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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	6	100	25	--	--	125
6	Professional Skill Development	1	--	--	1	--	25	--	--	25
7	Aircraft Component Drawing	--	--	2	2	--	50	25	--	75
8	Computer Programming using C++	--	--	2	2	--	25	--	--	25
Total		17	01	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-I	--	--	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	0	800

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

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

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S.E. (AERONAUTICAL ENGINEERING) Semester - III

1. ENGINEERING MATHEMATICS – III

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. per week	**Theory Paper: 100 Marks**
Tutorial: 1 Hr. per week	**Term Work: 25 Marks**

Pre-requisites: Engineering Mathematics-I and Engineering Mathematics–II

Course Objectives:

1. To introduce student about linear system.
2. To study basic concepts of Eigen values and Eigen vectors.
3. To study quadratic forms and various laws related to it.
4. To study need of Fourier series and Fourier transforms.
5. To introduce students to Partial differential equations and methods to solve them.

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

1. Understand basic concepts of Linear System.
2. Understand Eigen values, Eigen vectors and calculation of powers of matrix.
3. Apply Fourier series to solve problems related to Aeronautical Engineering.
4. Solve Partial differential equation problems related to Aeronautical Engineering.

Unit 1

Linear Systems and Transformations: **[10]**

Matrices: Elementary row transformations – Rank – Normal form - Echelon form – Consistency– Solution of system of simultaneous linear homogeneous and non-homogeneous equations.

Real matrices – Symmetric, Skew - Symmetric, Orthogonal, Linear Transformation – Orthogonal Transformation. Complex matrices: Hermitian, Skew-Hermitian and Unitary – Eigen values and Eigen vectors of complex matrices and their properties

Unit 2 **[5]**

Eigen Values and Eigen Vectors:

Eigen values, Eigen vectors – properties – Cayley-Hamilton theorem - Inverse and powers of amatrix by Cayley-Hamilton theorem – Diagonolization of matrix, Calculation of powers ofmatrix – Modal and Spectral matrices.

Unit 3 **[5]**

Quadratic Forms:

Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, Negative definite - Semi Definite - Index - Signature -Sylvester law, Applications of Quadratic law.

Unit 4 **[5]**

Fourier Series:

Fourier Series: Determination of Fourier coefficients – Fourier series – Even and odd functions – Fourier series in an arbitrary interval – Even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

Unit 5 **[10]**

Partial Differential Equations:

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations.

Method of separation of variables – Classification of second order linear partial differential equations, Solutions of one dimensional heat equation, Wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

Unit 6 **[5]**

Fourier Transforms

Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

TUTORIAL:

1. Tutorial are to be used to get enough practice.
2. In each tutorial make a group of 20 students and for each group minimum 10 problems are to be given on each topic.

TEXT BOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi and Others, "A Text Book of Engineering Mathematics", Vol-II, S. Chand and Company.
2. C. Sankaraiah, "A Text Book of Engineering Mathematics", V. G. S. Book Links.
3. Shahnaz Bathul, "A Text Book of Engineering Mathematics", Prentice Hall of India Ltd, New Delhi.
4. P. Nageshwara Rao, Y. Narasimhuluand N. Prabhakar Rao, "A Text Book of Engineering Mathematics", Deepthi Publications.
5. "A Text Book of Engineering Mathematics", Thomson Book Collection.

REFERENCE BOOKS:

1. B. V. Raman, "A Text Book of Engineering Mathematics", Tata McGraw Hill.
2. Irvin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt. Ltd.

S.E. (AERONAUTICAL ENGINEERING) Semester - III

2. APPLIEDTHERMODYNAMICS

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

Pre-requisites: Engineering Physics, Engineering Mathematics-I, Engineering Mathematics-II

Course Objectives:

1. To introduce student about basic physics and chemistry behind thermodynamics.
2. To study basic concepts of thermodynamics and its applications.
3. To study physical significance of entropy and its application.
4. To study different types of gas power cycles.
5. To study gas mixtures and chemical reactions

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

1. Understand basic concepts of physics and chemistry behind thermodynamics.
2. Understand importance of Gas power cycles.
3. Understand chemical reactions in fuel combustion.

Unit 1 **[8]**

Introduction and Basic Concepts:

SI units- dimensional homogeneity in equations – Systems and control volumes – Temperature and Zeroth law – Forms of energy - First law of thermodynamics, Energy conversion efficiencies- Mechanisms of heat transfer (basic concepts) - Pure substance and its phases- Ideal gas equation of state- Compressibility factor -Real equations of state (only introductory information)

Unit 2 **[7]**

Energy Analyses of Systems

Closed systems: Moving boundary work - Energy balance for closed systems - Internal energy, Enthalpies and specific heats of ideal gases, Solids and liquids. Open systems: Conservation of mass, Flow work, Conservation of energy, Steady flow energy equation.

Unit 3 **[4]**

Second Law of Thermodynamics

Thermal efficiency of heat engines – Kelvin-Planck statement and Clausius statement - Perpetual motion machines - Reversible and irreversible processes- Carnot cycle.

Unit 4[4]

Entropy

Increase of entropy principle- isentropic process - T-D-S relations and entropy change of ideal gases – Isentropic efficiencies of steady flow devices - Exergy (only introductory information)

Unit 5 **[7]**

Gas Power Cycles

The Carnot cycle and its value in engineering - Otto cycle- Diesel cycle- Stirling and Ericsson cycle- Brayton cycle - Ideal jet propulsion cycles – Modifications to turbojet engines

Unit 6 **[10]**

Gas Mixtures and Chemical Reactions

Mass fraction and mole fraction – P-V-T behavior of ideal gas mixtures –Properties of ideal gas mixtures, Chemical reactions: Fuels in combustion- Enthalpy of formation and enthalpy of combustion- First law analysis of reacting systems (steady flow systems and closed systems) – Adiabatic flame temperature – Entropy change of reacting systems – Complex chemical equilibrium composition (basic concept)

TERM WORK:

1. Significance and relevance of lubrication properties
2. Test on grease penetrometer of dropping point apparatus
3. Test on carbon residue
4. Test on cloud and pour point apparatus
5. Test on Redwood viscometer and Aniline point apparatus
6. Determination of flash point and fire point of lubricant oil.
7. Test on Bomb calorimeter to find C.V.
8. Study and demonstration of air compressor.
9. Industrial visit

TEXT BOOKS:

1. Nag P. K, "Engineering Thermodynamics", Tata McGraw Hill, New Delhi, 6th Edition, 1995.

REFERENCE BOOKS:

1. Michael Moran, J., and Howard Shapiro, N., "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, New York, 4th Edition,2000
2. Rayner Joel and Addison Wesley, "Basic Engineering Thermodynamics", New York, 5th Edition, 1996
3. Holman, J. P., "Thermodynamics", Tata McGraw Hill, New Delhi,4th Edition,1998
4. Rathakrishnan. E, "Fundamentals of Engineering Thermodynamics", Prentice –Hall, India, 2000.
5. Yunus A. Cengel and Michael A. Boles, "Thermodynamics an Engineering Approach", McGraw Hill Higher Education, 7th Edition,2011.

S.E. (AERONAUTICAL ENGINEERING) Semester - III

3. FLUID MECHANICS

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

Pre-requisites: Engineering Physics, Basic Mechanical Engineering.

Course Objectives:

1. To identify various properties of fluids and their SI units.
2. To state and illustrate fundamentals of Fluid Statics, Kinematics and Dynamics.
3. To identify and explain the fluid properties and concepts of Boundary layer, Drag and Lift force
4. To study use of Bernoulli's equation for various applications.
5. To understand the Physics of fluid flow and its applications.
6. To get conversant with Hydrodynamics.

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

6. Understand properties of fluids and classification of flows
7. Formulate and solve equations of the control volume for fluid flow systems
8. Calculate resistance to flow of incompressible fluids through closed conduits and over surfaces
9. Apply fundamentals of compressible fluid flows to relevant systems

Unit 1 **[7]**

Fluid Properties and Fundamentals of Flow

Brief history of fluid mechanics - Fluids and their properties - Continuum, Density, Viscosity, Surface tension, Compressibility and bulk modulus, Concept of pressure. Fluid statics - Pascal's law, Hydrostatic law - Piezometric head –Manometry.

Unit 2 **[8]**

Laws of Conservation

Lagrangian and Eulerian description of fluid flow, Types of fluid flow, Streamlines, pathlines, and streaklines, System and Control volume concept - Continuity, Momentum and energy equations and its applications, Velocity potential function and stream function, Vortex flow, Bernoulli's equation – Application through various examples including flow measuring devices –Orifice meter, Venturimeter, Pitot– tube.

Unit 3 **[5]**

Dimensional analysis

Dimensional Analysis -, Buckingham Pi - theorem, Derivations and applications of important dimensionless numbers, Basic modeling and similitude.

Unit 4 **[6]**

Fluid Flow in Closed Conduicts

Viscous fluid flow - Laminar and turbulent flow, Hagen - Poiseuille flow in circular pipes, Development of flow in pipes, Pipe friction, Darcy-Weisbach equation and Chezy's formula, Pipe losses - Major and Minor losses - Problems of parallel, series and branched pipes.

Unit 5 **[7]**

Fluid Flow over Bodies

Boundary layer theory - Boundary layer development on a flat plate, Displacement thickness, Momentum thickness, Energy thickness, Momentum integral equation, Drag on flat plate - Nature of turbulence, Separation of flow over bodies - Streamlined and bluff bodies, Lift and drag on cylinder and aerofoil.

Unit 6 **[7]**

Hydrodynamics

Stream function, Velocity potential, Relation between stream function and velocity potential, Basic elementary flows – Source, Sink, Free and forced vortex, Uniform parallel flow and their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows.

TERM WORK:

Minimum TEN Experiments based on the topics given below. (Experiment 2, 10 and 11 are compulsory)

1. Study and demonstration of pressure measuring devices and flow measurement using measuring tank.
2. Flow visualization of plotting of stream lines (Heleshaw Apparatus)
3. Verification of Bernoulli's equation.
4. Measurement of coefficient of discharge foe a given Venturi meter /Orifice meter.
5. Demonstration of coefficient of friction for different material pipes.
6. Reynolds experiment.
7. Determination of minor losses.
8. Verification of discharge equation for parallel pipe.($Q=Q_1+Q_2+Q_{3+\ldots}\ldots$)
9. Verification of head loss equation for series pipe.
10. Trial on wind tunnel for measurement of lift and drag.
11. Study of Magnus effect on circular and aerofoil body. (Study Type)
12. Demonstration on fluid flow using CFD tools.

TEXT BOOKS:

1. Kumar, K.L., "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 2nd Edition, 2000.

REFERENCE BOOKS:

1. Douglas. J. F., Gasiorek and Swaffield, "Fluid Mechanics", ELBS / Pitman. U.K., 3rd Edition, 1995.
2. Potter, M.C. and Wiggert, D.C., "Mechanics of Fluids", Prentice Hall of India, New Delhi, 2nd Edition, 1997.
3. Bedford, K.W. and Wylie, E. Benjamin, "Fluid Mechanics", Streeter, Victor, Tata McGraw Hill, New Delhi, 2nd Edition, 1997.
4. Irving H. Shames, "Fluid Mechanics", McGraw-Hill, 3rd Edition, 1992.
5. Robert W. Fox and Alan T. McDonald, "Introduction to Fluid Mechanics", John Wiley and Sons, Inc., U.K , 5thEdition,1998.

S.E. (AERONAUTICAL ENGINEERING) Semester - III

4. ELEMENTS OF AERONAUTICS

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

Pre-requisites: Engineering Physics, Basic Mechanical Engineering.

Course Objectives:

1. To introduce various types of aircraft configurations.
2. To introduce principles of Flight and Aerodynamics.
3. To introduce Airplane Structures and Materials.
4. To study of Power Plants used in Airplanes

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

1. Understand various types of aircraft configurations.
2. Understand principles of Flight and Aerodynamics.
3. Select different materials for various air craft structure.

Unit 1 **[5]**

Aircraft Configurations:

Brief history-Components of an airplane and their functions. Different types of flight vehicles, Classifications. Basic instruments for flying.

Unit 2 **[7]**

Introduction to Principles of Flight:

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, Drag and moment. Different types of drag.

Unit 3 **[8]**

Introduction to Aerodynamics:

Aerodynanic forces on aircraft – Classification of NACA aerofoils, Aspect ratio, Wingloading, Mach number, Centre of pressure and aerodynamic centre, Aerofoil characteristics lift and Drag curves.

Unit 4 **[6]**

Introduction to Airplane Structures:

General types of construction, Monocoque, Semi-monocoque. Typical wing and fuselage structure.

Unit 5 **[5]**

Introduction to Airplane Materials

Metallic and non-metallic materials, Use of Aluminium alloy, Titanium, Stainless steel and composite materials.

Unit 6 **[9]**

Power Plants used in Airplanes:

Basic ideas about piston, Turboprop and Jet engines, Use of propeller and jets for thrust production, Principles of operation of rocket, Types of rockets.

TERM WORK:
Minimum TEN assignments based on the above topics.

TEXT BOOKS:
1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 7th Edition, 2011

REFERENCE BOOKS:
1. Kermode, A.C., "Flight without Formulae", Pearson Education Ltd, 5th Edition, 2007.

S.E. (AERONAUTICAL ENGINEERING) Semester - III

5. MECHANICS OF SOLIDS

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 Hrs. per week	**Theory Paper: 100 Marks**
Practical: 2 Hrs. per week	**Term Work: 25 Marks**

Pre-requisites: Engineering Mechanics.

Course Objectives:

1. To gain knowledge of different types of stresses, strains and deformation induced in mechanical components due to external loads.
2. To study the distribution of various stresses in the mechanical elements.
3. To study the effect of component dimensions and shape on stresses and deformations.

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

1. Demonstrate fundamental knowledge about various types of loading and stresses induced.
2. Draw SFD and BMD for different types of loads and support conditions.
3. Compute and analyze stresses induced in mechanical components.
4. Analyze buckling and bending phenomenon in columns and beams.

Unit 1 **[8]**

Simple Stresses and Strain:

Introduction to concepts of Stress, Strain, Strain energy density at a point and Hookes law, Stress strain diagrams of mild steel, working stress, Factor of safety,-Lateral strain, Elastic limit, Yield point, Elastic moduli and analysis of axially loaded prismatic bars, Poisons ratio, Volumetric strain- Determination of axial load diagrams. Deflections and stresses in determinate and indeterminate uniform / Non –Uniform / Composite bars subjected to distributed and concentrated loads, Temperature stresses, Resilience, Gradual, Sudden, Impact and Shocking loads.

Unit 2 **[8]**

Shear Force and Bending Moment Diagrams:

Definition of beam – Types of beams – Concept and conventions of shear force and bending moment – Shear force and bending moment diagrams for cantilever, Simply supported and overhanging beams subjected to point loads, Uniformly distributed loads, Uniformly varying loads and their combinations-Point of contraflexure – Relations between distributed load (loading), Shear force and bending moment diagrams and rate of loading at a section of a beam.

Unit 3 **[10]**

Flexural and Shear Stresses:

Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination of bending stresses – Section modulus of rectangular and

circular sections (Solid and Hollow), I,T, Angle and Channel sections –Stress in composite beams using equivalent width concepts and its limitations. Design of simple beam sections. Derivation, formula for shear stress distribution across various beam sections like Rectangular, Circular, Triangular, T, Iand Angle sections.

Unit 4 **[8]**

Analysis of Pin-Jointed Plane Frames

Determination of forces in members of plane, Pin jointed, Perfect trusses by method of joints and method of sections. Analysis of various types of cantilever and simply supported trusses- by method of joints, method of sections and tension coefficient methods.

Unit 5 **[9]**

Deflection of Beams

Bending into acirculararc– Slope, Deflection and radius of curvature- Differential equation for elastic line of a beam- Double integration and Macaulay's methods- Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, uniformly distributed loads, uniformly varying load. Mohr's theorems- Moment area method- application to simple cases including overhanging beams.

Unit 6 **[9]**

Thin and Thick cylinders

Thin seamless cylindrical shells- Derivation of formula for longitudinal and circumferential stresses- Hoop, Longitudinal and Volumetric strains- Changes in diameter, and volume of thin cylinders- Riveted boiler shells- Thin spherical shells. Thick cylinders- Lame's equation- Cylinders subjected to inside and outside pressures- Compound cylinders.

TERM WORK:

1. Direct tension test
2. Bending test on
    a) Simply supported beam
    b) Cantilever beam
3. Torsion test
4. Hardness test
    a) Brinells hardness test
    b) Rockwell hardness test
5. Test on springs
6. Compression test on cube
7. Impact test
8. Punch shear test

TEXT BOOKS:

1. Byars E F., Snyder R.D,. plants H. L. and Harper Row, "Strength of Materials", Publishers, 4th Edition, 1983.
2. Gere J. M and Barry Goodno, "Mechanics of Materials", Cengage Learning Ltd, 8th Edition.
3. F.P. Beer, E.R. Johnston and J.T.Dewolf, "Mechanics of Materials", Tata McGraw Hill, 4th Edition, 2004.
4. R.S. Khurmi and N. Khrmi, "Strength of Materials", S. Chand and company Pvt. Ltd., Delhi, Revised Edition, 2013.
5. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications Pvt. Ltd., 2001

REFERENCE BOOKS:

1. G.H. Ryder, “Strength of Materials”, Macmilan India Ltd., 3rd Edition, 2008.
2. Nash W.A., “Strength of Materials” Tata Mcgraw Hill Publishing Company Ltd., 4th Edition, 2007.
3. Popov E. P, Nagarajan S. Cand Lu z., “Mechanics of Materials”, Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition.

S.E. (AERONAUTICAL ENGINEERING) Semester - III

6. PROFESSIONAL SKILL DEVELOPMENT

Teaching Scheme:	**Examination Scheme:**
Lecture:1 Hr. per week	**Term Work: 25 Marks**

Pre-requisites: Professional Communication-I and Professional Communication-II

Course Objective:

To enable learners to speak fluently and flawlessly in all kinds of communicative Contexts with speakers of all nationalities.

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

1. Speak confidently with any speakers of English, including native speakers,
2. Speak effortlessly in different contexts – Informal and formal,
3. 'Think on feet' even in difficult circumstances,
4. Hold interesting and meaningful conversations with others, including strangers, and listen to others with utmost attention.

Unit 1 **[2]**

Personal Communication:

Day-to-day conversation with family members, Neighbors, Relatives, Friends on various topics, Context specific – Agreeing/disagreeing, Wishing, Consoling, Advising, Persuading, Expressing opinions, Arguing.

Unit 2 **[2]**

Social Communication:

Telephone calls (official), Colleagues in the work spot, Discussing issues (Social, Political, Cultural) Clubs (any Social Gathering), Answering questions, Talking about films, Books, News items, T.V. programmes, Sharing jokes.

Unit 3 **[2]**

Group/Mass Communication:

Group discussion (brainstorming), Debate, Panel discussion, Anchoring/master of ceremony, Welcome address, Proposing vote of thanks, Introducing speakers, Conducting meetings, Making announcements, Just-a-minute (JAM), Block and tackle, Shipwreck, Spoof, Conducting quiz, Negotiations, Oral reports.

Unit 4 **[2]**

Integrated Speaking

Listening to speak (any radio programme /lecture), Reading to speak, Writing to speak, Watching to speak (any interesting programme on TV), Reading aloud any text/speech,

Unit 5 **[2]**

Presentation Skills

Lecturing, PowerPoint presentation, Interviews of different kinds (one to one, Many to one, Stress interview, Telephonic interview)

Unit 6 **[4]**

Employability and Corporate Skills

Interview skills – Types of interview, Preparation for interview, Mock interview. Group Discussion – Communication skills in Group Discussion, Structure of GD, GD Process, successful GD techniques, Skills bought out in GD – Leadership and co-ordination. Time management and effective planning – Identifying barriers to effective time management, Prudent time management techniques, Relationship between time management and stress management. Stress management – Causes and effect, Coping strategies – Simple physical exercises, Simple Yoga and Meditation techniques, Relaxation techniques, Stress and faith healing, Positive forces of nature, Relaxation by silence and music. Decision making and Negotiation skills, People skills, Team work, Development of leadership qualities.

TERM WORK:

Minimum TEN assignments based on the above topics and a presentation on a Non-technical subject.

TEXT BOOKS:

1. Sanjay Kumar and Pushplata, "Communication Skills", Oxford University Press, 1st Edition,2011

REFERENCE BOOKS:

1. Richard Denny, "Communication to Win", Kogan Page India Pvt. Ltd., New Delhi, 2008.
3. Listening to / watching great speeches such as TED talk TV channels (News, Documentaries)

S.E. (AERONAUTICAL ENGINEERING) Semester - III

7. AIRCRAFT COMPONENT DRAWING

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs. per week	**Term Work: 50 Marks**
	Oral Exam: 25 Marks

Pre-requisites: Engineering Graphics

Course Objectives:

1. To study the BIS conventions used in machine drawing
2. To study the function of various machine components
3. To study of simple Aircraft assembly drawings.

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

1. Use BIS conventions in machine drawings
2. Sketch the various machine components
3. Understand simple Aircraft assembly drawings.

TERM WORK:
Minimum ten drawing sheets (At least three from each unit)

Unit 1
Machine Drawing conventions. Need for drawings conventions – Introduction to BIS-Conventions

a. Conventional representation of materials, Common machine elements and parts such as Screws, Nuts, Bolts, Keys, Gears, Webs, Ribs
b. Types of sections – Selection of sectional planes and drawing of sections and auxiliary sectional views.
c. Parts not usually sectioned
d. Methods of dimensioning, General rules for sizes and placement of dimensions for Holes, Centres, Curved and Tapered features
e. Title boxes, their size, location and details –Common abbreviations and their liberal usage.
f. Types of drawing – Working drawing for machine parts

Unit 2
Drawing of machine elements and simple parts .Section of views, Additional views for the following machine elements and parts with every drawing proportion

a. Popular forms of Screw threads, Bolts, Set screws and Bolted joints.
b. Keys, Cotter joint and Knuckle joint
c. Riveted joints for plates.
d. Shaft couplings, Spigot and Socket pipe joint.
e. Journal, Pivot, Collar and Foot step bearing
f. Welded joints and welding symbols.

Unit 3
Following simple Aircraft assembly drawings only.

a) Different types of trusses used in wings fuselage including Ribs, Stringers, Skin, Brackets.
b) Different elements of fuselage structures, bulk head, rings (frame) long irons
c) Different types of fuselage.
d) Landing gear basic elements, Structural brackets, Wheel, Shock absorber and Hydraulic cylinder
e) Connecting rod for aero piston engine

TEXT BOOKS:

1. N.D. Bhat and V.M. Panchal, "Machine Drawing", Charotar Publication House Anand, 42nd Edition, 2007.
2. Megson, "Air Craft Structures", Tata Mcgraw Hill Publishing Company Ltd. 2nd Edition, 2007.

REFERENCE BOOKS:

1. K.L.Narayana, P.Kannaiah and K. Venkata Reddy, "Machine Drawing", New Age International Publishers, Mumbai, 2nd Edition, 2002.
2. Bruhn.E.H "Air Craft Structures",
3. P.S. Gill., S.K. Kataria and Sons, "Machine Drawing" New Delhi,7th Edition,2008.
4. Sadhu Singh and P.L.Sah, "Fundamentals of Engineering Drawing", Prentice- Hall India, New Delhi, 11th Edition, 2003.

S.E. (AERONAUTICAL ENGINEERING) Semester - III

8. COMPUTER PROGRAMMING USING C++

Teaching Scheme:	**Examination Scheme:**
Lectures: 2 Hrs. per week	**Term Work: 25 Marks**
Practical: 2 Hrs. per week	

Pre-requisites: Basic Electronics and Computer Programming in 'C'.

Course Objectives:

1. To develop and enhance the programming skills amongst the students in general as well as application of it in the field of Aeronautical Engineering.
2. To introduce an Object Oriented Programming Language.

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

1. Develop algorithms for solving problems using Object Oriented Language.
2. Apply their knowledge and programming skills to solve various computing problems in the field of Aeronautical Engineering.

TERM WORK:

1. Assignment based on Object-Oriented Programming: Introduction, Basic concepts, Benefits, Object-Oriented Languages, Applications.
2. Minimum one program on Input / Output and arithmetic expressions: Hierarchy of operators, Branching and loop control statements.
3. Classes and Objects: Introduction, structures and classes, Declaration of class, Member functions; Defining the object of a class; Accessing a member of a class; Array of class objects. Minimum three programs on Structure, Class and Objects.
4. Use of Pointers with Array and Function: Friend function. Minimum one program on pointers with Arrays and Function.
5. Inheritance: Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hybrid Inheritance, Hierarchical Inheritance; Types of base classes: Direct, Indirect; Types of derivation: Public, Private, Protected, Virtual base classes. Minimum two programs on Inheritance.
6. Overloading: Function overloading with various data types, Arguments; Operator overloading: Assignment operator; Arithmetic and comparison operators. Minimum two programs on Overloading.
7. Polymorphism: Virtual functions; Abstract base classes, Constructor under Inheritance, Destructor under Inheritance. Minimum two programs on Polymorphism.

(*Practical and Oral: Compilation and execution of any one program on OOPS concept followed by oral)

TEXT BOOKS:

1. E. Balguruswami, "Object Oriented Programming", Tata Mc Graw Hill Publishing Company Ltd.
2. Yashwant P. Kanetkar, "Let Us C++", BPB Publication, New Delhi, 11th Edition, 2011.

3. Jibitesh Mishra and Muktikanta Sah, “Object-Oriented Programming in C++”, Scitech Publications India Ltd., 2nd Edition, 2010.

REFERENCE BOOKS:

1. Alstevans, “C++ Programming”, Wiley India Pvt. Ltd., New Delhi, 7th Edition,2007.
2. Nicolai M. Josuttis, “Object-Oriented Programming in C++”, Wiley-Dreamtech India Pvt. Ltd., New Delhi, 1st Edition,2003.
3. Sourav Sahay, “Object-Oriented Programming with C++”, Oxford University Press, Incorporated, 2006.
4. Nicolas A. Solter and Scott J. Kleper, “Professional C++”, Wiley India Pvt. Ltd., New Delhi.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

1. AERODYNAMICS-I

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs. per week	**Theory Paper: 100 Marks**
Tutorial: 1 Hr. per week	**Term Work: 25 Marks**

Pre-requisites: Applied Thermodynamics, Fluid Mechanics

Course Objectives:

1. To take review of Fluid Mechanics.
2. To study inviscid, incompressible flow and viscous flow and boundary layers.
3. To study incompressible flow over aerofoils.
4. To study incompressible flow over wings and bodies
5. To introduce students to propellers and propeller design.

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

1. Understand inviscid, incompressible flow and boundary layer flow.
2. Analyze and optimize wing performance.
3. Apply the concepts of Aerodynamics to the design of Aerospace systems.
4. Understand Aerodynamic characteristics of Aerofoils and Wings.

Unit 1 **[5]**

Review of Fluid Mechanics:

Aerodynamics- Importance, The flow field, Fundamental aerodynamic variables, Aerodynamic force and moment coefficients, Dimensional analysis, Flow similarity, Classification of fluid flows. The continuity, Momentum and energy equations in integral form and in differential form.Euler's equation.Methods of determination of flow – Analytical and Numerical methods.

UNIT 2 **[10]**

Inviscid, Incompressible Flow, Viscous Flow and Boundary Layers

Angular velocity, Vorticity and circulation. Kelvin theorem. Irrotational flow. Thevelocity potential. Stream function for two dimensional incompressible flow. Laplace's equation. Boundary conditions at infinity and at the wall. Elementary flows and their combinations, Non-lifting flow over a circular cylinder, Vortex flow, Lifting flow over a cylinder. D'Alembert' sparadox. Kutta-Joukowski theorem and generation of lift. Non- lifting flow over arbitrary bodies-numerical source panel method. Real flow over a circular cylinder.

Role of viscosity in fluid flow. The Navier-Stoke's equation, Boundary layer approximation, Boundary layer thickness, Growth along a flat surface, Laminar boundary layers. Surface friction drag. Boundary layer separation. Transition. Turbulent boundary layers, Turbulence modelling, Eddy viscosity and mixing length concepts. The momentum integral equation. Approximate solution for laminar, Turbulent and mixed boundary layers- Computational methods. Thermal boundary layer. Reynold's analogy.

UNIT 3 **[5]**

Incompressible Flow Over Aerofoils:

Theoretical solutions of low speed flow over aerofoils- The vortex sheet representation.

The Kutta condition. Kelvin's circulation theorem and the starting vortex. The thin aerofoil theory. The aerodynamic centre. Lifting flows over arbitrary bodies- The vortex panel Numerical method. Aerofoil design for prescribed lift distribution. Real flow over an aerofoil, Effect of boundary layer transition and surface roughness on the aerodynamic forces.

UNIT 4 **[10]**

Incompressible Flow Over Wings and Bodies

Down wash and induced drag. The vortex filament- Biot- Savart's law, Helmholtz's theorems. The starting, bound and trailing vortices. Prandtl's classical lifting line theory for unswept wings- Determination of lift, Vortex induced drag. Nonlinear lifting- line, Lifting surface and Vortex lattice numerical methods. The mechanism of lift generation on delta wing in subsonic flow. Leading edge extensions to wings. Three dimensional flow – Source, doublet, Flow over a sphere. General three dimensional flows – Panel techniques. Real flow over a sphere. Asymmetric loads on fuselage at high angles of attack – Asymmetric vortex shedding, Wake-like flows. Flow field about aircraft at high angles of attack.

UNIT 5 **[5]**

Aerodynamic Characteristics of Aerofoils and Wings:

Aerodynamic force and moment coefficients. The drag polar. The lift curve slope, Maximum lift coefficient, Minimum drag coefficient, Lift drag ratio - Effect of aerofoil and wing geometry parameters, Reynolds' number, Boundary layer transition and surface roughness. NACA aerofoils, laminar flow aerofoils, Supercritical aerofoils. Aerodynamics of drag reduction and lift augmentation methods - Flap systems, Leading edge devices, Multi-element aerofoils, Power augmented lift, Circulation control, Laminar flow control, Winglets.

UNIT 6 **[5]**

Propellers:

Geometry of the propeller, Rankine - Froude momentum theory of propulsion, Airscrew coefficients, Thrust, Torque, Power coefficients, Propulsive efficiency, Activity factor, Airscrew pitch; Geometric pitch, Experimental mean pitch, Effect of geometric pitch on airscrew performance, Blade element theory, The vortex system of an airscrew, Rotational inflow and outflow, Performance of a blade element, Compressibility effects, Use of propeller charts, Propeller selection, Propeller design.

TERM WORK:

Minimum TEN assignments based on the above topics.

TEXT BOOKS:

1. Bertin, J.J and M. L. Smith, "Aerodynamics for Engineers", Prentice Hall International Inc., 3rd Edition, 1998.
2. J.D. Anderson Jr., "Fundamentals of Aerodynamics", Tata McGraw-Hill, Revised Edition, 2010.
3. Kuethe. A.M. and Chow C, "Foundations of Aerodynamics", Wiley Publications Ltd, 5th Edition, 1998.

REFERENCE BOOKS:

1. Kuchemann. D., "The Aerodynamic Design of Aircraft", Pergamon, 1978.
2. Shevell, R.S., "Fundamentals of Flight", Pearson Education Publications Ltd, 2004,
3. McCormick, B.W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, 2nd Edition, 1995.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

2. AIRCRAFT PRODUCTION TECHNOLOGY

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 Hrs. per week	**Theory Paper: 100 Marks**
Tutorial: 1 Hr. per week	**Term Work: 25 Marks**

Pre-requisites: Basic Mechanical Engineering

Course Objectives:

1. To introduce Manufacturing Processes.
2. To introduce various methods of Welding and Bonding Techniques.
3. To study various Metal Removal Processes and Machine tools.
4. To introduce Sheet Metal Forming and Joining Processes.
5. To study Nontraditional Machining Processes and Unconventional Machining.
6. To introduce Heat Treatment, Surface Finishing and NDT Techniques.
7. To introduce Quality Control And Assurance

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

1. Understand various Manufacturing Processes.
2. Understand importance of Welding and Bonding Techniques.
3. Understand different types of Sheet Metal Forming and Unconventional Machining.
4. Understand basic working principle, Configuration, Specification and classification of Machine Tools.
5. Understand Various Heat Treatment and Surface Finishing Processes and NDT Techniques.
6. Understand importance of Quality Control and Assurance.

Unit 1 **[6]**

Introduction:

Classification and comparison (Merits and Demerits) of manufacturing process, Criterion for selection of a process; General principles of various casting processes - Sand casting, Die-casting, Centrifugal casting, Investment casting, Shell moulding types

Unit 2 **[6]**

Welding and Bonding Techniques:

Principles and equipment used in arc welding, Gas welding, Resistance welding, Thermit welding, Recent advances in welding technology, Soldering and brazing techniques.

Unit 3 **[14]**

Machining and Sheet Metal Forming

General principles (with schematic diagram only) of working and types-Lathe, Shaper, Milling machine, Grinding, Drilling machine, CNC machining and General principles. Sheet metal operations-Shearing, Punching, Drop stamp forming, Advanced metal forming (super plastic forming and diffusion bonding). Bend correction for bending in single plane, Automation in bend forming and different operations in bending like stretch forming spinning drawing etc.

Unit 4 **[14]**

Unconventional Machining, Heat Treatment and Surface Finishing:

Principles (with schematic diagram only) of working and applications of Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Laser beam/electron beam/plasma arc machining Heat treatment of Aluminium alloys, Titanium alloys, Steels, Case hardening, Initial stresses and the stress alleviation procedures. Corrosion prevention, Protective treatment for aluminium alloys, Steels, Anodizing of Titanium alloys, Organic coating, and Thermal spray coatings. Grinding and Polishing, Burnishing, Lapping.

Unit 5 **[8]**

Aircraft Assembly, Quality Control and Assurance:

Aircraft Tooling Concepts, Jigs, Fixtures, Stages of assembly, Types and equipment for riveted joints, Bolted joints. Concepts and definitions of Quality, Reliability, Quality circles, Zero defect program: International standards, Six-sigma quality.

Unit 6 **[4]**

NDT and Other Inspection Techniques:

Dye penetrant test, X - ray, Magnetic particle and Ultrasonic testing. Acoustic Holography.

TERM WORK:

Minimum TEN assignments based on the above topics.

TEXTBOOKS:

1. Keshu S.C, Ganapathy K.K., "Aircraft Production Techniques", Interline Publishing House, Banglore, 1993
2. Serope Kalpakajian, "Manufacturing Engineering and Technology", Addison Wesley Publication Company, 3rd Edition, 1995.

REFERENCE BOOKS:

1. R.K. Jain, "Production Technology", Khanna Publishers, New Delhi, 15th Edition, 1995.
2. O.P. Khanna, "Production Technology", Dhanpat Rai Publications, New Delhi, Reprint Edition, 2005.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

3. MATERIAL SCIENCE AND ENGINEERING

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

Pre-requisites: Engineering Physics, Engineering Chemistry

Course Objectives:

1. To acquaint students with the basic concepts of Metal Structure
2. To impart a fundamental knowledge of Ferrous and Non Ferrous Metal Processing
3. To select Metals and Alloys for various applications
4. To know fundamentals of Metallography
5. To develop futuristic insight into Metals

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

1. Understand basic concept of metal structure.
2. Differentiate between Ferrous and Non Ferrous Metal.
3. Do selection of Metals and Alloys for different application.
4. Understand need of Heat treatment and various Heat treatment processes.

Unit 1 **[6]**

Atomic structure of metals: Crystal structure, Crystal lattice of (i) Body Centred Cubic (ii) Face Centred Cubic (iii) Closed Packed Hexagonal, Crystallographic Notation of atomic planes and directions (Miller Indices),Polymorphism and allotropy, Crystal imperfection.

Unit 2 **[6]**

Theories of plastic deformation. Phenomenon of slip, Twinning and dislocation. Identification of crystallographic possible slip planes and direction in FCC, BCC, HCP. Recovery and recrystallization, Preferred orientation causes and effects on the property of metals.

Unit 3 **[10]**

Classification of engineering materials. Solidification of metals and of some typical alloys: Mechanism of crystallisation (i) Nuclear formation (ii) Crystal growth. General principles of Phase transformation in alloys, Phase rule and equilibrium diagrams, Equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, Binary isomorphous alloy system, Hume-Rothery rule, Binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation. Equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon Equilibrium diagram, Phase transformation in the iron carbon diagram (i) Formation of Austenite (ii) Transformation of austenite into pearlite (iii) Martensite transformation in steel, TTT curves.

Unit 4 **[8]**

Engineering properties and their measurements.Principles and applications of Annealing, Normalising, Hardening, Tempering.Recovery and Recrystallization. Hardenability -Its measures, Variables, Effecting Hardenability, Methods for determination of Hardenability.

Over-heated and Burnt steel, its causes and remedies. Temper brittleness -Its causes and remedies. Basic principles involved in heat treatment of plain carbon steel, Alloy steels, Cast iron and Non-ferrous metals and their alloys. Chemical heat treatment of steels: Physical principles involved in chemical heat treatment procedure for Carburizing, Nitriding, Cyaniding,Carbo-nitriding of steel.

Unit 5 **[6]**

Effects produced by alloying element on the structures and properties of steel, Distribution of alloying elements (Si, Mn, Ni, Cr, Mo, Co, W, Ti, Al) in steel, Structural classes of steel, Classification of steels, BIS standards.

Unit 6 **[4]**

Fibre reinforced plastic composites: Various fibres and matrix materials, Basic composite manufacturing methods, Applications of composite materials.

TERM WORK:

1. Study of engineering materials and crystals structures. Study of models BCC, FCC, HCP and stacking sequence, Tetrahedral and octahedral voids.
2. To calculate the effective number of atoms, Co-ordination number, Packing factors, C/A ratio for HCP structure.
3. Study of brittle and ductile fracture.
4. To prepare metallic samples for metallographic examination and to study the principle and construction of the metallurgical microscope.
5. Study of the following micro structures: Hypo, Hyper and Eutectoid Steel, Grey, White, Nodular and Malleable Cast Iron.
6. Annealing of steel -Effect of annealing temperatures and time on hardness.
7. Study of microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
8. Hardening of steel, Effect of quenching medium on hardness.
9. Effect of carbon percentage on the hardness of steel.
10. Study of various crystal structures and dislocations through models.
11. Study of iron-carbon equilibrium diagram and sketch the various structures present at room temperature.

TEXT BOOKS:

1. S. H. Avner, “Introduction to Physical Metallurgy”, Mcgraw Hill Book Company Inc, Edition, 2nd, 1974.
2. Vijendrasingh, “Physical Metallurgy”, Standard Publishers Delhi
3. W.D Callister, “Material Science and Engineering”, Wiley India Pvt. Ltd., 5th Edition.
4. V.D. Kodgire, “Material Science and Metallurgy For Engineers”, Everest Publishers Pune,12th Edition.
5. T.V. Rajan / C.P. Sharma, “Heat Treatments Principles and Practices”, Prentice Hall of India Pvt Ltd, New Delhi,
6. V Raghwan., “Material Science and Engineering”, Prentice Hall of India Pvt. Ltd., New Delhi, 3rd Edition, 1995.

RFERENCE BOOKS:

1. R.A. Higgins, “Engineering Metallurgy”, Viva Books Pvt. Ltd., New Delhi, 1st Edition ,1998
2. D.S. Clark, W. R. Varney, “Physical Metallurgy for Engineers ”, AN East West Press Pvt. Ltd. , New Delhi, 2nd Edition,1962

3. J.L. Smith and S.C. Bhatia, "Heat Treatment of Metals", CBS Publishers and Distributors, New Delhi, 1st Edition, 2008.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

4. APPLIED NUMERICAL METHODS

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

Pre-requisites: Engineering Mathematics-I, II and III.

Course Objectives:

1. To introduce numerical methods for solving linear and non-linear equations.
2. To apply the knowledge of these methods to solve practical problems with suitable software.
3. To introduce numerical methods for evaluating definite integrals.

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

1. Identify, classify and choose the most appropriate numerical method for solving a problem.
2. Solve the mechanical engineering problems using software's.

Unit 1 **[7]**

A. **Errors:** Introduction, Types of errors, Rules for estimate errors, Error propagation, Error in the approximation of function
B. **Roots of Equation:**
   a. Bracketing method: Bisection method, False position method
   b. Open method: Newton Raphson's, Multiple roots, Iteration system of non- linear equations, Secant method.
C. Roots of polynomial: Muller's method

Unit 2 **[5]**

Linear Algebraic Equation:

1. Gauss elimination method- Naïve Gauss elimination, Pitfalls of elimination, techniques of improving solutions, Gauss- Jordan method
2. Matrix Invention- LU decomposition, Gauss Sedial, Jacobi iteration method

Unit 3 **[8]**

A. Curve Fitting:
   i. Least square regression – Linear regression, Polynomial regression
   ii. Interpolation – Newton's divided difference, Interpolating polynomial, Languages interpolating polynomial

B. Statistics:

Mean and standard deviation, Addition and multiplication laws, Probabilities, Binomial, Poisson and normal distribution.

Unit 4 **[7]**

Numerical Differentiation and Integration

a. Newton's cote's integration of equation: Trapezoidal rule, Simpson's rule, Integration unequal segments.
b. Integration of equation: Romberg's integration and Gauss quadrature.
c. Numerical differentiation, Differentiation formulae, Richardson extrapolation, Derivation of unequally spaced data, Forward difference, Central difference, Backward difference.

Unit 5 **[6]**

Ordinary Differential Equation:

a. Taylor's series method, Picard's method, Runge-Kutta method, Euler's method, Improved polygon method, System of equation
b. Boundary value and Eigen value problem, Shooting method, Finite Difference method, Eigen value problem based on polynomial method, Power method.

Unit 6 **[7]**

Partial Differential Equation:

a. Finite Difference – Elliptical equation, Laplace's equation, Liebmen's method, Secondary variables, Boundary condition.
b. Finite Difference- Parabolic equation, Explicit method- Bender- Schmidt method, Implicit method- Crank Nicolson method
(No numerical treatment on Crank Nicolson method)

TERM WORK:

Students are expected to solve at least two problems of different method by developing computer programs on each unit. (Algorithm, Flow charts, Computer code)

TEXT BOOKS:

1. Dr. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi,7th Edition,2005.
2. Dr.B.S. Grewal, "Numerical Methods", Khanna Publishers, New Delhi, 7th Edition, 2005.
3. E Balguruswamy, "Numerical Methods", Tata McGrawHill Publication Company Ltd.,8th Edition, 2002.
4. S.Arumugam, A.Thangapandi Isaac and A. Somasundaram, "Numerical Methods", Scitech Publications India Pvt. Ltd., Chennai, 2nd Edition,2007.

5. Dr. V.N.Vedamurthy, “Numerical Methods”, Vikas Publication
6. G. Haribaskaran, “Numerical Methods”, Laxmi Publications Pvt. Ltd, New Delhi, 1st Edition, 2006.

REFERENCE BOOKS:

1. S.C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2012.
2. R.L. Burden and J.D. Faires, “Numerical Analysis Theory and Applications”, Cengage Learning India Pvt.Ltd., New Delhi,1st Edition,2005.
3. W.Y.Yang, W.Cao and J.Morris, Applied Numerical Methods Using MATLAB, Wiley India Pvt. Ltd., New Delhi, 1st Edition,2005.
4. Ward Cheney, “Numerical Mathematics and Computing”, Cengage Learning India Pvt. Ltd., New Delhi,7th Edition.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

5. ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

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

Pre-requisites: Engineering Physics

Course Objectives:

1) To introduce essential Electrical and Electronics basics and applications of electrical drives.
2) To introduce basics of Digital Electronics and Transistors.
3) Study of DC Machines, AC Machines and Transformers.
4) To introduce basics of Communication Systems.
5) To introduce various Instruments and Measuring Devices.

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

1) Select the electrical drives for different applications.
2) Understand various electronic components and their application.
3) Select electrical drives for various applications.
4) Understand basics of space (Satellite) based communications.
5) Understand basic principle of Indicating Instruments.

Unit 1 **[12]**

Electrical Basics

Basic definitions, Types of elements, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, Capacitive networks, Series, Parallel circuits and Star-delta and Delta-star transformations.

Electronics (Semi-Conductors) Basics:

Diode and its characteristics, Overview of semiconductors - Basic principle, Operation and characteristics of PN diode- Symbol, V-I Characteristics, Zenerdiode, BJT, JFET, Optoelectronic devices (LDR, Photodiode, Phototransistor, Solar cell, Optocouplers); Diode applications, Rectifiers – Half wave, Full wave and Bridge rectifiers (simple problems)

Digital Electronics:

Number systems – Binary codes - Logic gates - Boolean algebra, Laws and theorems - Simplification of Boolean expression - Implementation of Boolean expressions using logic gates - Standard forms of Boolean expression.

Unit 2 **[2]**

Transistors:

PNP and NPN Junction transistor, Transistor as an amplifier, SCR characteristics and applications

Unit 3 **[7]**

DC Machines:

Principle of operation of DC Generator – EMF equation - Types – DC motor types – Torque equation – Applications – Three point starter.

AC Machines:

Principle of operation of alternators – Regulation by synchronous impedance method – Principle of operation of induction motor – Slip – Torque characteristics–Applications.

Unit 4 **[3]**

Transformers:

Principle of operation of single phase transformers – EMF equation – Losses – Efficiency and regulation

Unit 5 **[10]**

Communication Systems and Space (Satellite) Based Communications:

Block schematic of basic communication system – Frequency spectrum - Base band signals, RF bands, Necessity of modulation, Types of modulation – AM, FM, Phase modulation and pulse digital modulation – AM /FM transmitters and receivers (block diagram description only)- Noise types, Noise figure. Introduction to radio wave propagation, Ground wave, Space wave and sky wave.History of Satellite communication, Satellite communication in 2000.Orbital effects in communication system performance. Satellite subsystems, Attitude and control systems (AOCS), Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment reliability and space qualification. Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and Launch vehicles, Orbital effects in communication system performance.

Unit 6 **[6]**

Instruments and Measuring Devices:

Instruments

Basic Principle of indicating instruments – Permanent magnet moving coil and moving iron instruments.

Cathode Ray Oscilloscope

Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity, Electrostatic and Magnetic deflection, Applications of CRO-Voltage, Current and frequency measurements.

TERM WORK:

The following experiments are required to be conducted as compulsory experiments:

ELECTRICAL ENGINEERING:

List of Experiments

1. Swinburne's test on D.C. shunt machine. (Predetermination of efficiency of a given D.C. shunt machine working as motor and generator).OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors)
2. Brake test on 3-phase induction motor (Determination of performance characteristics)
3. Regulation of alternator by synchronous impedance method.
4. Speed control of D.C. shunt motor by
    a. Armature voltage control b. Field flux control method
5. Brake test on D.C shunt motor

ELECTRONICS ENGINEERING:

List of Experiments

1. Transistor CE characteristics (Input and Output)
2. Full wave rectifier with and without filters.
3. CE amplifiers.
4. RC phase shift oscillator
5. Class A power amplifier
6. Micro processor

COMMUNICATIONS ENGINEERING:

List of Experiments

1. Practical implementation of AM, FM modulation and demodulation schemes.
2. Establishment of uplink and downlink.

TEXT BOOKS:

3. David V. Kerns and JR. J. David, "Essentials of Electrical and Computer Engineering", Pearson Education Publication.
4. U.A.Bakshi and A.P.Godse, "Elements of Electrical and Electronics", Technical Publications, Pune, 1st Edition 1998.

REFERENCE BOOKS:

1. M.S Naidu and S. Kamakshaiah, "Introduction to Electrical Engineering", Tata McGraw Hill Publications,
2. Kothari and Nagarath, "Basic Electrical Engineering", Tata McGraw Hill Publications, 2nd Edition.
3. U.A.Bakshi and V.U. Bakshi, "Basic Electrical Engineering", Technical Publications, Pune, 1st Edition, 2008.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

6. INSTRUMENTATION LAB

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs. per week	**Term Work: 25 Marks.**
	Oral Exam: 25 Marks

Pre-requisites: Applied Physics, Applied Thermodynamics, Fluid Mechanics, Electrical, Electronics and Communications Engineering

TERM WORK:

The Journal based on experiments listed below is to be submitted as a part of Term Work**.**

1. Study of various electronic components, their identification, symbols and Testing: Study of Resistances, Capacitors, Inductors, Diodes, Transistors, SCRs, ICs, Photo diode, Photo transistor, LED, LDR, CRO demonstration kit and Potentiometers.
2. Plot V-I characteristics and measure open circuit voltage and short circuit current of a solar panel.
3. Measure unknown inductance capacitance resistance using following bridges
   (a) Anderson bridge (b) Maxwell bridge.
4. Measurement of the distance with the help of ultrasonic transmitter and receiver.
5. Measurement of displacement with the help of LVDT.
6. Draw the characteristics of the following temperature transducers: (a) RTD (Pt-100) (b) Thermistors (c) Thermocouple
7. Draw the characteristics between temperature and voltage of K type thermocouple.
8. Measurement of strain/ force with the help of strain gauge load cell.

TEXT BOOKS:

1. Beckwith and Buck, "Mechanical Measurement", Pearson Education Asia, 5th Edition,2001.
2. D.S. Kumar, "Mechanical Measurement and Control" Metropolitan Book Co. Pvt. Ltd., New Delhi,4th Edition,2007.
3. Shirohi and Radha Krishnan H.C., "Mechanical Measurements", New Age International, New Delhi, 3rd Edition,2007.
4. Kannaiah, "Engineering Practices Laboratory",Scitech Publication.

REFERENCE BOOKS:

1. Doebelin Emesto, "Measurement Systems", Tata McGraw Hill International Publication Co. New York,4th Edition,1990
2. A.K. Sawhney and P. Sawhney, "Mechanical Measurement and Control", Dhanpat Raiand Company Pvt. Ltd., New Delhi, 12th Edition, 2010.
3. Richard S. Figliola, Donald E. Beasley, "Theory and Design for Mechanical Measurements", Wiley India Edition.

S.E. (AERONAUTICAL ENGINEERING) Semester - IV

7. COMPUTER AIDED DRAFTING LAB

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs. per week	**Term Work: 50 Marks.**

Pre-requisites: Engineering Graphics, Aircraft Component Drawing

Course Objectives:

1. To understand importance of CAD tool
2. To develop an ability to create 2-D drawings
3. To develop an ability to create 3-D models of machine components
4. To develop an ability to create assembly of simple machine components

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

1. Analyze and interpret design data.
2. Draw 2D drawings and 3D models.
3. Use modern engineering techniques, tools and skills for engineering practice.

Unit 1
Fundamentals of CAD and Design process

Unit 2
Geometric Modeling
- 2D Drawings: Points, Lines, Curves, and planes
- 3D Drawings: Solids (Boolean operations)
- Part Drawings and Dimensioning
- Part modeling through 2D, 3D modeling techniques.

Unit III
Solid and Surface Modeling
- 2D Drawing:
- 3D Drawing:
- Part Drawing and Dimensioning from Aircraft Drawing
- Part modeling from Aircraft Components
- Solid and Surface modeling.

TERM WORK:

1. Computer aided drafting of four simple components and print out of the same.
2. One assignment on drawing of details and assembly containing 6 - 8 components with tolerance, machining symbol etc. and plotting the same.
3. One assignment on 3-D drawing of one simple component and plotting its 2-D views along with 3 D object drawing.
4. Redraw given production drawing and to interpret it.

TEXT BOOKS:

1. Ibrahim Zeid, “CAD/CAM - Theory and Practice”, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 16th Edition, 2005.
2. M. P. Groover and E. W. Zimmers Jr., “CAD/CAM” - Prentice Hall of India Pvt. Ltd. New Delhi, 18th Edition, 1999.

REFERENCE BOOKS:

1. P N Rao, “CAD/CAM Principles and Applications”, Tata McGraw Hill Education Pvt. Ltd. New Delhi, 3rd Edition.

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S.E. (AERONAUTICAL ENGINEERING) Semester - IV

8. AIRCRAFT PRODUCTION TECHNOLOGY LAB

Teaching Scheme:	**Examination Scheme:**
Practical: 2 Hrs. per week	**Term Work: 25 Marks.**
	Practical & Oral Exam: 25 Marks

Pre-requisites: Aircraft Production Technology

Course Objective:
To develop and enhance the practical skills amongst the students in general as well as application of it in the field of Aeronautical engineering.

1. LATHE
1.1. Facing, Plain turning and step turning
1.2. Taper turning using compound rest.
1.3. Single start V thread, Cutting and knurling
1.4. Boring and internal thread cutting.

2. SHAPER
2.1. Machining a V- block (on a Shaper)
2.2. Machining hexagonal shape (on a Shaper)

3. DRILLING
3.1 Drilling 4 or 6 holes at a given pitch circle on a plate
3.2. Drilling, Reaming and Tapping

4. MILLING
4.1. Plain milling exercise
4.2. Gear milling exercise