-B Interference. Generalized nature of Aerodynamic forces and stability derivatives.

Unit-6 **06 Hrs**

Missile Aerodynamic Control; Types of Controls-Conventions. Change in Missile Attitude due to Impulsive Pitch Control. Altitude effects. Equations of motion for missile pitch control. All moving control for Cruciform Controls.

Unit-7 **06 Hrs**

Thrust Vector Control: Thrust Vector Control Mechanism-advantages and disadvantages. TVC with multiple thrust chamber or nozzle. Testing, Integration with Vehicle.

Unit-8 **06 Hrs**

Rocket Testing Different types of tests, Test facility and safe guards. Instrumentation and data management Flight testing & post accident procedure.

Text Books:

1. George P Sutton and Oscar Biblarz, `Rocket Propulsion Element`, John Wiley and Sons Inc 2001
2. Jack N Neilson, `Missile Aerodynamics`, McGraw hill Book Company, Inc 1960

Reference Books:

1. S S Chin, `Missile Configuration Design

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

Structures Laboratory

Sub Code:	**10AEL67**	**IA Marks:**	**25**
Hrs/ Week:	**03**	**Exam Hours:**	**03**
Total Hours:	**42**	**Exam Marks:**	**50**

. **List of Experiments**

1. Deflection of a Simply Supported Beam.
2. Verification of Maxwell's Reciprocal Theorem..
3. Determination of Young’s Modulus using strain gages.
4. Poisson Ratio Determination
5. Buckling load of slender Eccentric Columns and Construction of Southwell Plot
6. Shear Failure of Bolted and Riveted Joints
7. Bending Modulus of sandwich Beam
8. Verification of Superposition Theorem
9. Determination of fundamental frequency of a cantilever beam and harmonics.
10. Frequency spectrum analysis for a cantilever beam.

Propulsion Laboratory

Sub Code:	**10AEL68**	**IA Marks:**	**25**
Hrs/ Week:	**03**	**Exam Hours:**	**03**
Total Hours:	**42**	**Exam Marks:**	**50**

List Of Experiments

1. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)
2. Study of an aircraft jet engine (Includes study of assembly of sub systems, various components, their functions and operating principles)
3. Study of forced convective heat transfer over a flat plate.
4. Cascade testing of a model of axial compressor blade row.
5. Study of performance of a propeller.
6. Determination of heat of combustion of aviation fuel.
7. Study of free jet
8. Measurement of burning velocity of a premixed flame.
9. Fuel-injection characteristics
10. Measurement of nozzle flow.