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SHIVAJI UNIVERSITY, KOLHAPUR

A syllabus of

(B.E. Aeronautical Engineering)

Structure (Semester III to VIII)

and

Syllabus of

Semester (III and IV)

To be introduced from Academic Year 2014-15

i.e. from June 2014 Onwards

(Subject to the modifications will be made from time to time)

SHIVAJI UNIVERSITY, KOLHAPUR,

Structure of S.E. (AERONAUTICAL ENGINEERING) **Semester III**

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2014-2015

Sr. No.	Course Title	Teaching Scheme				Examination Scheme				
		L	T	P	Total Hrs.	TP	TW	OE	POE	Total Marks
1	Engineering Mathematics – III	3	1	--	4	100	25	--	--	125
2	Applied Thermodynamics	3	--	2	5	100	25	--	25	150
3	Fluid Mechanics	3	--	2	5	100	25	--	25	150
4	Elements of Aeronautics	3	--	2	5	100	25	--	--	125
5	Mechanics of Solids	4	--	2	5	100	25	--	--	125
6	Professional Skill Development	1	--	--	1	--	25	--	--	25
7	Aircraft Component Drawing	--	--	2	2	--	50	25	--	75
8	Computer Programming in C++	--	--	2	2	--	25	--	--	25
Total		17	1	12	30	500	225	25	50	800

L: Lecture, T: Tutorial, P: Practical, TP: Theory Paper, TW: Term Work, OE: Oral Exam. , POE: Practical and Oral Exam.

SHIVAJI UNIVERSITY, KOLHAPUR,

Structure of S.E. (AERONAUTICAL ENGINEERING) **Semester IV**

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2014-2015

Sr. No.	Course Title	Teaching Scheme				Examination Scheme				
		L	T	P	Total Hrs.	TP	TW	OE	POE	Total Marks
1	Aerodynamics-I	3	1	--	4	100	25	--	--	125
2	Aircraft Production Technology	4	1	--	5	100	25	--	--	125
3	Material Science and Engineering	3	--	2	5	100	25	25	--	150
4	Applied Numerical Methods	3	--	2	5	100	25	--	--	125
5	Electrical, Electronics and Communications Engineering	3	--	2	5	100	25	--	--	125
6	Instrumentation Lab	--	--	2	2	--	25	25	--	50
7	Computer Aided Drafting Lab	--	--	2	2	--	50	--	--	50
8	Aircraft Production Technology Lab	--	--	2	2	--	25	--	25	50
Total		16	02	12	30	500	225	50	25	800

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SHIVAJI UNIVERSITY, KOLHAPUR,

Structure of T.E. (AERONAUTICAL ENGINEERING) **Semester V**

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2015-2016

Sr. No.	Course Title	Teaching Scheme				Examination Scheme				
		L	T	P	Total Hrs.	TP	TW	OE	POE	Total Marks
1	Aircraft Structures	4	--	2	6	100	25	--	--	125
2	Aerodynamics – II	3	1	--	4	100	25	--	--	125
3	Aerospace Propulsion- I	3	1	--	4	100	25	--	--	125
4	Flight Mechanics- I	3	--	2	5	100	25	--	--	125
5	Air Transportation Systems	3	--	2	5	100	25	--	25	150
6	Aircraft Structures Lab	--	--	2	2	--	25	25	--	50
7	Aerodynamics Lab	--	--	2	2	--	25	--	25	50
8	Mini Project-I	--	--	1	1	--	50	--	--	50
Total		16	02	11	29	500	225	25	50	800

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SHIVAJI UNIVERSITY, KOLHAPUR,

Structure of T.E. (AERONAUTICAL ENGINEERING) **Semester VI**

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2015-2016

Sr. No.	Course Title	Teaching Scheme				Examination Scheme				
		L	T	P	Total Hrs.	TP	TW	OE	POE	Total Marks
1	Machines and Mechanisms	3	--	2	5	100	25	--	--	125
2	Design of Aircraft Structures	3	--	2	5	100	25	--	--	125
3	Aerospace Propulsion- II	3	1	--	4	100	25	--	--	125
4	Industrial Management and Operation Research	3	--	2	5	100	25	--	--	125
5	Flight Mechanics- II	3	--	2	5	100	25	25	--	150
6	Aerodynamics and Propulsion Lab	--	--	2	2	--	25	--	25	50
7	Seminar	--	--	2	2	--	50	--	--	50
8	Mini Project-II	--	--	1	1	--	25	--	25	50
Total		15	01	13	29	500	225	25	50	800

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SHIVAJI UNIVERSITY, KOLHAPUR,

Structure of B.E. (AERONAUTICAL ENGINEERING) **Semester VII**

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2016-2017

Sr. No.	Course Title	Teaching Scheme				Examination Scheme				
		L	T	P	Total Hrs.	TP	TW	OE	POE	Total Marks
1	Mechanical Vibration and Structural Dynamics	4	--	2	6	100	25	25	--	150
2	Computational Aerodynamics	3	--	2	5	100	25	25	--	150
3	Control Theory- Application to Flight Control Systems.	3	--	2	5	100	25	25	--	150
4	Elective-I.	3	--	2	5	100	25	--	--	125
5	Elective-II	3	--	2	5	100	25	--	--	125
6	Industrial Training@	--	--	--	--	--	50	--	--	50
7	Project Phase– I	--	--	2	2	--	50	--	--	50
Total		16	00	12	28	500	225	75	00	800

Sr. No.	Elective – I
1	Helicopter Theory
2	Aircraft Design
3	Airframe Maintenance and Repair
4	Flight Scheduling and Operations
5	Aircraft Materials

Sr. No.	Elective – II
1	Industrial Aerodynamics
2	Heat Transfer
3	Total Quality Management
4	Computer Aided Design and Analysis
5	Aircraft Maintenance Engineering

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@ Industrial training of minimum two (2) weeks should be done after T.E. (II) in summer vacation and it's assessment will be done in B.E. (I) based on report submitted.
Work load of the assessment can be assigned to the project seminar guide.

SHIVAJI UNIVERSITY, KOLHAPUR,

Structure of B.E. (AERONAUTICAL ENGINEERING) **Semester VIII**

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2016-2017

Sr. No.	Course Title	Teaching Scheme				Examination Scheme				
		L	T	P	Total Hrs.	TP	TW	OE	POE	Total Marks
1	Finite Element Method	3	--	2	5	100	25	--	--	125
2	Avionics and Instrument Systems	3	--	2	5	100	25	25	--	150
3	Airport Planning and Operations	3	--	2	5	100	25	25	--	150
4	Elective – III	3	--	2	5	100	25	--	--	125
5	Elective – IV	3	--	2	5	100	25	--	--	125
6	Project Phase– II	--	--	4	4	--	75	50	--	125
Total		15	00	14	29	500	200	100	00	800

Sr. No.	Elective – III
1	Hypersonic Aerodynamics
2	Air traffic Control and Planning
3	Cryogenics
4	Composite material and structures
5	Rocket and Missile Design

Sr. No.	Elective – IV
1	Satellite communication and Navigation
2	Probability and Statistics
3	Engineering Design Optimization
4	Reliability Engineering
5	Management Information System

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SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
1. Mechanical Vibration and Structural Dynamics

Teaching Scheme:
Lectures : 4 Hrs./ Week
Practical : 2 Hrs. / Week

Examination Scheme:
Theory Paper : 100 Marks
Term Work : 25 Marks
Oral Exam : 25 Marks

Course Objectives:
The course aims to:
1.Study the dynamic behavior of different aircraft components
2. Interaction among the aerodynamic, elastic and inertia forces.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1 Know the concept of vibration and single degree of freedom systems.
2 Analyze the two degree and multi degree of freedom systems.
3 Understand the interaction among the aerodynamic, elastic and inertia forces.

Unit 1 **Introduction** **[08]**
Simple Harmonic Motion, Terminology, Degrees of freedom, Newton's Law, D'Alembert's principle, Energy Methods, Rayleigh's and Equilibrium Method.

Unit 2 **Single Degree of Freedom Systems** **[08]**
Free vibrations, Damped vibrations, Forced vibrations, with and without damping, Support excitation, Vibration measuring instruments.

Unit 3 **Multi Degrees of Freedom Systems** **[10]**
Two degrees of freedom systems ,Static and dynamic couplings Vibration absorber, Principal coordinates, Principal modes and orthogonal condition ,Eigen value problems, Hamilton's principle, Lagrangian equation and application ,Vibration of elastic bodies, Vibration of strings, Longitudinal, Lateral and Torsional vibrations.

Unit 4 **Force Deflection Properties of Structures** **[09]**
Constraints and generalized coordinates, Virtual work and generalized forces, Force, Deflection influence functions, Stiffness and flexibility methods.

Unit 5 **Approximate Methods** **[09]**
Approximate methods of evaluating the Eigen frequencies and the dynamics response of continuous systems, Matrix methods of dynamic stress analysis, Rayleigh's and Holzer Methods and Matrix Iteration to find natural frequencies.

Unit 6 **Elements of Aeroelasticity** **[08]**
Concepts, Coupling,Aero elastic instabilities and their prevention ,Basic ideas on wing divergence, Loss and reversal of aileron control, Flutter and its prevention.

Term Work:

1. Experiment on equivalent spring mass system.
2. Experiment on study of forced vibration characteristics
3. Determination of logarithmic decrement for single DOF damped system
4. Experiment on torsional vibration of two rotors without damping
5. Experiment on free vibration of a coupled pendulum and double pendulum
6. Use of different types of exciters for vibration analysis
7. Measurement of vibration parameters using vibration instruments
8. Exercise on numerical calculation of natural frequencies by Holzer method.
9. Exercise on numerical calculation of natural frequencies by Raleigh's Method
10. Matrix Iteration Method.

Text Books:

1. "Dynamics of Structures", R.W. Clough and Penzien, Tata McGraw Hill, 2nd Edition (1993).
2. "Mechanical Vibrations", Singiresu. S. Rao, Pearson Education LPE. 4th Edition, (2004).
3. "Vibration Problems in Engineering", Timoshenko S., John Wiley and Sons, New York, (1993).
4. "An Introduction to Theory of Aero elasticity" Fung Y.C.,John Wiley and Sons, New York, (1995).

Reference Books:

1. "Aero elasticity", Bisplinghoff R.L., Ashley H and Hoffman R.L., Addision Wesley Publication, New York, (1983).
2. "Mechanical Vibrations", Tse. F.S., Morse, I.F., Hinkle, R.T.,Prentice Hall India, New York, (1984).
3. "Introduction to the study of Aircraft Vibration and Flutter", Scanlan R.H. and Rosenbaum R., John Wiley and Sons. New York, (1982).
4. "Principles of Vibration", Tongue. B. H., Oxford University Press, (2000).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
2. Computational Aerodynamics

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs/week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks
	Oral Exam : 25 Marks

Course Objectives:
The course aims to:

1 Enable importance of CFD
2 Know the importance of partial differential equations on CFD
3 Enable knowledge of descretization
4 Familiarize with finite volume techniques in computational fluid analysis
5 Introduce to grid generation and its importance
6 Enable knowledge of transformation technique

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1 Understand CFD and its need
2 Have a knowledge on impact of partial differential equation on CFD
3 Understand the importance of discretization
4 Understand implementation of finite volume technique
5 Acquire knowledge of grid generation, its importance and types of grids
6 Have fundamental knowledge in transformation technique

Unit 1 **Introduction** **[06]**

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, Physical boundary conditions, Forms of the governing equations particularly suited for CFD work: Shock fitting and Shock capturing methods, Generic form of equations.

Unit 2 **Partial Differential Equations: The Impact on CFD** **[07]**

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 inviscid flow; Steady boundary layer flow; and unsteady thermal conduction.

Unit 3 **Discretization** **[07]**

Essence of discretization, Taylor series approach for the construction of finite-difference quotients; Higher order difference quotients, Up-wind differencing, Midpoints 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.

Unit 4 Finite Volume Techniques **[06]**

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 5 Grid Generation **[08]**

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 Appropriate Transformation **[06]**

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,

Term Work:

List of Experiments

1. Introduction to Meshing and Simulating Tool, eg, ANSYS(GAMBIT and FLUENT)
2. Modeling of Symmetric Aerofoil geometry and Grid generation.
3. Modeling of 2-D Incompressible and In viscid flow over an aerofoil, Computations and analysis for velocity vectors and pressures distributions.
4. Incompressible and Viscous flow analysis for velocity vectors and pressures distributions over an aerofoil.
5. Geometric modeling and mesh generation of 2-D Convergent-Divergent nozzle and Compressible flow analysis inside the nozzle.
6. 3-D Grid generation inside a Convergent-Divergent nozzle.
7. Compressible flow analysis inside a 3-D Convergent-Divergent nozzle.
8. Modeling of 3-D Incompressible and In viscid flow over a slender body, Computations and analysis for velocity vectors, contours and pressures distributions.
9. Modeling of 3-D Compressible flow over a blunt body.
10. 3-D computations and flow analysis for density contours, velocity vectors and pressure distributions.

Text Books:

1. *"*Computational Techniques for Fluid Dynamics*",* Fletcher, C,A,J, Vols, I and II, Springer - Verlag, Berlin, (1988).
2. *"*Computational Fluid Dynamics for Engineers*"* Vols, I and II , Klaus A Hoffmann and Steve T, Chiang, Engineering Education System, P,O, Box 20071, W,Wichita, K,S,, 67201 - 1071 USA,(1993).

Reference Books:

1. *"*Fundamentals of Aerodynamics*" ,* Anderson, Jr,D, Tata McGraw-Hill, 5th Edition (2010).
2. *"*Computational Fluid Dynamics- An Introduction*"*,John F, Wendt (Editor), Springer – Verlag, Berlin,(1992).
3. *"*Numerical Computation of Internal and External Flows*"* Vols, I and II ,Charles Hirsch, John Wiley and Sons, New York, (1988).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
3. Control Theory – Application to Flight Control Systems

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs / week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks
	Oral Exam : 25 Marks

Course Objectives:
The course aims to:

1. Create awareness of fundamental concepts of control systems and Mathematical modeling of the system
2. Enrich concept of time response, Frequency response of the system and the basics of stability analysis of the system
3. Enable the concept of aircraft response to control systems,
4. Enable classical control theory for analysis and Design of Autopilots
5. Enrich students with Modern control theory and Design of optimal control systems

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Represent the mathematical model of a system
2. Determine the response of different order systems for various step inputs and analyze the stability of the system
3. Understand typical Aircraft's Autopilot systems of Civil and Military Aircraft their description design, construction, operation, Performance,
4. Understand limitations of classical methods of control system and understand state space modeling, analysis,
5. Understand optimal control system design and their application to stability augmentation and aircraft autopilots

Unit 1 Introduction **[07]**

Concepts of Control Systems, Open Loop and closed loop control systems Classification of control systems, Feed-Back Characteristics, Effects of feedback, Mathematical models – Differential equations, Impulse Response and Transfer functions - Translational and rotational mechanical systems analogies - Mechanical and Electrical components, Development of flight control systems, Transfer Function of DC Servo motor - AC servo motor- synchro transmitter and receiver, Block diagram representation of electrical systems , Representation by signal flow graph , Reduction using Mason's Gain Formula.

Unit 2 Transient, Steady-State Response Analysis And Concept Of Stability **[07]**

Standard test signals ,Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems ,Time domain specifications, Steady state response, Steady state errors, Effects of proportional derivative, Proportional integral systems, Proportional integral derivative system, Stability definitions, characteristic equation, Location of roots in the s-plane for stability, Routh-Hurwitz criteria of stability, Root locus and bode techniques, Concept and construction, Frequency response.

Unit 3 Aircraft Response to Controls **[06]**

Approximations to aircraft transfer functions, Control Surface actuators Review, Response of Aircraft to Pilot's control inputs to atmosphere, The control task of the pilot, Flying qualities of aircraft, Relation to airframe transfer function, Reversible and Irreversible flight control systems, Pilot's opinion ratings, Flying quality requirements pole-zero, Frequency Response and Time-Response specifications, Stability augmentation systems- Displacement and rate feedback, Determination of gains, conflict with pilot inputs, Resolution, Control augmentation systems, Full authority fly-by-wire, Need for automatic control.

Unit 4 **Application of Classical Control Theory to Analysis and Design of Autopilots** **[07]**

Autopilots- purpose, Functioning- inputs- hold, Command, Track, Displacement autopilots, Pitch, Yaw, Bank, Altitude and velocity hold- Purpose, Maneuvering autopilots- Normal acceleration, Turn rate, Pitch rate commands- Applications, Autopilot design by displacement and rate feedback- Iterative methods, Design by displacement feedback and series PID compensator, Zeigler and Nichols method, Autopilots viewed as stability augmentors, Robust control, Typical aircraft autopilots of civil and military aircraft description of design, construction, operation, performance.

Unit 5 **Modern Control Theory- State Space Modeling, Analysis** **[07]**

Limitations of classical methods of control system modeling, Analysis and design, Applied to complex, Multiple input multiple output systems, State space modeling of dynamical systems, State variables, Definition, State equations, The output variable, the output equation, Representation by vector matrix first order differential equations, General form, Time invariant linear systems, Matrix transfer function, State transition matrix, Matrix exponential, Properties, Numerical solution of state equations, Illustrative examples,

Unit 6 **Optimal Control System Design- Application to Stability Augmentation and Aircraft Autopilots** **[06]**

Statement of the problem, The objective function, Inclusion of cost constraints, Determination of Feedback Gain Matrix, Outline of the solution, Illustrative examples, Application to stability augmentation, Extension to autopilot design, Digital control systems- Overview- Advantages, Disadvantages

Term Work:

Minimum ten Assignments based on the following topics

1. Comparison of open and closed loop system.
2. Block diagram reduction.
3. Signal flow graph by Masson‘s gain formula.
4. Modeling of mechanical systems.
5. Time response of second order system.
6. Steady state analysis of systems.
7. Control augmentation system.
8. PID controller design using Zieglar Nichols method.
9. State space modeling of dynamics systems.
10. Multi-input multi-output systems.
11. Digital control system.
12. Determination of feedback gain matrix.

Text Books:

1. "Automatic Control Systems", Kuo, B, C Prentice Hall of India, ISBN 0-87692-133-0. (1992).
2. "Aircraft Control and Simulation", Stevens, B,L, and Lewis, F,L John Wiley, , ISBN0-471-61397-5. (1992).
3. "Flight Stability and Automatic Control", Nelson, R, C, Tata McGraw-Hill, 2nd edition ISBN: 0-07-066110-3. (2007).
4. "Introduction to Aircraft Flight Mechanics", Yechout, T, R, AIAA, ISBN 1-56347-577-4. (2003).

Reference Books:

1. "Automatic Flight Control Systems", Mc Lean, D, Prentice Hall, ISBN: 0-13-154008-0. (1990).
2. "Control of Aircraft and Spacecraft", by Bryson, A,E,, , Princeton University Press, 1994, ISBN: 0-691-08782-2.
3. "Introduction to Avionics Systems", Collinson, R.P.G., Springer, ISBN: 978-81-8489-795-1. 2nd Edition, (2003).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
4. Helicopter Theory (Elective -I)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs / week	Theory Paper: 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1 Enable lift, propulsion and control of V/ STOL aircraft
2 Enable helicopter aerodynamics
3 Enable knowledge on ideal rotor theory
4 Enrich the knowledge on power estimates
5 Give knowledge on ground effect machines

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1 Understand the various configuration propulsive devices and its performances at different flight conditions.
2 Acquire a knowledge of different types of helicopter and its control system
3 Understand the momentum theory, power estimation and constant chord and ideal twist rotors.
4 Understand power requirements, performance curves, variation altitude in forward flight and helicopter stability.
5 Understand hovercraft types, Lift augmentation and Power calculations of plenum chambers, Applications.

Unit 1 Elements of Helicopter Aerodynamics and Rotor Control [08]
Configurations based on torque reaction ,Jet Rotors and Compound Helicopters, Methods of Control , Collective and cyclic pitches changes ,Lead ,Lag and flapping hinges.

Unit 2 Ideal Rotor Theory [06]
Hovering performance, Momentum and Simple blade element theories.

Unit 3 Rotor Performance [06]
Figure of merit, Profile and induced power estimation, Constant chord and ideal twist rotors.

Unit 4 Power Estimates, Stability and Trim power Estimates [08]
Induced, profile and parasite power requirements in forward flight, Performance curves with effects of altitude.

Preliminary ideas on Helicopter stability.

Unit 5 Lift and Control of V/Stol Aircraft [06]
Various configurations - Propeller, Rotor ducted fan and jet lift - Tilt wing and vectored thrust - Performances of VTOL and STOL Aircraft in hover, Transition and Forward motion.

Unit 6 Ground Effect Machines [06]

Types, Hover height, Lift augmentation and Power calculations for plenum chamber and peripheral jet machines, Drag of hovercraft on land and water. Applications of hovercraft.

Term Work:

Minimum 10 Assignments from the following topics:

1. Comparative analysis for Rotor control for at least 2 major or popular helicopters in operation in India.
2. Comparative analysis for Hovering Performance for at least 2 major or popular helicopters in operation in India.
3. Comparative analysis for Performance curves with effects of altitude for at least 2 major or popular helicopters in operation in India.
4. Comparative analysis for Elements of typical hovercraft for at least 2 major or popular hovercrafts in operation in World.
5. Performances of VTOL and STOL aircraft in hover
6. Lift augmentation (Ground Effect Machines).
7. Case study on tip jet Helicopter.
8. Case study on Helicopter NOTAR.
9. Case study on VTOL and STOL aircrafts.
10. Case study on tandem and coaxial helicopter.

Text Books:

1. "Aerodynamics of V/STOL Flight", B.W. McCormic, Academic Press, New York, (1978).
2. "Aerodynamics of the Helicopter", A. Gessow and G.C.Meyers, Macmillan and Co., New York, (1982)

Reference Books:

1. "Hovercraft Design and Construction", G.H. Elsley and A.J. Devereux, David Charies, London, (1982).
2. "Aerodynamics", Anderson J.D., John Wiley, (1995).

SHIVAJI UNIVERSITY, KOLHAPUR

B.E. (Aeronautical Engineering) Semester VII
4. Aircraft Design (Elective – 1)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs/week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1 Introduce basics of the design process, sizing from a conceptual view-point.
2 Understand concepts of airfoil and geometry selection thrust to weight ratio, wing loading.
3 Introduce how Initializing and configuration layout, crew station, passengers and payload happens
4 Introduce basics of Propulsion and fuel system integration, landing gear and subsystems.
5 Basic understanding of baseline design, stability and control, performance and constraint analysis.
6 Introduce Cost estimation, parametric analysis, optimization, refined sizing and trade studies conducted.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1 Understand basics of the design process, sizing from a conceptual view-point.
2 Apply concepts of airfoil and geometry selection, thrust to weight ratio, wing loading.
3 Understand how sizing and configuration layout, crew station, passengers and payload happens.
4 Understand concepts of propulsion and fuel system integration, landing gear and subsystems.
5 Understand of baseline design, stability and control, performance and constraint analysis.
6 Apply concepts of cost estimation, parametric analysis, optimization, refined sizing and trade studies.

Unit 1 **Overview of the Design Process, Sizing From a Conceptual Sketch** **[07]**

Phases of aircraft design, Aircraft conceptual design process, Project brief / request for proposal, Problem definition, Information retrieval, Aircraft requirements, Configuration options, Integrated product development and aircraft design, The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, Empty weight estimation, Historical trends, Fuel fraction estimation, Mission profiles, Mission segment weight fractions.

Unit 2 **Airfoil and Geometry Selection, Thrust to Weight Ratio, Wing Loading** **[06]**

Airfoil selection, Airfoil design, Design lift coefficient, Stall, Airfoil thickness ratio and other airfoil considerations, Wing geometry and wing vertical location, Wing tip shapes, Tail geometry and arrangements,

Thrust to weight ratio, Statistical estimation, Thrust matching, Wing loading, Performance constraints, Selection of thrust-to-weight ratio and wing loading.

Unit 3 **Initial sizing and Configuration Layout, Crew station, Passengers and Payload** **[07]**

Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, Wing, Tail, Control surfaces, Development of configuration lay out from conceptual sketch, The inboard profile drawing, Wetted area, Volume distribution and fuel volume plots, Lofting-definition, Significance and methods, Flat wrap lofting, Special consideration in configuration lay out, Isobar tailoring, Sears-Haack volume distribution, Structural load paths, Radar, IR, Visual detectability, Aural signature, Considerations of vulnerability, Crashworthiness, Producibility, Maintainability.

Fuselage design- Crew station, Passenger Compartment, Cargo provisions, Weapons carriage, Gun installation.

Unit 4 **Propulsion and Fuel System Integration, Landing Gear and Subsystems** **[05]**

Propulsion selection, Jet engine integration, Engine dimensions, Inlet geometry, Inlet location, Capture area calculation, Boundary layer diverters, Nozzle integration, Engine cooling provisions, Engine size estimation, Fuel system design and integration, Landing gear arrangements, Guidelines for lay out, Shock absorbers ,Types, Sizing, Stroke determination, Gear load factors, Gear retraction geometry, Aircraft subsystems, Significance to configuration lay out, The baseline design layout and report of initial specifications.

Unit 5 **Baseline Design Analysis** **[10]**

Aerodynamics and propulsion, structures and weight and balance

Estimation of lift curve slope, Maximum lift coefficient, Complete drag build up, Installed performance of an engine, Installed thrust methodology, Net propulsive force, Part power operation. Aircraft loads, categories, Manoeuvre, Gust, Inertial, Power plant, landing gear loads, Limit loads, the V, n diagram, Air load distribution on lifting surfaces, Review of methods of structural analysis, Material selection, Weights and moments- Statistical group estimation method, Centre of gravity excursion control.

Stability and control, performance and constraint analysis

Estimation of static pitch stability, Velocity stability and trim. Estimation of stability and control derivatives, Static lateral-directional stability and trim, Estimation of aircraft dynamical characteristics, Handling qualities. Cooper – Harper scale, Relation to aircraft dynamic characteristics,

Performance analysis and constraint analysis, Steady level flight, Minimum thrust required for level flight, Range and loiter endurance, Steady climbing and descending flight, Best angle and rate of climb, Time to climb and fuel to climb, Level turning flight, Instantaneous turn rate, Sustained turn rate, Energy maneuverability methods of optimal climb trajectories and turns, The aircraft operating envelope, Take off analysis, Balanced field length, Landing analysis, Fighter performance measures of merit, Effects of wind on aircraft performance,

Initial technical report of baseline design analysis and evaluation, Refined baseline design and report of specifications.

Unit 6 **Cost Estimation, Parametric Analysis, Optimization, Refined Sizing and Trade Studies** **[05]**

Elements of life cycle cost, Cost estimating method, RDT and E and production costs, operation and maintenance costs, Fuel and oil costs, Crew salaries, Maintenance expenses, depreciation. Cost measures of merit, Aircraft and airline economics, DOC and IOC, Airline revenue, Breakeven analysis, Investment cost analysis, Parametric analysis and optimization, Refined conceptual sizing methods, Sizing matrix plot and carpet plot, Trade studies, Design trades, Requirement trades, Growth sensitivities, Multivariable design optimization methods, Measures of merit. Determination of final baseline design configuration, Preparation of type specification report.

Term Work:

Case Studies and Design of Unique Aircraft Concepts (At least 3 types from each below category to complete)

1. Design of DC – 1, DC – 2, DC- 3 aircraft, Boeing B-47 and 707, General Dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber.
2. A Survey of The Indian Aircraft Design Effort. Design Of VTOL Aircraft, Helicopters, Hypersonic Vehicles, Delta And Double Delta Wings, Forward Swept Wings, Uninhabited Air Vehicles.

Text Books:

1. "Aircraft Design: A Conceptual Approach", Raymer, D.P., AIAA Education Series, AIAA, ISBN: 1-56347-281-0. 3rd Edition, (1999).
2. "Aircraft Conceptual Design Synthesis", Howe, D., Professional Engineering Publishing, London, ISBN: 1-86058-301-6, (2000).
3. "Introduction to Aircraft Design", Fielding, J.P Cambridge University Press, ISBN: 0-521-657222-9, (2005).

Reference Books:

1. "Aircraft Performance and Design", Anderson, J.D. Jr., Tata McGraw-Hill,ISBN: 0-07-001971-1.,(1999).
2. AIAA Aerospace Design Engineer's Guide, AIAA Education Series, ISBN 1-56347-590-1. 5th Edition, (2003).
3. "Introduction to Aeronautics: A Design Perspective", Brandt, S.A. et. al., AIAA Education Series, AIAA, ISBN: 1-56347-701-7 2nd Edition (2004).
4. "Aircraft Design Projects for Engineering Students", Jenkinson, L.R. and Marchman III, J. F. Butterworth Heinemann, ISBN: 0 7506 5772 3. (2003).
5. "Flight Theory and Aerodynamics: A Practical Guide to Operational Safety", Dole, C.E., Wiley,ISBN: 0-471-09152-9 (1981).
6. "The Design of the Airplane" Stinton, AIAA, 2001, ISBN: 0-56347-524-6. 2nd Edition.
7. "Computational Approaches for Aerospace Design" Keane, A.J. And Nair, P.B., Wiley, ISBN: 0-470-85540-1. (2005).
8. http://www.desktopaero.com/appliedaero/preface/welcome.html
9. "Applied Aerodynamics: A Digital Textbook", Kroo I Desktop Aeronautics Inc.,

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
4. Aircraft Maintenance and Repair (Elective - I)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./week	Theory Paper : 100 Marks
Practical : 2 Hrs./ week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Overview of aircraft maintenance procedures briefly about different systems in aircraft.
2. Introduce maintenance and repair by welding of aircraft structural components through different techniques.
3. Introduce Sheet metal repair and maintenance through different techniques.
4. Introduce plastics and composites in aircraft repair and maintenance through different techniques.
5. Introduce maintenance of different systems in aircraft including landing gear, Hydraulic, Pneumatic, Rain, Fire, Ice protection systems.
6. Introduce importance of aircraft jacking, assembly and rigging of both fixed wing and rotor wing aircraft.
7. Safety practices in maintenance and repair in overall aircraft including furnishings and miscellaneous equipment.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand importance of aircraft maintenance procedures about different systems in aircraft.
2. Understand maintenance and repair by welding of aircraft structural components through different techniques.
3. Understand sheet metal repair and maintenance through different techniques.
4. Understand plastics and composites in aircraft repair and maintenance through different techniques.
5. Understand basic maintenance of different systems in aircraft including landing gear, Hydraulic, Pneumatic, Rain, Fire, Ice protection systems.
6. Understand procedures of aircraft jacking, assembly and rigging of both fixed wing and rotor wing aircraft.
7. Understand SOP's (Standard Operating Procedures) to follow when safety practices in maintenance and repair in overall aircraft including furnishings and miscellaneous equipment.

Unit 1 Welding of Aircraft Structural Components **[06]**
Equipments used in welding shop and their maintenance, Ensuring quality welds, Welding jigs and fixtures, Soldering and brazing.

Unit 2 Sheet Metal Repair and Maintenance **[08]**
Inspection of damage, Classification, Repair or replacement, Sheet metal inspection, N.D.T. Testing, Riveted repair design, Damage investigation, Reverse technology.

Unit 3 Plastics and Composites In Aircraft **[06]**

Review of types of plastics used in airplanes, Maintenance and repair of plastic components, Repair of cracks, holes etc., Various repair schemes, Scopes, Inspection and Repair of composite components, Special precautions, Autoclaves.

Unit 4 Aircraft Jacking, Assembly and Rigging **[06]**

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

Unit 5 Review of Hydraulic and Pneumatic System **[08]**

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 and maintenance of auxiliary systems , Fire protection systems , Ice protection system , Rain removal system , Position and warning system , Auxiliary power units (APUs).

Unit 6 Safety Practices **[06]**

Hazardous materials storage and handling, Aircraft furnishing practices, Equipment. Trouble shooting, Theory and practices.

Term Work:

List of Assignments

1 List different kinds of Welding procedures involved in Aircraft Industry. Explain briefly equipments used in welding shop and their maintenance.

2 Explain how sheet metal repair and its maintenance is very critical for overall safety and explain different inspection techniques involved for a specific repair involved.

3 Explain how important are plastics and composites in aircraft in current scenario, explain with at least ten points giving sufficient reasons in relevance to current industry.

4 Explain the procedure for each with respect to both fixed-wing and Rotor-wing aircraft: Aircraft jacking, weighing, assembly and rigging

5 Compare with at least four differences how Testing ,Inspection and maintenance of auxiliary systems , Fire protection systems , Ice protection system , Rain removal system , Position and warning system , Auxiliary power units; are different for the two different types of aircraft and detail your understanding by valid reasons and Justify.

6 Explain the Hazardous materials storage and handling procedures in actual practise in Aircraft industry, for at least six materials with each material separately in a tabular format against the precautions and handling procedures separately in three different columns.

Text Books:

1. "Aircraft Maintenance and Repair", Kroes, Watkins, Delp, Tata McGraw-Hill, New York, (1992).

Reference Books:

1. "Aircraft Repair Manual", Larry Reithmeir, Palamar Books, Marquette, (1992).
2. "Aircraft Maintenance", BrimmD.J. BoggesH.E., Pitman Publishing corp. New York, (1940).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
4. Flight Scheduling and Operations (Elective – 1)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3Hrs. / week	Theory Paper : 100 Marks
Practical : 2 Hrs. / week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1. Introduce air transportation industry and compare with other modes of transport. Significance of IATA, ICAO, General aviation industry airline, Factors affecting general Aviation.
2. Introduce airline economics associated to factors which influence forecasting.
3. Introduce fleet planning, Selection process, Factors affecting choice of fleet, route selection.
4. Introduce principles of airlines scheduling, Equipment maintenance, Flight operations and crew scheduling and practices.
5. Introduce basics of Aircraft reliability with maintenance schedule and its Condition monitoring, Importance of EROPS and ETOPS
6. Introduce overall perspective of airlines scheduling, Maintenance sharing of equipment and tools for aircraft maintenance, Budgetary control.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Understand why Airlines, need and importance of IATA, ICAO.
2. Determine what factors and which influence forecasting of Airline economics.
3. Reason how fleet planning, selection process is done and in-turn factors which affect choice of fleet, route selection.
4. Describe and understand principles of airlines scheduling, Equipment maintenance, Flight operations and crew scheduling and practices
5. Understand importance of different aircraft reliability programs with maintenance schedules and its condition monitoring, including importance of EROPS and ETOPS
6. Reason why airlines scheduling, Maintenance sharing of equipment and Tools for aircraft maintenance , Budgetary control and their importance

Unit 1 Introduction **[08]**

Development of air transportation, Comparison with other modes of transport, Role of IATA, ICAO, General aviation industry airline, Factors affecting general aviation, Use of aircraft, Airport: airline management and organization, Levels of management, Functions of management, Principles of organization planning the organization chart, Staff departments and line departments.

Unit 2 Airline Economics **[06]**

Forecasting – Fleet size, Fleet planning, The aircraft selection process, Operating cost, Passenger capacity, Load factor etc., Passenger fare and tariff, Influence of geographical, Economic and Political factors on routes and route selection.

Unit 3 **Fleet Planning** **[06]**

The aircraft selection process, Fleet commonality, Factors affecting choice of fleet, Route selection and capitol acquisition, Valuation and Depreciation, Budgeting, Cost planning, Aircrew evaluation, Route analysis, Aircraft evaluation.

Unit 4 **Principles of Airlines Scheduling** **[08]**

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, Equipments and types of schedule, Hub and spoke scheduling, Advantages / disadvantages and preparing flight plans, Aircraft scheduling in line with aircraft maintenance practices.

Unit 5 **Aircraft Reliability** **[06]**

Aircraft reliability, The maintenance schedule and its determinations, Condition monitoring maintenance, Extended range operations (EROPS) and ETOPS, Ageing aircraft maintenance production.

Unit 6 **Airlines Scheduling** **[06]**

Airlines Scheduling (With Reference To Engineering), Product Support And Spares, Maintenance Sharing, Equipments And Tools For Aircraft Maintenance, Aircraft Weight Control, Budgetary Control.

Term Work:

List of Assignments

1 Write brief history about IATA, ICAO with their significance and their role as of today.
2 Explain the Influence of geographical, Economic and Political factors on routes and route selection in Airline Economics.
3 Explain aircraft selection process, Fleet commonality, Factors affecting choice of fleet.
4 Principles of airlines scheduling, List different types of scheduling and explain any three in detail.
5 Explain Condition monitoring maintenance, Extended range operations (EROPS) and ETOPS, Ageing aircraft maintenance for different Aircrafts at least compare 2 aircrafts.
6 Explain the major Budgetary control factors in Airline industry. Explain How the best practices in Airline industry could be achieved. List several factors and list key factors. Give justification.

Text Books:

1. "Airport Management", FedricJ.H.,(2000).
2. "Aircraft Maintenance Management", C.H. Friend, Longman, Harlow, (2000).

Reference Books:

1. "Airline Procedures", Gene Kropf, Tata McGraw-Hill Book Company, (1949).
2. "Air Transportation", Wilson and Bryon, Prentice Hall India ,(1949).
3. "Economics of Transportation", Philip Locklin D, 3rd Edition, (1949).
4. "Indian Aircraft manual" DGCA Publication.
5. "Air Transportation" Alexander T. Wells, Wadsworth Publishing Company, California, 3rd Edition ,(1994).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
4. Aircraft Materials (Elective – I)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs/week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Introduce basics of mechanical behaviour of engineering materials
2. Introduce different kind of materials in Aircraft construction
3. Introduce adhesive and sealants for aircraft used in Aircraft Industry
4. Introduce importance of Corrosion and Heat treatment of metals and alloys used in Aircraft Industry
5. Introduce composites in Aircraft construction

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand and reason with basic mechanical behaviour of engineering materials
2. Reason why different kind of materials in Aircraft construction are required and Justify.
3. Understand which Adhesive and sealants are used in Aircraft Industry and reason.
4. Justify why Corrosion and Heat treatment of metals and alloys are required and what kinds are used in Aircraft Industry.
5. Understand the importance of Composites in Aircraft construction and overall benefits and applications in maintenance perspective.

Unit 1 **Mechanical Behaviour of Engineering Materials** **[07]**

Knowledge of various Types of Hardness Testing Machines and various types of Hardness Numbers, Linear and Nonlinear Elastic Properties, Stress and Strain Curves, Yielding and Strain Hardening, Toughness, Modules of resilience, Bauchinger's effect, Effect of notches, Testing and flaw detection of materials and components.

Unit 2 **Materials In Aircraft Construction - I** **[06]**

Aluminium and its alloys: Types and identification. Properties, Castings, Heat treatment processes, Surface treatments.

Magnesium and its alloys: Cast and Wrought alloys, Aircraft application, Features specification, Fabrication problems, Special treatments.

Titanium and its alloys: Applications, Machining, Forming, Welding and Heat treatment.

Unit 3 **Materials In Aircraft Construction - II** **[07]**

Steels: Plain and low carbon steels, Various low alloy steels, Aircraft steel specifications, Corrosion and heat resistant steels, Structural applications,

Maraging Steels: Properties and Applications

Copper Alloys – Monel, K.Monel

Super Alloys: Use – Nickel base – Cobalt base – Iron base – Forging and Casting of Super alloys – Welding, Heat treatment.

Unit 4 **Adhesive and Sealants For Aircraft** **[08]**

Advantages of Bonded structure in airframes, Crack arresting, Weight saving ,Technology of adhesive, Bonding structural adhesive materials, Test for bonding structure, Typical bonded joints and non destructive tests for bonded joint, Bonded sandwich structures, Materials, Methods of construction of honeycombs

Unit 5 Corrosion and Heat Treatment of Metals and Alloys [05]

Types of corrosion, Effect of corrosion on mechanical properties, Stress corrosion cracking, Protection against corrosion, Corrosion resistant materials used in aircraft.

Unit 6 Composites In Aircraft Construction [07]

Composites and their types, Polymer matrix composites: Various processing Techniques, Open mold processes, Closed mold processes, Filament winding, Pultrusion, Ceramic Matrix composites, Various processing techniques, Aerospace applications of composites.

Term Work:

List of Experiments:-

1 Hardness Test
2 Tensile Test
3 NDT test
4 Impact Test
5 Manufacturing of a laminate
6 Dismantling and reassembling of an aircraft piston engine
7 Aircraft wood gluing- single and double scarf joints
8 Study of camshaft operation, firing order and magneto, valve timing
9 Study of auxiliary systems, pumps and carburetor
10 Study of Lubrication and cooling system

Text Books:

1. "Aircraft General Engineering", Lalith Gupta, Himalaya Book House, Delhi ,(2003).
2. "Workshop Technology", Vol 1 and 2 by Hajira Chowdhry,Nedia Promoters, Mumbai.

Reference Books:

1. "Aircraft Material and Processes", Titterton (2004).
2. "Advanced Composite Materials", Lalith Gupta, Himalaya Book House, Delhi,(2006).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
5. Industrial Aerodynamics (Elective – II)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./week	Theory Paper : 100 Marks
Practical : 2 Hrs./ week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1 Enabling concept of atmosphere
2 Enable knowledge of aerodynamics on bluff bodies
3 Enable the wind energy calculation
4 Enable knowledge on vehicle aerodynamics
5 Enrich the knowledge on building aerodynamics
6 Give knowledge on flow inducted vibrations

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1 Understand the types of winds, its variation, atmospheric boundary layer, effect terrain w.r.t gradient and flows
2 Have knowledge on Bluff body aerodynamics
3 Have a fundamental knowledge on different types wind machines and Betz coefficient momentum theory
4 Understand the power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and hovercraft
5 Understand of pressure distribution, forces of building and special problems of tall buildings.
6 Understand effects of Reynolds number, wake formation of bluff shapes, vortex induced vibrations, galloping and stall flutter

Unit 1 Atmosphere **[06]**
Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

Unit 2 Bluff Body Aerodynamics **[08]**
Boundary layers and separation, Two dimensional wake and vertex formation, Strouhal and Reynolds numbers , Separation and reattachments, Power requirements and drag coefficients of automobiles, Effect of cut back angle, Aerodynamics of Trains

Unit 3 Wind Energy Collectors **[06]**
Horizontal axis and vertical Axis Machines, Power coefficient, Betz coefficient by momentum theory.

Unit 4 Vehicle Aerodynamics **[06]**
Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and hovercraft.

Unit 5 Building Aerodynamics **[08]**
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 6 Flow Induced Vibrations **[06]**

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

Term Work:

Minimum ten assignments from the following topics:

1. Types of winds, Causes of variation of winds.
2. Effect of terrain on gradient height.
3. Bluff body aerodynamics.
4. Horizontal axis and vertical Axis Machines.
5. Betz coefficient by momentum theory.
6. Power requirements and drag coefficients of automobiles.
7. Aerodynamics of trains and hovercraft.
8. Wind forces on buildings.
9. Problems of tall buildings.
10. Architectural aerodynamics.
11. Effects of Reynolds number on wake formation of bluff shapes.
12. Vortex induced vibrations.

Text Books:

1. "Aerodynamics drag mechanisms of bluff bodies and road vehicles", M.Sovran (Ed), Plenum press, New York, (1978).
2. "Winds Forces In Engineering", P. Sachs, Pergam on Press, (1978).
3. Environnemental Aerodynamics Scorer.R.S, Ellis Harwood ltd ,England ,(1978).

Reference Books:

1. "Flow Induced vibrations",R.D. Blevins, Van Nostrand Reinfold, 2nd Edition,(1990).
2. "Wind Power Principles", N.G. Calvent, Charles Griffin and Co., London, (1979).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
5. Heat Transfer (Elective – II)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs / week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1. Study physical behaviour of various modes of heat transfer, like, conduction, convection and radiation.
2. Study application of various experimental heat transfer correlations in engineering calculations.
3. Study thermal Analysis and sizing of heat exchangers.
4. Basic concept of mass transfer, its types and its correlations.
5. Study the Heat Transfer problems in aircraft and rocket engine combustion chamber.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Understand the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction.
2. Learn to use the basic methods in Conduction. Understand the concept of Lump Parameter analysis and when it is applicable and earn the concepts of boundary layer.
3. Learn to apply various correlation used in Convective Heat Transfer and Understand the concepts of Black Body, Grey Body, View factor, Radiation shielding.
4. Design/size Heat Exchanger and understand the concept of Mass transfer, its types and laws associated with it.
5. Learn to apply various technique used for high speed flow heat transfer.

Unit 1 Modes of Heat Transfer **[04]**

Introduction to heat transfer, Modes of heat transfer, Basic laws governing heat transfer, Thermal conductivity and effect of temperature on thermal conductivity of various materials.

Unit 2 Conduction Heat Transfer **[08]**

Mechanism of heat conduction, Fourier's law of heat conduction, Heat conduction through plane wall, Cylinder and sphere; Electrical analogy of heat conduction, Generalized heat conduction equation in Cartesian co-ordinate, its reduction to Fourier, Laplace and Poisson's equations. Critical radius of insulation for cylinder and sphere, One dimensional steady state heat conduction with uniform heat generation for wall and cylinder.

Extended Surfaces: Types and applications of fins, Heat transfer through rectangular and circular fins, Fin effectiveness and efficiency

Unsteady State Heat Conduction: Systems with negligible internal resistance, Biot and Fourier number and their significance, Lumped Heat capacity Analysis.

Unit 3 Convective Heat Transfer **[08]**

Introduction – Natural and forced convection, Concept of hydrodynamic and thermal boundary layer,: Local and average convective coefficient for laminar and turbulent flow over flat plate and through pipe.

Forced Convection: Dimensional analysis applied to forced convection, Physical significance of dimensionless numbers, Reynolds analogy for laminar flow, Numerical correlations to solve various problems.

Natural Convection: Dimensional analysis applied to natural convection, Physical significance of dimensionless numbers, Numerical correlations to solve natural convection problems,

Unit 4 Radiative Heat Transfer **[08]**

Nature of thermal radiation, Definitions of absorbitivity, Reflectivity, Transitivity, Monochromatic emissive power. Total emissive power and emissivity, Concept of black body and gray body, Kirchhoff's law, Wien's law and Planck's law. Deduction of Stefan Boltzman equation. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces, Geometric shape factor. Energy exchange by radiation between two gray surfaces without absorbing medium and absence of reradiation and Radiosity, Radiation shields.

Unit 5 Heat Exchangers, Boiling and Condensation **[08]**

Heat Exchangers -Classification, Temperature Distribution, Overall heat transfer coefficient, Heat Exchange Analysis by LMTD and NTU method for parallel and counter flow.

Boiling and Condensation- Pool boiling curves, Forced boiling, Techniques for enhancement of boiling, Nusselt's theory of condensation, Condensation number, Filmwise and dropwise condensation.

Unit 6 Heat Transfer Problems in Aerospace Engineering **[04]**

High-Speed flow Heat Transfer, Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.

Term Work:

List of Experiments (Minimum 10):

1 Determination of thermal conductivity of insulating powder.
2 Determination of thermal conductivity of composite wall or lagged pipe.
3 Determination of thermal conductivity of metals at different temperatures
4 Determination of heat transfer coefficient for natural convection.
5 Determination of heat transfer coefficient for forced convection.
6 Determination of emissivity.
7 Determination of Stefan Boltzmann Constant.
8 Boiling heat transfer.
9 Condensation heat transfer.
10 Trail on heat exchangers.
11 Heat pipe demonstration/trial.
12 Determination of mass transfer coefficient in Solid.
13 Two computer programs assignments.

Text Books:

1. "Heat Transfer – A Practical Approach", Yunus A. Cengel., Tata McGraw-Hill, 2nd Edition,(2002).
2. "Introduction to Heat Transfer", Incropera. F.P.and Dewitt.D.P. , John Wiley and Sons, (2002).

Reference Books:

1. "A Heat Transfer Text Book", Lienhard, J.H., Prentice Hall India, (1988).
2. "Heat Transfer", Holman, J.P. Tata McGraw-Hill Book Co., Inc., New York, 6thEdition, (1991).
3. "Fundamentals of Engineering Heat and Mass Transfer", Sachdeva, S.C., Wiley Eastern Ltd., New Delhi, (1988).
4. "Gas Turbine and Jet and Rocket Propulsion", Mathur, M. and Sharma, R.P., Standard Publishers, New Delhi, (1988).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
5. Total Quality Management (Elective – II)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs/week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1. Understand term 'Quality', concepts of Total Quality Management, roles of personnel to implement quality.
2. Introduce TQM principles its impact and relevance to Customer satisfaction.
3. Introduce Statistical fundamentals, tools of Quality, concept of Six-Sigma.
4. Introduce quality systems their need and implementation universally.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Understand Importance of term 'Quality', concepts of Total Quality Management, roles of personnel to implement quality.
2. Understand TQM principles its impact and relevance to Customer satisfaction.
3. Understand Statistical fundamentals, tools of quality, concept of Six-Sigma.
4. Understand quality systems their need and implementation universally.

Unit 1 **Introduction** **[06]**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

Unit 2 **TQM Principles** **[07]**

Customer satisfaction , Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement , Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance measure.

Unit 3 **TQM Tools and Statistical Fundamentals** **[07]**

The seven traditional tools of quality, New management tools, Six sigma: Concepts, methodology, Applications to manufacturing, Service sector including IT , Bench marking – Reason to bench mark, Bench marking process , FMEA , Stages, Types.

Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability.

Unit 4 **TQM Tools and Techniques** **[04]**

Quality circles, Quality Function Development (QFD), Taguchi quality loss function, TPM, Concepts, Improvement needs, Cost of Quality – Performance measures.

Unit 5 TQM Tools **[08]**

Benchmarking, Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD), House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), Concept, Improvement Needs, FMEA – Stages of FMEA.

Unit 6 QUALITY SYSTEMS **[08]**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Term Work:

Minimum ten assignments from the following topics:

1. Concept of Quality, quality cost and Analysis Techniques for Quality Costs.
2. Concept and principles of TQM, Barriers to TQM Implementation.
3. Deming Philosophy.
4. Leadership concepts.
5. Juran's Quality triology, PDSA Cycle and concept of 5S.
6. Concept of Kaizen and its applications.
7. Supplier Partnership.
8. Six-sigma-meaning and benefits.
9. Reasons and Process of Benchmarking.
10. Concept of FMEA: Stages and Types.
11. Measures of central Tendency and Dispersion.
12. Quality circles, Taguchi quality loss function, TPM.
13. House of Quality, QFD.
14. Quality systems: ISO 9000, ISO 9000:2000 meaning and Benefit.
15. QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Text Books:

1. "Total Quality Management", Dale H. Besterfiled, et al., Pearson Education, Inc. (2004).
2. "The Management and Control of Quality", James R. Evansand William M. Lidsay, South-Western (Thomson Learning), 5th Edition, (2002).

Reference Books:

1. "Total Quality Management",Feigenbaum.A.V., Tata McGraw Hill, ISBN 81-297-0260-6 4th Edition ,(2004).
2. "Total Quality Management Butterworth", Oakland.J.S. "", Heinemann Ltd., Oxford. (2005).
3. "Quality Management – Concepts and Tasks", Narayana V. and Sreenivasan, N.S., New Age International ISBN 81-234-0832,(2005).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
5. Computer Aided Design and Analysis (Elective – II)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs/ week	Theory Paper : 100 Marks
Practical : 2 Hrs / week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Introduce the students to CAD and computer graphics
2. Give the knowledge of geometric modeling
3. Have a knowledge of Numerical Control
4. Give the knowledge of Computer Aided Process Planning
5. Have a knowledge of Computer Aided Quality Control
6. Introduce the basic of computer integrated manufacturing systems.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand the CAD tools
2. Understand the geometric modeling.
3. Demonstrate the design skills using different CAD tools
4. Write the CNC program and simulate the respective program.
5. Use CAD models for Computer Aided Manufacturing.

Unit 1 **Introduction** **[07]**

Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, Input devices, Display devices, Hard copy devices, and storage devices.

Computer Graphics

Raster scan graphics coordinate system, Database structure for graphics modeling, Transformation of geometry, 3D transformations, Mathematics of projections, Clipping, Hidden surface removal.

Unit 2 **Geometric modeling** **[05]**

Requirements, Geometric models, Geometric construction, models, Curve representation methods, Surface representation methods, Modeling facilities desired.

Unit 3 **Numerical control** **[08]**

NC, NC modes, NC elements, NC machine tools, Structure of CNC machine tools, Features of Machining center, Turning center, CNC Part Programming: fundamentals, Manual part programming methods, Computer Aided Part Programming.

Unit 4 **Group Tech** **[06]**

Part family, Coding and classification, Production flow analysis, Advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

Unit 5 Computer Aided Quality Control **[08]**

Terminology in quality control, The computer in QC, Contact inspection methods, Non contact inspection methods-optical, Computer aided testing, Integration of CAQC with CAD/CAM.

Unit 6 Computer Integrated Manufacturing Systems **[06]**

Types of Manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, Human labor in the manufacturing systems, CIMS benefits.

Term Work:
List of Experiments:

1. 2D Drawing of aircraft piston engine parts.
2. Four components of aircraft piston engine drawing.
3. Assembly of the aircraft piston engine.
4. CNC programs and simulation on CNC turning machine.
5. CNC programs and simulation on CNC milling machine.

Text Books:

1. "CAD / CAM", A Zimmersand P. M.P.Groover, Pearson Education, (2008) /Prentice Hall of India , 5th Impression.
2. "CAD / CAM Theory and Practice", Ibrahim Zeid Tata Mc Grawhill Publication.

Reference Books:

1. "Automation, Production systems and Computer integrated Manufacturing", Groover, Pearson Education Limited, 4th Edition,(2014).
2. "CAD / CAM / CIM", Radhakrishnan and Subramanian, New Age, 2nd Edition.
3. "Principles of Computer Aided Design and Manufacturing", Farid Amirouche , Pearson Education / Prentice Hall of India 2nd Edition,(2004).
4. "CAD/CAM: Concepts and Applications", Alavala, Prentice Hall of India, (2009).
5. "Computer Numerical Control Concepts and programming", Warren S Seames Thomson, 4th Edition, (2002).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
5. Aircraft Maintenance Engineering (Elective – II)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1. Make students realize the importance of aircraft maintenance with its need and developing different programs for maintenance of Aircrafts.
2. Teach and Emphasize basic criterion for certification of Aircraft design and Aircraft components, Aircraft systems with their requirements and documentation with respect to maintenance perspective.
3. Enrich students with basic M and E Organizational Structure and Production Planning and Control
4. Introduce different maintenance programs including Line Maintenance, Hangar Maintenance and Maintenance, Overhaul Shops

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Understand the importance of Aircraft Maintenance with its need and developing different programs for maintenance of Aircrafts.
2. Understand the basic criterion for certification of Aircraft design and Aircraft components, systems their requirements and documentation with respect to maintenance perspective.
3. Understand the importance of Reliability, Maintenance, Safety and Trouble shooting and especially preventive techniques in maintenance.

Unit 1 Need for Maintenance and Development of Maintenance Programs [08]

Role of Engineer, Role of mechanic, Types of maintenance, Reliability, Redesign, Failure rate patterns, Establishing a maintenance program Maintenance steering group approach, Process oriented maintenance, Task oriented maintenance, Maintenance program documents, Maintenance intervals, Changing basic intervals, Goals and objectives in maintenance, Maintenance program content

Unit 2 Certification Requirements And Documentation For Maintenance [06]

Aircraft certification, Delivery inspection, Operator certification, Certification of personnel, Aviation industry interaction; Manufacture's documentation-Regulatory documentation-Airline generated documentation

Unit 3 Maintenance And Engineering Organization Structure, Production Planning And Control [06]

Maintenance and Engineering organizational chart, Manager level functions, Organizational structure, Variation of the typical organization
Forecasting, Production Planning, Production Control-Feedback for Planning

Unit 4 Line Maintenance, Hangar Maintenance And Maintenance Overhaul Shops **[08]**

Makeup of line maintenance, Maintenance center responsibilities, Line operations, Aircraft logbooks, Ramp and terminal operations, Line station activities; Organization of hangar maintenance, Problem areas of hangar maintenance, Maintenance support shops, Ground support equipment, A typical C check; Organization of overhaul shops, Operation of overhaul shops, Shop data collection

Unit 5 Quality Control and Quality Assurance

Quality control organization, Basic inspection policies, Requirement for quality assurance, Quality audits-ISO 9000 standards, Technical records **[04]**

Unit 6 Reliability, Maintenance Safety And Trouble Shooting

Types of reliability, Typical reliability program, Administration of reliability program; Industrial safety-safety regulations maintenance safety program, Accident and injury reporting; Three levels of trouble shooting, Knowledge of malfunctions building a knowledge base, Understanding the sequence of events, Eight concepts of trouble shooting **[08]**

Term Work:

Following Six Assignments and two case studies based on above syllabus should be submitted.

1 i. Is the Maintenance of Aircrafts same in every organization? Explain.
ii. Do all the Organizations have same or similar program for a specific aircraft say A-320. Why If Yes/ No. Explain.
iii. Explain Importance of Aircraft maintenance and mentioning different kinds of maintenance programs in-place, mention the best practices reasoning why? Also, cite why these so called best practices should be in place and mention any real-life examples related to your reasons.

2 Licensing and Certification in Aviation is stringent, so as documentation. Explain with valid reasons and Justification all you would want to explain for equipment and personnel.

3 Explain in detail what does Line maintenance, hangar maintenance and maintenance overhaul shops mean for an Aircraft Industry. How do they operate in an Airline operations, mentioning their role for running any Airline successfully?

4 What are the typical contents of an Aircraft Maintenance Organisation? Can Aircraft maintenance organization exist without Airline being an integral part of it? Will it be successful and Justify with reasons.

5 What are the roles and responsibilities of an Aircraft Maintenance Organisation? Write the scope of this organisation with reason why do you think it needs to have specifically that scope? Justify.

6 Suggest any methods or methodologies, criterion to adopt for an Aircraft Maintenance (which are currently not in practice) Organisation to be successful with zero-error. Is it practical? If practical how much percentage you think is practical. Explain this citing an example with real-time example from Industry.

Text Books:

1. “Aviation Maintenance Management”, Harry A Kinnison, and Harry Kinnison, Tata McGraw-Hill, (2004).

Reference Books:

1. “Aircraft Maintenance Management”, C.H.Friend, Longman, (1992).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
6. Industrial Training

Examination Scheme:
Term Work : 50 Marks

Course Objectives:-
The course aims to:

1. Familiar the students to realize an industrial work.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Comprehend the knowledge gained in the course work
2. Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.

Industrial Training
The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with Aeronautical engineering during the semester break after Sixth semester and complete within 15 calendar days before the start of seventh semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.
It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, process capability evaluation, Industrial automation, process or machinery modification as identified.

Industrial Training Report Format:
Maximum fifteen students in one batch, involving three groups of maximum five students, shall work under one Faculty. The same group shall work for project under the same guide. However, each student should have different industrial training and its presentation.
The report should be of 20 to 30 pages. For standardization of the report the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point . Times New Roman
9. Headings: Times New Roman, 14 Point, Bold Face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director.

The entire report should be documented as one chapter with details like
1. “Name of Industry with address along with completed training certificate”
2. Area in which Industrial training is completed

All Students have to present their reports individually.

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VII
7. Project Phase – I

Teaching Scheme: **Examination Scheme:**
Practical: 2 Hrs / Week/ Batch Term Work : 50 Marks

Course Objectives:

Students will be able to solve problems related with Aeronautical or Aerospace engineering using knowledge of mathematics, basic sciences, Aeronautical engineering and relevant engineering disciplines and skills developed during graduation studies to demonstrate:

i. Ability to design and conduct experiments, as well as to analyze and interpret data.
ii. Ability to design a system, component, or process to meet desired specifications within realistic constraints.
iii. Ability to function on multidisciplinary teams.
iv. An ability to identify, formulates, and solves engineering problems.
v. Understanding of professional and ethical responsibility and ability to communicate effectively.
vi. Understand impact of engineering solutions in a global, economic, environmental and societal context.
vii. Recognize need for, and an ability to engage in life-long learning.
viii. Awareness of contemporary issues and ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
ix. Ability to find out, articulate the local industrial problems and solve with the use of Aeronautical engineering tools for realistic outcomes.

Course Outcome:

Upon successful completion of this course, the student will be able/expected to:
Demonstrate and realize all the above mentioned abilities with respect to Aeronautical engineering and allied disciplines which may also include inter-disciplinary engineering abilities and skills.

Project Phase I Load:

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of Aeronautical Engineering Department. The group of one student is strictly not allowed.

Project Phase I Definition:

The project phase I work can be a design project / experimental project and or computer simulation project on Aeronautical engineering or any of the topics related with Aeronautical Engineering stream. The project phase I work is allotted in groups on different topics.
The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe.

The project phase I work is to be extended for project phase II at B.E. (Aeronautical) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.

Project Phase I Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for

a. Searching suitable project work

b. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.

c. Day to day activities carried out related to project work for entire semester.

d. Synopsis.

The group should submit the synopsis in following form.

i. Title of Project

ii. Names of Students

iii. Name of Guide

iv. Relevance

v. Present Theory and Practices

vi. Proposed work

vii. Expenditure

viii. References

2. The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department

3 Presentation: The group has to make a presentation in front of the Faculty members of department at the end of semester.

Project Phase I Report Format:

Project Phase I report should be of 25 to 30 pages (typed on A4 size sheets). For standardization of the project phase I reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 . Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9. Headings: Times New Roman, 14 Point , Bold Face
10. References: References should have the following format

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

Important Notes

- Project group should continue maintaining a diary for project and should write (a) Book referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking.
- The Diary along with Project Phase I Report shall be assessed at the time of oral examination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
1. Finite Element Method

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Understand fundamentals of Finite Element Analysis/Methods and importance of FEM.
2. Understand the type of analysis, element to be used, boundary conditions, importance of symmetry.
3. Understand different co-ordinate systems, shape functions, stiffness matrices.
4. Study higher order element formulation and field problems.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Distinguish between different methods of analysis, analyze primary steps of FEM.
2. Finding approximate solutions by using different methods.
3. Select proper elements, boundary conditions and shape functions.
4. Understand natural coordinate system and solve 1–D, 2–D problems.
5. Understand numerical integration and formulate higher order shape function for Quadratic.

Unit 1 Introduction: **[08]**

Brief history, Introduction to Matrix Notation, General steps of FEM using a simple 1-d element for stress analysis of a stepped bar, Thermal rod, Heat conduction through wall. Applications of FEM.

Types of Analysis

Linear Static Analysis, Non Linear Analysis, Dynamic Analysis, Linear Buckling Analysis, Thermal Analysis, Fatigue Analysis, Optimization, Computational Fluid Dynamics, Crash Analysis, Noise, Vibration And Harshness (NVH).

Meshing

Types of element, concepts of discretization, Meshing techniques.

Unit 2 Basic Procedure **[06]**

Principle Of Virtual Work, Principle of Minimum Potential Energy, Raleigh's Ritz Method. Direct Approach for Stiffness Matrix Formulation of Bar Element. Galerkin's Method.

Unit 3 Interpolation Models **[06]**

Interpolation Polynomials- Linear and Quadratic, Simplex, Complex and Multiplex Elements, Natural Coordinates. Cst Elements-Shape Functions and Nodal Load Vector, Strain Displacement Matrix And Jacobian For Triangular and Rectangular Element.

Unit 4 Solution of 1-D Bars **[06]**

Solutions of Bars And Stepped Bars For Displacements, Reactions And Stresses By Using Penalty Approach And Elimination Approach. Guass-Elimination Technique.

Unit 5 Higher Order Elements **[06]**

Higher Order One Dimensional Elements-Quadratic and their Shape Functions, Shape Function of 2-D Quadrilateral Element-Linear, Quadratic Element Iso–Parametric and Sub Parametric.

Unit 6 Trusses And Beams **[08]**

Trusses, Stiffness Matrix of Truss Element. Numerical Problems. Beams
Hermite Shape Functions for Beam Element, Derivation of Stiffness Matrix. Numerical Problems of Beams Carrying Concentrated, UDL and Linearly Varying Loads.

TERM WORK:

Minimum Ten Assignments from the following topics:

1. General steps of FEM using a simple 1-D element for stress analysis of a stepped bar.
2. Types of Finite element Analysis.
3. Concepts of discretization and types of elements.
4. Principle of Virtual Work and Principle of Minimum Potential Energy.
5. Raleigh's Ritz Method.
6. Direct Approach for Stiffness Matrix Formulation of Bar Element.
7. Galerkin's Method.
8. Interpolation Polynomials- Linear and Quadratic, Simplex, Complex and Multiplex Elements.
9. Strain Displacement Matrix and Jacobian for Triangular and Rectangular Element.
10. Solutions of Bars and Stepped Bars for Displacements, Reactions and Stresses by Using Penalty Approach and Elimination Approach.
11. Guass-Elimination Technique.
12. Higher Order One Dimensional Elements-Quadratic and Their Shape Functions
13. Shape Function of 2-D Quadrilateral Element.
14. Stiffness Matrix of Truss Element-Numerical Problems.
15. Hermite Shape Functions for Beam Element, Derivation of Stiffness Matrix.
16. Numerical Problems of Beams Carrying Concentrated, UDL and Linearly Varying Loads.

Text Books:

1. "Introduction to Finite Elements in Engineering", Tirupathi.R. Chandrapatha and Ashok D. Belegundu Prentice Hall of India.
2. "Text Book of Finite Element Analysis", P. Seshu, Prentice Hall of India Private Limited, New Delhi, (2003).

Reference Books:

1. "An Introduction to Finite Element Method", Reddy J.N., Tata McGraw-Hill, (2000).
2. "Finite Element Analysis", Krishnamurthy, C.S., Tata McGraw-Hill, 9th Reprint, (2002).
3. "Numerical Methods in Finite Elements Analysis" Bathe K.J. and Wilson, E.L., Prentice Hall of India, (1985).
4. "An Introduction to Finite Element Method", J. N. Reddy; Tata McGraw Hill International Editions, ISBN 0-07-112799-2, 2nd Edition.

5. “Finite Element Methods for Engineers” U.S. Dixit, Cengage Learning Asia, (2009).
6. “Practical Finite Element Analysis”, N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N. Thite, Finite to Infinite Publication ISBN 978-81-906-195-0-9.
7. “The Finite Element Method for Engineers”, Huebner Willy Student Edition India, 4th Edition.
8. “Finite Element Analysis – Theory and Practice”, M.J. Fagan, Longman Scientific and Technical, (1992).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
2. Avionics and Instrument Systems

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks
	Oral Exam : 25 Marks

Course Objectives:
The course aims to:
1. Know the various types of air planes flight control systems, its components and applications.
2. Know the working principle of flight deck and display systems
3. Understand the various types of Aircraft instrumentation - sensors and displays
4. Understand the purpose of fuel system and its component requirement in a modern aircraft.
5. Understand systems design and development, specifications and requirement, guidelines and certification

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Acquaint with various types of aircrafts flight control systems, its components and applications.
2. Understand the working principle of flight deck and display systems.
3. Understand various types of Aircraft instrumentation - sensors and displays
4. Understand the purpose of fuel system and its component requirement in a modern aircraft.
5. Understand systems design and development, specifications and requirement, guidelines and certification.

Unit 1 Basics **[06]**

Basic principles of Avionics – Typical avionics sub system in civil/ military aircraft and space vehicles.

Flight Deck and Display Systems

Flight deck display technologies, CRT, LED, LCD, Touch screen, Head up display, Electronic instrumentation systems.

Unit 2 Flight Control Systems **[08]**

Principles of flight control, Flight control surfaces, Control surface actuation, Flight control linkage systems, Trim and feel, Power control, Mechanical, Direct drive, Electromechanical, Electro-hydrostatic actuation, Multiple redundancy, The fly by wire system, Airbus and Boeing implementations. Inter-relationship of flight control, Guidance and vehicle management systems.

Unit 3 Engine Control Systems **[06]**

The engine control problem, Fuel flow control, Air flow control, Control system parameters, Example systems, Design criteria, Engine starting, Fuel control, Ignition control, Engine rotation, Throttle levers, Engine indications, Engine control on a modern civil aircraft, Integrated flight and propulsion control.

Unit 4 Aircraft Instrumentation - Sensors and Displays **[06]**

Air data sensors, Magnetic sensing, Inertial sensing, Radar sensors. The electromechanical instrumented flight deck, Early flight deck instruments, Attitude direction indicator, Horizontal situation indicator, Altimeter, Airspeed indicator, Advanced flight deck display system architectures, Display systems, Display media, Future flight deck displays.

Unit 5 Fuel Systems **[06]**

Characteristics of aircraft fuel systems, Fuel system components, Fuel transfer pumps, Fuel booster pumps, Fuel transfer valves, Non return valves. Fuel quantity measurement systems, Level sensors, Fuel gauging probes. Fuel system operation, Fuel pressurization, Engine feed, Fuel transfer, Use of fuel as heat sink, External fuel tanks, Fuel jettison, In-flight refueling, Integrated civil aircraft fuel systems.

Unit 6 Systems Design and Development **[08]**

System design, Specifications and requirement, Regulations, Guidelines and certification. Safety processes, Functional hazard analysis, Preliminary systems safety analysis, System safety analysis, Common cause analysis. Requirements capture, Top-down approach and bottoms-up approach. Fault tree analysis, Failure mode and effects analysis, Component reliability, Dispatch reliability, Markov analysis, Development processes, Software and hardware, Product life cycle phases - Concept, Definition, Design, Build, Test, Operate and disposal or refurbish, Major review processes, Software development process, Verification and integration with hardware.

Term Work:

Following Six Assignments and two case studies based on above syllabus should be submitted.

1 Draw a typical avionics and sub system in a modern civil aircraft on a chart and label with their functions.

2 Draw a typical avionics and sub system in a modern military aircraft on a chart and label with their functions.

3 Draw a typical avionics and sub system in a human space vehicle on a chart and label with their functions.

4 Perceive and draw advanced flight deck display system architecture of a commercial aircraft from 15 years from now. What would you think would differ most significantly, Justify with detailed answer.

5 Explain what has been missing from current architecture of a modern commercial aircraft from 25 years back from now. What you think is most significant change, Justify with detailed answer explaining for good or bad.

6 Give a detailed account about how you would start approaching designing a completely new Avionics and Instrumentation system for a particular aircraft or a spacecraft- give a systems engineering approach to this from every perspective.

Text Books:

1. "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration" , Moir, I. and Seabridge, A., AIAA(American Institute of Aeronautics and Astronautics) ,(2001)
2. "Avionic systems Operation and Maintenance", JanesW.Wasson, Jeppesen Sandersen Training products (Sterling Book House, Mumbai), (1994).

3. “Civil Avionics Systems”, Moir, I. and Seabridge, A., AIAA (American Institute of Aeronautics and Astronautics), (2002).

Reference Books:

1. “Principle of Avionics”, Albert Hel frick, Avionics Communications Inc., 7th Edition, (2000).
2. “Elements Of Electronic Navigation”, N.S.Nagaraja, Tata McGraw Hill, (1995).
3. “Ground Studies for Pilots: Flight Instruments and Automatic Flight Control Systems”, Harris, D., Blackwell Science, ISBN 0-632-05951-6 6th Edition, (2004).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
3. Airport Planning and Operations

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks
	Oral Exam : 25 Marks

Course Objectives:
The course aims to:

1 Introduce airport management on an international level and systems
2 Give introduction to components of an airport and airfield
3 Introduce basics of airspace and air traffic control
4 Give Introduction to airport terminals and ground access, security
5 Give introduction to airport operations, airport financial management
6 Introduction to airport capacity and delay

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1 Understand airport management on an international level and systems
2 Understand basic components of an airport and airfield
3 Understand basics of airspace and air traffic control
4 Understand airport terminals and ground access, security
5 Understand concepts of airport operations, airport financial management
6 Understand and calculate airport capacity and delay

Unit 1 **Airports and Airport Systems** **[06]**

Introduction, Airport Management on an international level, Rules that govern airport management, Airport ownership and organization, Airport organization chart, Airport manager and public relations.

Unit 2 **The Airfield** **[08]**

Components of an airport, The airfield, Navigation aids (NAVAIDS) located on airfields, Air traffic control and surveillance facilities located on the airfield, Weather reporting facilities located on airfields, Security infrastructure on airfields.

Unit 3 **Airspace and Air Traffic Control** **[06]**

Air traffic control management and operating infrastructure, Basics of air traffic control, Current and future enhancements to air traffic control.

Unit 4 **Airport Terminals and Ground Access** **[07]**

Historical development of airport terminals, Components of airport terminal, Airport ground access.

Airport Security

Transportation Security Administration, Security at commercial service airports, Security at general aviation airports.

Unit 5 **Airport Operations Management** **[05]**

Pavement management, Aircraft rescue and firefighting(ARFF), Snow and ice control, Safety inspection programs, Bird and wildlife hazard management.

Airport Financial Management

Airport financial accounting, Revenue strategies at commercial airports, Pricing of airport facilities and services, Variation in the sources of operating revenues, Rise in airport financial burdens, Airport funding, Airport financing, Private investment, Sale of the airport.

Unit 6 Airport Capacity and Delay **[08]**

Defining capacity, Factors affecting capacity and delay, Estimating capacity, Simulation models, Defining delay, Estimating delay, Analytical estimates of delay, Queuing diagram, Approaches to reducing delay, Administrative and demand management.

Term Work:

Topics List

1 Explain in detail how an Airport in domestic and International Airports differ? How the operations and management in these airports differ.

2 Detail out all known components of an airport: The airfield, Navigation aids located on airfields, Air traffic control and surveillance facilities, weather reporting facilities and explain their functions in detail. Give a lay out diagram of Airport and all these equipment.

3 Importance of Air traffic control management and list out operating infrastructure. How you would foresee current to future enhancements to air traffic control advice with reasoning.

4 i. Write an incident or accident (Real-time) about an Aircraft at the proximity of an Airport giving all details how it happened with reasons.
ii. Also how it could have been avoided-IF managed properly with appropriate Airport Operations.

5 How to understand IF Airport is generating revenues, What airport facilities and services account for those revenues, pricing for those. Explain in detail with strategies.

6 How an Airport's capacity is designed, mention factors affecting capacity and delay. The tools for modeling these, Explain how Administrative and demand management are relevant with Airport management with details.

Text Books:

1. "Airport Planning and Management", Alexander T. Wells and Seth B. Young,Tata McGraw Hill, 5th Edition , (2004).

Reference Books:

1. "Airport Operations", Norman Ashford and H. P. Martin Stanton, Tata Mc,Graw,Hill, (1999).
2. "Managing Airports: An International Perspective", Anne Graham, Butterworth, Heinemann, (2003).
3. "The Airport Business", RigasDoganis, Routledge,(1992).
4. "Airport Systems: Planning, Design and Management",Richard D Neufville, McGraw, Hill, (2002).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
4. Hypersonic Aerodynamics (Elective – III)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1 Enable basics in hypersonic aerodynamics
2 Introduce to numerical methods of hypersonic aerodynamics
3 Enable knowledge of inviscid hypersonic flows
4 Enrich the knowledge of viscous hypersonic flow theory
5 Study the viscous interaction in hypersonic Flows
6 Introduce to high temperature effects

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1 Understand the shock layers, entropy layers, low and high density flows. Hypersonic flight paths, Shock wave and expansion wave relations of in viscid hypersonic flows.
2 Understand local surface inclination, Modified Newtonian Law, Newtonian theory, tangent wedge or tangent cone and shock expansion methods.
3 Understand approximate methods related to hypersonic small disturbance equation, Thin shock layer theory and exact method of characteristics of shock wave shapes and correlations.
4 Understand Navier–Stokes equations, Boundary layer equations for hypersonic flow, Similar and non similar hypersonic boundary layers, Hypersonic aerodynamic heating.
5 Understand Strong and weak viscous interactions, Hypersonic shock waves and boundary layer interactions – Role of similarity parameter for laminar viscous interactions in hypersonic viscous flow.
6 Understand the high temperature effects in the hypersonic flows.

Unit 1 **Fundamentals of Hypersonic Aerodynamics** **[08]**

Introduction to hypersonic aerodynamics, Differences between hypersonic Aerodynamics and supersonic aerodynamics, Concept of thin shock layers, Hypersonic flight paths, Hypersonic similarity parameters, Shock wave and expansion wave relations of in viscid hypersonic flows.

Unit 2 **Simple Solution Methods For Hypersonic In Viscid Flows** **[05]**

Local surface inclination methods, Newtonian theory-modified, Newtonian law-tangent wedge and tangent cone and shock expansion methods.

Unit 3 **Hypersonic Inviscid Flows** **[07]**

Approximate methods Hypersonic small disturbance equation and theory, Thin shock layer theory, Exact methods of characteristics hypersonic shock wave shapes and correlations.

Unit 4 **Viscous Hypersonic Flow Theory** **[08]**

Boundary layer equation for hypersonic flow, Hypersonic boundary layers, Self similar and non self similar boundary layers, Solution methods for non self similar boundary layers aerodynamic heating.

Unit 5 **Viscous Interactions in Hypersonic Flows** **[06]**

Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions, Hypersonic viscous interaction similarity parameter, Introduction to shock wave boundary layer interactions.

[06]

Unit 6 **Introduction to High Temperature Effects**

Nature of high temperature flows, Chemical effects in air, Real and perfect gases, Gibb's free energy and entropy, Chemically reacting mixtures-recombination and dissociation.

Term Work:

List of Experiments:

1. Study of High speed tunnels and their applications.
2. Study of flow visualization techniques in high speed flows.
3. Schlieren flow visualization over conical body at Hypersonic flow.
4. Investigate the change in flow field over a conical body on introduction of spike
5. Flow investigation of the surface of a conical body using oil flow visualization at Hypersonic speed.
6. Study the flow field over a cavity at hypersonic flow using schlieren flow visualization.
7. Study of flow field on a protrusion using oil flow visualization.
8. Study of shock wave and boundary layer interaction.
9. Over expanded flow studies on a jet.
10. Study of shock reflections inside an air intake at hypersonic speed.

Text Books:

1. "Hypersonic and High Temperature Gas Dyanmics", John. D. Anderson. Jr., Tata Mc. Graw hill Series, New York,(1996).
2. "Modern Compressible Flow With Historical Perspective", John. D. Anderson. Jr., Tata Mc. Graw Hill Publishing Company, New York,(1996).

Reference Books:

1. "Hypersonic Air Breathing Propulsion",William H. Heiser and David T. Praff AIAA Education Series.
2. "Hypersonic Aerothermodynamics", John. T Bertin, Published by AIAA Inc., Washington. D.C.,(1994).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
4. Air Traffic Control and Planning (Elective - III)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1. Introduce the concepts of air traffic need for planning and controlling.
2. Introduce the procedure of formation of aerodrome and its configuration and requirements.
3. Introduce the design and air traffic control regulation
4. Introduce flight information alerting services, coordination, Emergency procedures and rules of the air.
5. Introduce Aerodrome data, physical characteristics and obstacle restriction
6. Introduce air traffic management and its operations.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Understand the concepts of Air Traffic need for Planning and Controlling.
2. Understand the procedure of formation of aerodrome and its configuration and requirements.
3. Understand the design and air traffic control regulation.
4. Understand the importance of flight information alerting services, coordination, Emergency procedures and rules of the air.
5. Understand Aerodrome data, physical characteristics and obstacle restriction.
6. Understand importance of Air traffic management and its operations.

Unit 1 Basic Concepts **[06]**

Objectives of ATS, Parts of ATC, Service, Scope and Provision of ATCs ,VFR and IFR operations, Classification of ATS air spaces, Varies kinds of separation, Altimeter setting procedures , Establishment, Designation and identification of units providing ATS, Division of responsibility of control.

Unit 2 Air Traffic Services **[06]**

Area control service, Assignment of cruising levels, Minimum flight altitude ATS routes and significant points, RNAV and RNP , Vertical, lateral and longitudinal separations based on time / distance, ATC clearances, Flight plans, Position report

Unit 3 Flight Information Alerting Services, Coordination, Emergency Procedures and Rules of the Air **[08]**

Radar service, Basic radar terminology, Identification procedures using primary / secondary radar ,Performance checks , Use of radar in area and approach control services, Assurance control and co-ordination between radar / non radar control ,Emergencies, Flight information and advisory service ,Alerting service ,Co-ordination and emergency procedures, Rules of the air.

Unit 4 Aerodrome Data, Physical Characteristics and Obstacle Restriction [07]

Aerodrome data, Basic terminology, Aerodrome reference code, Aerodrome reference point, Aerodrome elevation, Aerodrome reference temperature ,Instrument runway, Physical Characteristics, Length of primary / secondary runway , Width of runways, Minimum distance between parallel runways etc. , Obstacles restriction.

Unit 5 Visual Aids for Navigation, Visual Aids for Denoting obstacles Emergency and Other Services [07]

Visual aids for navigation Wind direction indicator, Landing direction indicator ,Location and characteristics of signal area ,Markings, General requirements ,Various markings , Lights, General requirements, Aerodrome beacon, Identification beacon ,Simple approach lighting system and various lighting systems ,VASI and PAPI - Visual aids for denoting obstacles; Object to be marked and lighter, Emergency and other services.

Unit 6 Air Traffic Management [06]

Services provided to aircraft carriers, Government responsibilities, Flight rules and airspace organization, Airways and procedures, Phases of flight, Subsystems, Facilities and operations, System capacity, Airborne Collision Avoidance Systems

Term Work:

Following Six Assignments should be submitted and preferably visit to nearest Airport and a Case study based on that visit

1. List all the elements of ATC and explain in detail each element with a block diagram.
2. Write in detail all the responsibilities of Air traffic services, ATS. Also list what to your perception should more be included/ excluded are currently there as responsibilities of ATS but which if assigned to another body would yield good results.
3. What are over all objectives of Flight information alerting services? Explain in detail what does it contains?
4. Give a practical Over-view of an existing aerodrome of India with complete details of its Aerodrome data, physical characteristics with all its facilities with layout and obstacle clearance limits etc., and reasoning by concluding what makes it an ideal Aerodrome.
5. Whether still Visual aids for navigation are used? Why if used Visual aids for denoting obstacles emergency and other services are important and mention it in orderly manner
6. Which of the procedures you think will avoid accidents installing or having Airborne Collision Avoidance Systems like equipment or having more appropriate management systems or both. Which is cost effective and do you think there needs to be any regulatory changes required in any of the existing known procedures or rules to you: take a particular regulatory body (National or International) and be very specific citing a particular example and Justify your answer.

Text Books:

1. **"**Avionics Navigation Systems**"**, Myron Kayton and Walter R.Freid, John Wiley and Sons, Inc, ISBN 0-471-54795-6, 2nd Edition, (1997).
2. "The English Book Store", AIP (India) Vol. I and II, 17-1, Connaught Circus, New Delhi.

Reference Books:

1. "Aircraft Manual (India) Volume I", The English Book Store, 17-1, Connaught Circus, New Delhi. Latest Edition.
2. "PANS, RAC, ICAO DOC 4444", The English Book Store, 17-1, Connaught Circus, New Delhi. Latest Edition.

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
4. Cryogenics (Elective - III)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims:

1. Enable fundamentals of cryogenics
2. Enable efficiency of cryogenic system
3. Enable knowledge on thermodynamic cycles for cryogenic plants
4. Enrich the knowledge on problems on cryo propellants
5. Give knowledge on cryogenic rocket engines

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Understand cryogenic liquids as propellants and handling problems
2. Understand losses and efficiency of cycles and thermodynamic efficiency
3. Understand classification of cryogenic cycles and thermo dynamic analysis
4. Understand different problems of propellants like storage, handling and leakage
5. Understand the system design system and its Performance

Unit 1 **Basics of Cryogenic Propellants** **[08]**

Introduction to cryogenic propellants, Liquid hydrogen, Liquid oxygen, Liquid nitrogen and liquid nitrogen and liquid helium and their properties, Theory behind the production of low temperature, Expansion engine, Heat exchangers ,Cascade process, Joule Thompson effect , Magnetic effect, Cryogenic liquids as cryogenic propellants for cryogenic rocket engines, Properties of various cryogenic propellants: Ortho and Para H2,Helium 4 and Helium3, Ideal cycles and efficiency of cryo systems.

Unit 2 **Cryogenic Systems Efficiency** **[06]**

Types of losses and efficiency of cycles, Amount of cooling, The features liquefied, Cooling coefficient of performance, Thermodynamic efficiency, The energy balancing method.

Unit 3 **Thermodynamic Cycles for Cryogenic Plants** **[06]**

Classification of cryogenic cycles ,The Structure of cycles ,Throttle expansion cycle , Expander cycles ,Mixed throttle expansion and expander cycles ,Thermodynamic analysis ,Numerical problems.

Unit 4 **Peculiar Problems Associated with Cryopropellants** **[06]**

Storage problems of cryogenic propellants, Cryogenic loading Aerospace Materials, Zero gravity problems associated with cryopropellants, Phenomenon of tank collapse, Geysering effect.

Unit 5 Cryogenic Rocket Engines **[07]**

Peculiar design difficulties associated with the design of feed system, Injector and thrust chamber of cryogenic rocket engines, Relative performance of cryogenic when compared to non cryo engines.

Unit 6 Propellant Testing **[07]**

Laboratory testing , Arc Image Furnace , Ignitability studies , Differential Thermal Analysis , Thermo, Gravimetric analysis , Particle size measurement Micromerograph, Strand burner tests impulse bomb , Performance estimation.

Term Work:

Minimum Ten Assignments from the following topics:

1. Cryogenic propellants and their properties,
2. Ideal cycles and efficiency of cryogenic systems.
3. Cryogenic cycles.
4. Types of losses and efficiency of cycles.
5. Thermodynamic analysis and numerical problems on cryogenic cycles.
6. Problems associated with cryo-propellants.
7. Design of feed system, Injector and thrust chamber of cryogenic rocket engines and difficulties associated with it.
8. Performance comparison of cryogenic engines when with non-cryogenic engines.
9. Different propellant testing methods.
10. Study of CE-20 Cryogenic rocket engine.
11. Study of RS-83 Cryogenic rocket engine.

Text Books:

1 "Cryogenic Fundamentals", Haseldom, G., Academic Press, (1971).

2 "Rocket Propulsion and Space Dynamics", Cornelissse, J.W., J.W. Freeman and Co., Ltd., London, (1982).

3 "Cryogenic Systems", Barron, R.F., Oxford University, 2nd Edition, (1985).

Reference Books:

1 "The Handbook of Cryogenic Engineering", Weisend, J. G., Taylor and Francis, (1948).

2 "Rocket Propulsion Elements", Sutton, G.P., John Wiley, (2012).

3 "Design of Liquid Propellant Rocket Engines", Hazel D.K. and Hungdh, N.A.S.A. Special Publications, 125, (1971).

4 "Propellant Chemistry", Panrner, S.F., Reinhold Publishing Corp., N.Y, (1985).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
4. Composite Material and Structures (Elective – III)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1 Introduce composite materials their classification-types, types of other materials
2 Different fabrication processes and techniques involved
3 Review Stress-Strain relationship, applications and advantages of composite materials
4 Introduce to Micro mechanics of materials approach, elasticity approach
5 Introduce to Macro mechanics: Stress-strain relations with respect to natural axis, arbitrary. Experimental characterization of lamina. Failure theories of a lamina
6 Introduce to Laminated Plates: governing differential equation, Angle ply and cross ply laminates. Hygrothermal stresses and strains, Failure analysis. Impact resistance and Inter laminar stresses.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1 Distinctly understand composite materials with classification, types of other materials.
2 Understand different fabrication processes and techniques involved.
3 Relate practically Stress-Strain relationship, applications and advantages of composite materials.
4 Understand Micro mechanics of materials, approach, elasticity.
5 Understand Macro mechanics with stress-strain relations and Experimental characterization of lamina. Failure theories of a lamina.
6 Understand laminated Plates and apply governing differential equation, Angle ply and cross ply laminates. Understanding hygrothermal stresses and strains, Failure analysis. Impact resistance and Inter laminar stresses of laminates.

Unit 1 Introduction **[07]**
Introduction to Composite Materials; Classification of composites, Fibrous Composites, FRP constituents, Reinforcement types, Types of materials (Isotropic, Orthotropic, Anisotropic; Homogeneous and Non-Homogeneous) and terminology used.

Unit 2 Fabrication Processes **[06]**
Various processing Techniques, Open mold processes, Closed mold processes, Filament winding, Pultrusion, Netting analysis.

Unit 3 Stress-Strain Relation **[07]**
Introduction, Advantages and application of composite materials, Reinforcements and matrices, Generalised Hooke's Law, Elastic constants for anisotropic, Orthotropic and isotropic materials.

Unit 4 Micromechanics **[06]**

Micro mechanics, Mechanics of materials approach, Elasticity approach, Bounding techniques, Fiber volume ratio, Mass fraction, Density of composites, Effect of voids in composites.

Unit 5 Macromechanics **[08]**

Generalized Hooke's Law, Elastic constants for anisotropic, Orthotropic and isotropic materials, Macro mechanics, stress-strain relations with respect to natural axis, Arbitrary axis, Determination of in plane strengths of a lamina, Experimental characterization of lamina, Failure theories of a lamina, Hygrothermal effects on lamina.

Unit 6 Laminated Plates **[06]**

Governing differential equation for a general laminate, Angle ply and cross ply laminates, Hygrothermal stresses and strains in alaminate, Failure analysis of a laminate, Impact resistance and Interlaminar stresses.

Term Work:

Minimum Ten Assignments from the following topics:

1. Fibre reinforced polymer (FRP).
2. Elastic constants for anisotropic.
3. Closed mold processes and Netting analysis.
4. Elastic constants for Orthotropic.
5. Advantages and application of composite materials.
6. Effect of voids in composites.
7. Determination of in plane strengths of a lamina.
8. Failure theories of a lamina.
9. Governing differential equation for a general laminate.
10. Stress-strain relations with respect to natural axis and arbitrary axis.
11. Composite materials used in Boeing 737 – 600/-700/800/-900
12. Composite materials used in ATR-72 aircraft.

Text Books:

1. "The Analysis of Laminated Composite Structures", Calcote, L R. Von – Noastrand Reinhold Company, New York, (1998).
2. "Mechanics of Composite Materials", Jones, R.M. Tata McGraw-Hill, KogakushaLtd.,Tokyo, , 2nd Edition,(1998).
3. "Mehcanics of Fibrous Composites", M H Datoo., Elsevier, London, (1991).

Reference Books:

1. "Analysis and Performance of Fibre Composites",Agarwal, B.D., and Broutman, L.J., John Wiley and Sons. Inc., New York, (1995).
2. "Handbook on Advanced Plastics and Fibre Glass", Lubin, G., Von Nostrand Reinhold Co., New York, (1989).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
4. Rocket and Missile Design (Elective-III)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course objectives:
The course aims to:
1. Introduce rocket motion in free space and gravitational field.
2. Introduce staging and control of rockets and missiles and purpose.
3. Introduce aerodynamics of rockets and missiles.
4. Introduce different rocket propulsion systems and their need.
5. Introduce materials for rockets and missiles.
6. Introduce aerodynamic forces and moments, design considerations of hypersonic vehicles

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand the concepts of a rocket motion in free space and gravitational field.
2. Understand basics of staging and control of rockets and missiles with purpose.
3. Understand basics of aerodynamics of rockets and missiles.
4. Understand different rocket propulsion systems and their need with applications.
5. Understand different materials used for rockets and missiles in different components.
6. Understand basics of aerodynamic forces and moments, design considerations of hypersonic vehicles.

Unit 1 **Rocket Motion in Free Space and Gravitational Field** **[07]**

One Dimensional and Two Dimensional rocket Motions in free space and Homogeneous gravitational fields, Description of vertical, Inclined and gravity turn trajectories, Determination of range and altitude simple approximations to burnout velocity.

Unit 2 **Staging and Control of Rockets and Missiles** **[06]**

Multi-staging of rockets, Vehicle optimization, Stage Separation dynamics, Separation techniques, Rocket thrust vector control methods.

Unit 3 **Aerodynamics of Rockets and Missiles** **[07]**

Airframe Components of Rockets and Missiles, Forces Acting on a Missile While Passing Through Atmosphere, Classification of Missiles, Methods of Describing Aerodynamic Forces and Moments, Lateral Aerodynamic Moment, Lateral damping Moment and Longitudinal Moment of a Rocket, Lift and Drag Forces, Drag Estimation.

Unit 4 **Rocket Propulsion Systems** **[08]**

Ignition System in rockets, Types of Igniters, Igniters' Design considerations, Design consideration of liquid rocket combustion chamber, Injector propellant feed lines, Valves, Propellant tanks outlet and helium pressurized and turbine feed systems, Propellant slash and propellant hammer, Elimination of geysering effect in missiles, Combustion system of solid rockets.

Unit 5 **Materials for Rockets and Missiles** **[04]**

Selection of materials, Special requirements of materials to perform under adverse conditions.

Unit 6 **Aerodynamic Forces and Moments and Design considerations of Hypersonic Vehicles** **[08]**

Newtonian aerodynamic coefficients, Re-entry capsule aerodynamics, Shuttle orbiter aerodynamics, X-15 aerodynamics, Hypersonic aerodynamics of research plane, Dynamic stability considerations; Design Considerations, Reentry vehicles, Design philosophy, Design considerations for rocket-launched/glide re-entry vehicles, Air breathing vehicles, Combined rocket/air-breathing powered vehicles, Design of a new vehicle.

Term Work:

1. Explain the need for SSTO- if there is, in detail.
2. Burnout velocity
3. Multi-staging of rockets
4. Explain rocket and missile thrust vector control methods and their various designs with diagrams. Which design or method is effective to your understanding for a specific application and Why?
5. Aerodynamic Forces and Moments Acting on a Missile
6. Classification of Missiles
7. Igniters types and design considerations
8. Combustion system of solid rockets
9. Materials for rockets and missiles
10. Re-entry capsule aerodynamics

Text Books:

1. "Hypersonic Aerothermodynamics", John J. Bertin, AIAA Education Series, (1994).
2. "Rocket Propulsion Elements",Sutton, G.P., et al., John Wiley and Sons Inc., New York,(1993).

Reference Books:

1. "Gas Turbines and Jet and Rocket Propulsion", Mathur, M., and Sharma, R.P., Standard Publishers, New Delhi, (1998).
2. "Rocket Propulsion and Space Dynamics", Cornelisse, J.W., J.W., Freeman and Co. Ltd., London, (1982).
3 "Materials for Missiles and Spacecraft", Parker, E.R., Tata McGraw-Hill Book Co. Inc., (1982).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
5. Satellite Communication and Navigation (Elective – IV)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Differentiate the satellite links and performance parameters analysis of links, design of satellite links for corresponding communication network
2. Get knowledge about multiple access systems and network aspects in existing and planned subsystems.
3. Explain various error coding techniques and analyze propagation effects on satellite links.
4. Explain hyperbolic system of navigation
5. Describe the different satellite navigation systems
6. Explain different integrated navigation techniques

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand the uplinks and downlink and design of a satellite having performance parameters as constraints.
2. Interpret the multiple access systems in networks on various platforms.
3. Implement error coding and detection techniques and analyze propagation effects.
4. Understand hyperbolic system of navigation.
5. Understand and compare various navigation techniques such as GPS.
6. Understand the integrated navigation systems

Unit 1 Satellite Link Design **[08]**
Introduction, Basic transmission theory, System noise temperature and G/T Ratio, Design of downlinks, Satellite systems using small earth stations, Uplink Design, Design of Specified C/N : Combining C/N and C/I values in satellite links, System design examples.

Unit 2 Modulation, Multiple Access and multiplexing techniques for Satellite Links **[06]**
Digital Transmission, Digital modulation and demodulation, Digital transmission of analog signal, TDM, FDMA, TDMA, DAMA, CDMA.

Unit 3 Error control and Propagation Effects on Satellite Links **[06]**
Error detection and correction, Channel capacity, Error control coding, Convolution codes, Implementation of error detection on satellite links, Quantifying attenuation and depolarization, Propagation effects that are not associated with hydrometers, Rain and ice effects, Prediction of rain attenuation, Propagation impairment counter measures.

Unit 4 Hyperbolic System of Navigation **[07]**
Introduction: Kinds of navigation; LORAN Systems; DECCA; OMEGA, Very high frequency Omni-Directional Range (VOR), DME and TECAN, Aids to approach and landing.

Unit 5 Introduction to GPS and Satellite Navigation **[07]**

Introduction, Radio and satellite navigation, GPS position location principles, GPS receivers and codes, Satellite signal acquisition. GPS navigation message, GPS Signal levels, Timing accuracy, GPS receiver operation, GPS C/A Code accuracy, Differential GPS,Transit system,NAVSTAR.

Unit 6 Inertial Navigation Systems: **[06]**

Principles of operation, Navigation over the earth, Components of an INS, Earth coordinate mechanism, Strapped down systems, Accuracy of INS.

Term Work:

Minimum Five assignments and Five experiments out of list, apart from submission of a report after visiting satellite ground-station as per above syllabus.

List of Experiments:

1 Active/passive satellite, uplink/downlink and transponders.
2 Telecom and Telemetry
3 RS 232 satellite communication link using RS 232 ports
4 Propagation delay of signal in a satellite communication link.
5-10 Six practical's using MATLAB on relevant topics.

Note: Students, as a part of their term work, should visit satellite earth station and submit a report of visit.

List of Assignments:

1. Explain the main objective of Satellite Link Design detailing each component in it.
2. Make a chart with comparative analysis of different Modulation, Multiple Access and multiplexing techniques for Satellite Links and their advantages and dis-advantages.
3. Explain different error control and Propagation effects on Satellite Links
4. Explain with operation and principle of working of Aircraft Navigational aids with how they are in applications as of today in modern aircrafts.
5. Write about IRNSS design, its significance and related probable Satellite Navigation possible with all applications possible.
6. Explain principle of Inertial Navigation System with applications and need for INS.

Text Books:

1. "Satellite Communications", Timothy Pratt, Charles Bostian, Jeremy Allnutt - John Wiley and Sons, 2nd Edition.
2. "Elements of Electronics Navigation", N. S. Nagraja, 2nd Edition.

Reference Books:

1. "Satellite Communications", Dennis Roddy, Tata Mc Graw Hill International Edition, 3rd Edition,(2001).
2. "Fundamentals of Radar Signal Processing", Mark A Richards, Tata Mc Graw Hill, 2nd Edition, (2014).
3. "Radar principles", Peebles Jr. P. Z., John Wiley and Sons, NY, (1988).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
5. Probability and Statistics (Elective-IV)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1 Apply the basic rules and theorems of probability theory such as Baye's Theorem, to determine probabilities that help to solve engineering problems and to determine the expectation and variance of a random variable from its distribution.

2 Appropriately choose, define and/or derive probability distributions such as the Binomial, Poisson and Normal etc. to model and solve engineering problems.

3 Learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.

4 Understand how regression analysis can be used to develop an equation that estimates how two variables are related and how the analysis of variance procedure can be used to determine if means of more than two populations are equal

5 Understand the fundamentals of quality control and the methods used to control system and processes.

Course Outcome:
Upon successful completion of this course, the student will be able to:

1 Acquire basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving engineering problems.

Unit 1 Probability **[05]**
Sample space and events, Probability, The axioms of probability, Some Elementary theorems - Conditional probability, Baye's theorem, Random variables, Discrete and continuous.

Unit 2 Distributions **[05]**
Binomial , Poisson and normal distributions related properties, Sampling distributions, Sampling distribution of means (σ known and Unknown)

Unit 3 Testing of Hypothesis- I **[10]**
Tests of hypothesis point estimations, Interval estimations Bayesian estimation. Large samples, Null hypothesis, Alternate hypothesis type I and type II errors, Critical region confidential interval for mean testing of single variance, Difference between the mean.

Testing of Hypothesis - II
Confidential interval for the proportions, Tests of hypothesis for the proportions single and difference between the proportions.

Unit 4 Small Samples **[10]**
Confidence interval for the t- distribution, Tests of hypothesis, t- distributions, F- distributions χ^2 distribution, Test of Hypothesis.

Correlation and Regression
Coefficient of correlation, Regression Coefficient, The lines of regression, The rank correlation

Unit 5 Queuing Theory **[04]**
Arrival Theorem - Pure Birth process and Death Process M/M/1 Model.

Unit 6 Stochastic Processes **[06]**
Introduction to Stochastic Processes, Markov process, Classification of states, Examples of Markov Chains, Stochastic Matrix, Limiting probabilities.

Term Work:

1. Numerical problems on probability.
2. Numerical problems on distributions.
3. Numerical problems on testing of hypothesis.
4. Numerical problems on small samples and correlation and regression.
5. Numerical problems on queuing theory.
6. Numerical problems on stochastic processes.

Text Books:

1 "Probability and Statistics", D.K. Murugesanand P.GuruSwamy, Anuradha Publications.

2 "Probability and Statistics for Engineers", G.S.S.Bhisma Rao, Scitech Publications.

Reference Books:

1 "Probability and Statistics", T.K.V.IyengarandB.Krishna Gandhi and Others, S.Chand Publications.

2 "Probability and Statistics" William Mendenhall and Others, Cengage Publications, 14th Edition.

3 "Higher Engineering Mathematics", B.S. Grewal, Khanna Publications, (2000).

4 "Higher Engineering Mathematics" Jain and S.K.R. Iyengar, Narasa Publications.

5 "A First course in Probability and Statistics", B.L.S. PrakasaRao, World Scientific Publication Co.Pvt.Ltd.

6 "Probability and Statistics for Engineers", Miller and John E. Freund, Prentice Hall of India, New Delhi, (1992).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
5. Engineering Design Optimization (Elective – IV)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Introduce engineering design optimization its terminology, concepts, importance, classification and applications.
2. Introduce basics of classical optimization techniques: single variable optimization, multivariable optimization with equality and inequality constraints
3. Introduce techniques of linear programming simplex method and applications.
4. Introduce techniques of nonlinear programming and applications.
5. Introduce techniques of unconstrained optimization techniques and applications.
6. Introduce genetic algorithm and neural network based optimization techniques from aeronautical and aerospace perspective.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand and apply the techniques of engineering design optimization, concepts.
2. Understand and apply the techniques of classical optimization single and multivariable optimization with equality and inequality constraints.
3. Understand and apply the techniques of linear programming through simplex method.
4. Understand and apply techniques of non linear programming through different methods.
5. Understand and apply techniques of unconstrained optimization through different methods.
6. Understand and apply the techniques of genetic algorithm and neural network based optimization and applications.

Unit 1 Introduction and Basic Concepts **[06]**

Review of differential calculus and matrix algebra. Optimization meaning, Engineering applications with special reference to design, Statement of optimization problem, Classification of optimization problem.

Unit 2 Classical Optimization Techniques **[07]**

Single variable optimization: Local and global minima and maxima, Necessary and sufficient conditions, Stationary point, Multivariable optimization: Necessary and sufficient conditions, Hessian Matrix of a function, Positive/negative definite and semi definite matrix, saddle point, Multivariable optimization with equality constraint: Solution by direct substitution, Multivariable optimization with inequality constraint: Kuhn Tucker conditions.

Unit 3 Linear Programming- Simplex method **[07]**

Introduction, Application, general form, Solution by graphical method and Simplex algorithm, Construction of Simplex tableau, Dual Simplex Method, Sensitivity analysis, Minimization versus maximization problems, Quadratic

programming.

Unit 4 **Non Linear Programming** – One dimensional minimization methods **[07]**

Unrestricted search with fixed step size and with accelerated step size, Exhaustive search, Fibonacci method, Golden Section method, Direct Methods: Newton Method and Quasi Newton Method.

Unit 5 **Unconstrained Optimization Techniques:** **[07]**

Indirect search (descent) Methods: Gradient of a function, Evaluation of gradient, Rate of change of function along a direction, Steepest descent method, Fletcher Reeves method, Newton's method.

Unit 6 **Introduction to Genetic Algorithm and Neural Network based Optimization:** **[06]**
(Elementary treatment with only applications and examples for Aeronautics and Aerospace).
Aircraft control system and need for adaptive control for Aircraft overall performance, Distributed genetic algorithm application for aircraft structural optimization, Only applications and examples.

Term Work:
Assignments based on the following topics:

1. Introduction and classification of optimization technique.
2. Single and Multivariable optimization
3. Multivariable optimization with inequality constraint.
4. Linear Programming Solution using graphical method.
5. Simplex method.
6. One dimensional minimization methods for Non Linear Programming.
7. Unconstrained Optimization Techniques.
8. Applications and Examples of Genetic Algorithm and Neural Network based optimization.

Text Books:

1. "Research Methodology – A Step-By-Step Guide for Beginners", Ranjit Kumar, Pearson Education, Delhi, ISBN: 81-317-0496-3, (2006).
2. "Optimization Theory and Applications", Dr S.S. Rao, Wiley Eastern Ltd., New Age International, New Delhi, 2nd Edition, (1994).
3. "Operations Research", S. D. Sharma, KedarNath Publishers, (1972).
4. "Optimization Techniques", G S SBhishma Rao; Scitech Publications Pvt.Ltd.
5. "Formulation of Hypothesis", Wilkinson K.P.L. Bhandarkar, Himalaya Publishing House.

Reference Books:

1. "Taguchi Techniques for Quality Engineering", Ross P.J., Tata McGraw Hill,(2005).
2. "Engineering Optimization – Methods and Applications", Ravindran et al; Wiley Student Edition, 2nd Edition.
3. "Optimization in Engineering Design – Algorithms and Examples", K. Deb; Prentice Hall of India, 2nd Edition.
4. "Optimum Design", J. Arora; Tata McGraw Hill, (1989).
5. "Quantitative Techniques in Management",N. D. Vora; Tata McGraw Hill, 3rd Edition.
6. "Operations Research", Panneerselvam; Prentice Hall of India, 2nd Edition.
7. "Optimization Methods for Engineering Design", Fox R.L., Addison Wesley Publication, (1971).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
5. Reliability Engineering (Elective – IV)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:

1 Introduce principles of reliability in engineering design.

2 Develop understanding of concepts of failures, maintainability and availability of the intended products/systems and services.

3 Develop an ability to analyze field failure data in order to evaluate system reliability.

4 Develop an ability to apply various reliability techniques to solve problems related to aeronautical engineering.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1 Explain basics of reliability, maintainability and availability and differentiate among them.
2 Apply fundamentals of reliability to estimate reliability of electronic devices, software's and human.
3 Analyze field failure data for reliability analysis.
4 Evaluate system reliability using various techniques.

Unit 1 Fundamentals and Measures of Reliability **[07]**

Brief history, Concepts, Terms and definitions, Safety, reliability and quality, Life cycle of a system, System effectiveness, Concept of failure, Theory of probability and reliability, Laws of probability, Random variables, Discrete and continuous probability distributions.

Measures: Reliability function, Hazard rate function, CDF, PDF, MTTF, MTBF, Median time to failure, Mean, Mode, Median, Skewness, Kurtosis, Variance and standard deviation, Typical forms of hazard rate function, Bathtub curve and conditional reliability.

Unit 2 Basic Reliability Distributions **[06]**

Constant Failure Rate (CFR) model, Binomial distribution, Normal, Poisson, Lognormal, Rayleigh, Weibull, Exponential etc., Fitting probability distributions graphically and estimation of distribution parameters, Renewal and Poisson process, Calculation of R(t),F(t),f(t), $\lambda(t)$,MTTF, t_{med}, t_{mode} for above distributions.

Unit 3 Reliability Evaluation of Systems **[07]**

System reliability block diagram- Series configuration, Parallel configuration, Mixed configurations, Redundant systems, Standby redundant, High level versus low level redundancy, K-out-of-n redundancy, Network reduction and decomposition methods, Cut and tie set approach for reliability evaluation, Fault tree analysis (FTA), Success tree diagram, Failure Mode and Effect Analysis (FMEA), Failure Modes Effects and Criticality Analysis (FMECA).

Unit 4 Maintainability and Availability **[07]**

Maintainability - Objectives of maintenance, Types of maintenance, Concept of maintainability, Measures of maintainability, Mean time to repair (MTTR), Analysis of downtime, Repair time distributions, Stochastic point processes, Reliability centered maintenance (RCM).

Availability -Availability concepts and definitions, Important Availability measures, inherent, Achieved and operational availability.

Unit 5 Reliability Testing and Data Analysis **[07]**

Reliability Testing - Reliability life testing, Burn-in testing, Acceptance testing, Accelerated life testing, Highly Accelerated Life Testing (HALT) and reliability growth testing.

Data Collection and Analysis - Data collection and empirical methods, Estimation of performance measures for ungrouped compete data, Grouped complete data, Analysis of censored data, Pareto analysis, Goodness-of-fit tests.

Unit 6 Electronic, Software and Human Reliability **[06]**

Electronics - Reliability of electronic components, Component types and failure mechanism.

Software – Introduction, Errors, Software testing, Hardware/ Software interface.

Human Reliability Analysis (HRA) - Introduction, Human error in maintenance, Impact on system reliability.

Term Work:

A. Assignments based on following topics.

1. Probability and measures of reliability.
2. Fitting probability distributions graphically and estimation of distribution. parameters, Calculation of R(t), F(t), f(t), $\lambda(t)$, MTTF, t_{med}, t_{mode}
3. Numerical on- System reliability block diagram, Fault tree analysis (FTA), Success tree diagram, Failure Mode and Effect Analysis (FMEA).
4. Maintainability and availability.
5. Reliability Testing and numerical on Data Collection and Analysis.
6. Electronic, Software and Human Reliability.

B. Minimum Two Case Studies on system reliability estimation.

Text Books:

1. "An Introduction to Reliability and Maintainability Engineering", Charles E. Ebling, Tata McGraw Hill Education Private Limited, New Delhi, (2004).
2. "Reliability Engineering", L. S. Srinath, East West Press, New Delhi. , (1991).
3. "Reliability Engineering: Theory and Practice", Alessandro Birolini, Springer, 3rd Edition, (2010).
4. "Reliability Evaluation of Engineering Systems: Concepts and Techniques", Roy Billiton and Ronald Norman Allan, Springer, (1992).
5. "Practical Reliability Engineering", Patrick D.T. O'Conner, David Newton, Richard Bromley, John Wiley and Sons, 5th Edition, (2002).
6. "Reliability Engineering: Probabilistic Models and Maintenance Methods", Joel A. Nachlas, Taylor and Francis, (2005).

Reference Books:

1. "Life Cycle Reliability Engineering", Guangbin Yang, John Wiley and Sons,(2007)
2. "Case studies in Reliability and Maintenance", W. R. Blischke, D.N.P. Murthy, John Wiley and Sons, (2003).
3 "Maintenance, Replacement and Reliability", Theory and Applications", Andrew Kennedy, Skilling Jardine, Albert H. C. Tsang, CRC/Taylor and Francis, 2nd Edition, (2006).
4. "Engineering Reliability", New Techniques and Applications", B. S. Dhillon, Chanan Singh, John Wiley and Sons. , (1981).
5. "Engineering Maintainability", B. S. Dhillon, "Prentice Hall of India, (1999).

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
5. Management Information System (Elective - IV)

Teaching Scheme:	**Examination Scheme:**
Lectures : 3 Hrs./ Week	Theory Paper : 100 Marks
Practical : 2 Hrs./ Week	Term Work : 25 Marks

Course Objectives:
The course aims to:
1. Introduce purpose of data, information, and information systems, right to information, exemption from disclosure of information, grounds for rejection to access in certain cases; CIC; SIC-Powers and functions.
2. Introduce to information technology and different tools: hardware and software.
3. Understand tools of business networks and telecommunication with applications, web enabled commerce
4. Introduce to decision support and business intelligence, knowledge management and data analysis
5. Introduce to planning, acquisition, and control their issues.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand and interpret Purpose of data, information, and information systems. Right to information, special cases and CIC; SIC-powers and functions.
2. Understand information technology and different tools: hardware and software.
3. Acquaint tools of business networks and telecommunication with applications, web enabled commerce.
4. Understand decision support and business intelligence, knowledge management and data analysis
5. Understand planning, acquisition, and control their issues.

Unit 1 Information Age and Strategic uses of Information Systems [10]

Information Age

An overview: The purpose, data, Information, and information systems and their types, Ethical and societal issues, Information systems in business functions, Web Empowered Enterprises.

Uses of Information Systems and Right to Information

Strategies and Strategic moves, Achieving a competitive advantage, Creating and maintaining strategic information systems, Business functions and supply chains, Effectiveness and efficiency, Accounting, Finance, Engineering, Supply chain management, Human resource management, Enterprise resource planning.

Right to Information

Right to information act 2005- Short title, Extent and commencement, Definitions Right to information and obligations of public authorities; Request for obtaining information; Exemption from disclosure of information, Grounds for rejection to access in certain cases; The Central Information Commission; The State Information Commission; Powers and functions of the Information Commissions, appeal and penalties; Miscellaneous

Unit 2 Information Technology **[05]**

Business Hardware , Components, Classification of computers, Output devices, Storage media and purchasing.

Business Software , Programming languages and software development tools, Language translation, Compilers and interpreters, System software, Open source software, Software licensing, Ethical issues.

Unit 3 Business Networks and Telecommunication **[05]**

Telecommunication in Business and daily use, Bandwidths and Media, Networks, protocols, Internet networking services, Telecommuting , Pros and cons, Future of Networking Technologies.

Unit 4 Web Enabled Commerce **[04]**

Web enabled enterprises, Web business and technologies, Web enabled business, Challenges of Global Information Systems, Multinational organizations, International commerce, and Ethical issues.

Unit 5 Decision Support and Business intelligence **[06]**

Decision support and expert systems , Decision support and decision making process, Structured and unstructured problems, Decision support systems, Expert systems, Geographical systems, Business Intelligence and Knowledge Management , Data Mining and online analysis, Knowledge management.

[10]

Unit 6 Planning, Acquisition, and Control

Systems Planning and Development, Planning Information systems, Systems development life cycle, Agile methods, Systems integration, Ethical issues, IS professional's certification.

Choices in Systems Acquisition

Options and Priorities, Outsourcing, Licensing applications, Software as a service, User application development, Ethical issues, Computer use policies for employees.

Term Work:

Minimum Ten Assignments to be submitted from the following topics.

1. Uses of Information Systems.
2. Right to information act 2005.
3. Programming languages and software development tools.
4. Software licensing and Ethical issues.
5. Open source software.
6. Protocols of Business Networks and Telecommunication.
7. Challenges of Global Information Systems in Web enabled enterprises
8. Web business and technologies.
9. Business Intelligence and Knowledge Management.
10. Structured and unstructured problems.
11. Planning, Acquisition, and Control.
12. Choices in Systems Acquisition.

Text Books:

1. "Management Information Systems", Effy Oz, Cengage Learning,India Edition, (2009).
2. "Management Information Systems", James A O'Brien, Irwin, Tata McGraw Hill. 9th Edition.

Reference Books:

1. "Management Information Systems", Laudonand Laudon, Prentice Hall of India ISBN 81-203-1282-11998, (1998).
2. "Management Information systems", S.Sadagopan , Prentice Hall of India, ISBN 81-203-1180-91998.
3. "Information Systems for Modern Management", G.R.Murdick Prentice Hall of India 3rd Edition, (2002).

Online Links: (Right to Information**)**
https://rtionline.gov.in/;
http://www.humanrightsinitiative.org/programs/ai/rti/india/user_guide/user_guide.htm
http://rti.india.gov.in/manual4.php

SHIVAJI UNIVERSITY, KOLHAPUR
B.E. (Aeronautical Engineering) Semester VIII
6. Project Phase – II

Teaching Scheme:
Practical: 4 Hrs / week

Examination Scheme:
Term Work : 75 Marks
Oral Exam : 50 Marks

Course Objectives:
The course aims to:

Students will be able to solve problems related with Aeronautical or Aerospace engineering using knowledge of mathematics, basic sciences, Aeronautical engineering and relevant engineering disciplines and skills developed during graduation studies to demonstrate:

i) Design and conduct experiments, as well as to analyze and interpret data.
ii) Design a system, component, or process to meet desired specifications within realistic constraints.
iii) Function on multidisciplinary teams.
iv) Identify, formulate, and solve engineering problems.
v) Understand professional and ethical responsibility and ability to communicate effectively.
vi) Understand impact of engineering solutions in a global, economic, environmental and societal context.
vii) Recognize need for, and an ability to engage in life-long learning.
viii) Aware contemporary issues and ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
ix) Articulate the local industrial problems and solve with the use of Aeronautical Engineering tools for realistic outcomes.

Course Outcome:
Upon successful completion of this course, the student will be able to:

1. Demonstrate and realize all the above mentioned abilities with respect to Aeronautical Engineering and Allied Disciplines which may also include inter-disciplinary engineering abilities and skills.

Project Phase II Load:
A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed. Same groups of Seventh Semester shall work under same faculty member of department.

Project Phase II Definition:
Project phase-II is a continuation of project phase-I started in the seventh semester. Before the end of the eighth semester, there will be two reviews, one at start of the eighth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.

Project Phase II Term Work:

The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for

a) Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.
b) Brief report of feasibility studies carried to implement the conclusion.
c) Rough Sketches/ Design Calculations/ Testing reports/ Experimentation results.

Project Report:

Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point, Times New Roman
9. Headings: Times New Roman, 14 Point, Bold Face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director.
11. Index of Report:
    i) Title Sheet
    ii) Certificate
    iii) Acknowledgement
    iv) Table of Contents.
    v) List of Figures
    vi) List of Tables
    1. Introduction
    2. Literature Survey/ Theory
    3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation.
    4. Observation Results
    5. Discussion on Result and Conclusion
12. References: References should have the following format

    For Books: "Title of Book", Authors, Publisher, Edition

    For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

The Project report shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department

Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Important Notes:

- Project group should continue maintaining a diary for project and should write:
  (a) Book referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking.
- The Diary along with Project Report shall be assessed at the time of oral examination

- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.