

**AFFILIATED INSTITUTIONS**  
**ANNA UNIVERSITY, CHENNAI**  
**CURRICULAM AND SYLLABI – 2010**  
**B.Sc – AIRCRAFT MAINTENANCE SCIENCE ( 3 YEARS )**  
**SEMESTER I**

Course Code	Course Title	L	T	P	C
<b>Theory</b>					
YEN 005	Technical English – I	3	1	0	4
YMA 008	Applied Mathematics – I	3	1	0	4
YAE 911	Engineering Graphics	1	3	0	4
YAE 912	Fundamentals of Computing	3	0	0	3
YAE 913	Mechanics & Materials	3	1	0	4
YAE 914	Fluid Mechanics	3	0	0	3
<b>Practicals</b>					
YAE 916	Engineering Practice Laboratory	0	0	3	2
YAE 917	Computer Practices Lab	0	0	3	2
<b>TOTAL</b>		<b>16</b>	<b>6</b>	<b>6</b>	<b>26</b>

**SEMESTER II**

Course Code	Course Title	L	T	P	C
<b>Theory</b>					
YMA 009	Mathematics – II	3	1	0	4
YAE 921	Applied Engineering Mechanics	3	1	0	4
YAE 922	Basic Electrical & Electronics Engineering	3	0	0	3
YAE 923	Elements of Aeronautics	3	0	0	3
YAE 924	Aerospace Materials & Composites	3	0	0	3
<b>Practicals</b>					
YAE 926	Strength of Materials Laboratory	0	0	3	2
YAE 927	Composite Lab	0	0	3	2
<b>TOTAL</b>		<b>15</b>	<b>2</b>	<b>6</b>	<b>21</b>

**SEMESTER III**

Course Code	Course Title	L	T	P	C
<b>Theory</b>					
YAE 931	Flight Mechanics and Performances	3	0	0	3
YAE 941	Aircraft Engine and Components	3	0	0	3
YAR 931	Airframe Maintenance	3	0	0	3
YAR 932	Aircraft Instrumentation	3	0	0	3
YAR 933	Aircraft Control Engineering	3	0	0	3
<b>Practicals</b>					
YAE 946	Aircraft Structures Laboratory	0	0	3	2
YAE 937	Aerodynamics Laboratory	0	0	3	2
<b>TOTAL</b>		<b>15</b>	<b>0</b>	<b>6</b>	<b>19</b>

### SEMESTER IV

Course Code	Course Title	L	T	P	C
<b>Theory</b>					
YCH 003	Environmental Science and Engineering	3	0	0	3
YAR 941	Helicopter Aerodynamics	3	0	0	3
YAE 955	Aircraft Communication and Navigation	3	0	0	3
YAE 951	Aviation Legislation	3	0	0	3
YAR 942	Aero Engine Maintenance and Repair	3	0	0	3
<b>Practicals</b>					
YAE 958	Avionics Laboratory	0	0	3	2
YAR 944	Aero-engine Testing Laboratory	0	0	3	2
<b>TOTAL</b>		<b>15</b>	<b>0</b>	<b>6</b>	<b>19</b>

### SEMESTER V

Course	Course Title	L	T	P	C
<b>Theory</b>					
YAR 951	Aircraft Production Toolings	3	0	0	3
YAE 954	Modeling & Simulation	3	0	0	3
YAR 952	Flight Performance & Measurements	3	0	0	3
YAR 953	Flight Navigation & Guidance	3	0	0	3
YAE 952	Aircraft Rules and Regulations	3	0	0	3
<b>Practicals</b>					
YAE 957	Aircraft Systems Laboratory	0	0	3	2
YAR 955	Aircraft Overhaul & Run test Laboratory	0	0	3	2
<b>TOTAL</b>		<b>15</b>	<b>0</b>	<b>6</b>	<b>19</b>

### SEMESTER VI

Course Code	Course Title	L	T	P	C
<b>Theory</b>					
YAR 961	Reliability Engineering	3	0	0	3
YAE 962	Ground Handling, Safety and Support systems	3	0	0	3
YAR 962	Production & Maintenance Management	3	0	0	3
<b>Practicals</b>					
YAR 963	Project Work	0	0	12	6
<b>TOTAL</b>		<b>9</b>	<b>0</b>	<b>12</b>	<b>15</b>

**UNIT I FOCUS ON LANGUAGE****12**

Word formation with prefixes and suffixes - synonyms and antonyms - nominal compounds – subject - verb agreement - tenses (simple present, present continuous, present perfect, simple past, past continuous, past perfect, simple future) - impersonal passive - comparative adjectives – purpose and function cause and effect – imperatives – gerund - preposition

**Activities Suggested**

- Using prefixes and suffixes to change the grammatical functions of words – giving synonyms and antonyms
- Expansion of noun + noun phrases - correction of errors in the given sentences.
- Providing a context for the use of the tenses - rewriting the sentences in the impersonal passive form.
- Using comparative forms of adjectives in sentences giving a pair of purpose and function statements to be linked with expressions like to / in order to / so as to (Eg: He wanted to check the oil in the engine. He used a dipstick. He used a dipstick in order to check the oil in the engine).
- Giving pairs of cause and effect statements to be linked with expressions like as / since / because - rewriting imperative sentences using 'should'- (e.g.: Store the cylinders in upright position. – The cylinders should be stored in upright position).
- Rewriting infinitive forms as gerunds (eg: To modernize sick industries is difficult - Modernizing sick industries is difficult.) - fill in the blanks with appropriate prepositions.

**Note:** All examples pertaining to this unit should preferably be related to science and technology.

**UNIT II READING I****12**

Predicting the content – skimming the text for the gist – identifying the topic sentence – guessing the meaning of words from contexts – scanning for specific information - transfer of information – cloze reading.

**Activities Suggested**

- Taking a quick glance at the text to predict the content – reading to identify the main content
- Identifying the topic sentence in a paragraph – providing suitable titles for paragraphs – matching the titles with the paragraphs.
- Guessing the contextual meaning of words – comprehending a passage and answering questions of varied kinds.
- Transferring of information from a text to graphical representations like tree diagram / flow chart / bar chart / pie chart/ tables.
- Filling the gaps with appropriate missing words from the given list.

**UNIT III READING II****12**

Note – making, guided and open: providing a suitable title – identifying main and supporting ideas – listing ideas using a numbering scheme – understanding the organization of text – understanding discourse coherence – sequencing of sentences.

### **Activities Suggested**

- Making notes based on a passage in the format given.
- Using an appropriate format to make notes from a given passage.
- Providing a suitable title after reading the passage.
- Identifying main and supporting ideas by scanning.
- Sequencing of jumbled sentences using linguistic clues (e.g.: reference words).

### **UNIT IV WRITING I**

**12**

Writing definitions and descriptions – paragraph writing (topic sentence and its role, unity, coherence and use of cohesive expressions) - Formal letters: seeking permission for practical training, application for a job with biodata, letter to the editor of a newspaper). - Business letters: calling for quotations, asking for clarification, placing order, letter of complaint – sending an E-Mail.

### **Activities Suggested**

- Using appropriate expressions to define / describe an object / device / process.
- Writing paragraphs on different scientific discourse patterns like classification, comparison and problem / solution – identifying the topic sentence.
- Using unity, cohesion and coherence in paragraph writing.
- Writing formal and business letters using the appropriate format.
- Note – taking (guided and open).
- Summarizing and writing paragraphs based on listening tasks in the prescribed textbooks.

### **UNIT V WRITING II**

**12**

Making recommendations by using modal auxiliary verbs like should, must, ought to etc. – preparation of checklists – giving instructions – essay writing.

### **Activities Suggested**

- Identifying the phrases used for making recommendations in given texts and employing them in making recommendations.
- Writing checklists in the appropriate format.
- Writing instructions for performing tasks at home or at work (use of imperatives).
- Summarizing the discussions and other oral practice activities like role play in the prescribed textbooks.
- Essay writing based on discussion of scientific and technical topics given in the prescribed textbooks.

**TOTAL : 60 PERIODS**

### **TEXT BOOK:**

1. Department of Humanities and Social Sciences, Anna University, English for Engineers and Technologists, Vols. I & II (Combined Edition), Orient Longman Pvt. Ltd., 2006.

### **REFERENCE BOOKS:**

1. V.R. Narayanaswami, Strengthen Your Writing, 3<sup>rd</sup> Edition, Orient Longman, 2005.
2. Andrea J. Rutherford, Basic Communication Skills for Technology, 1<sup>st</sup> Edition, Pearson Education Asia (Singapore) Pvt. Ltd., Bangalore, 2001.
3. Nell Ann Pickett, Ann A. Laster, Katherine E. Staples, Technical English (Writing, Reading and Speaking), 8<sup>th</sup> Edition, Pearson Education, USA, Addison Wesley Longman Inc., 2001.

**UNIT I            MATRICES****12**

Rank of a matrix – Consistency of linear system of equations – Eigenvalue problem – Eigenvalues and eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley –Hamilton theorem (without proof) – Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

**UNIT II            THREE DIMENSIONAL ANALYTICAL GEOMETRY****12**

Direction cosines and ratios – Angle between two lines – Equations of a plane –Equations of a straight line – Coplanar lines – Shortest distance between skew lines – Sphere – Tangent plane – Plane section of a sphere – Orthogonal spheres.

**UNIT III            GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS****12**

Curvature – Cartesian and polar co-ordinates – Centre and radius of curvature – Circle of curvature – Involutives and evolutes – Envelopes – Properties of envelopes and evolutes – Evolute as envelope of normals.

**UNIT IV            FUNCTIONS OF SEVERAL VARIABLES****12**

Functions of two variables – Partial derivatives – Total differential – Taylor's expansion – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians – Differentiation under integral sign.

**UNIT V            ORDINARY DIFFERENTIAL EQUATIONS****12**

Simultaneous first order linear equations with constant coefficients – Linear equations of second order with constant and variable coefficients- Homogeneous equations of Euler type – Equations reducible to homogeneous form – Method of variation of parameters.

**TOTAL : 60 PERIODS****TEXT BOOKS:**

1. Veerarajan, T., "Engineering Mathematics (for First Year)", Second Edition, Tata McGraw–Hill Pub. Co. Ltd., New Delhi, 2002.
2. Venkataraman, M.K., "Engineering Mathematics, Volume I," Fourth Edition, The National Pub. Co., Chennai, 2003.
3. Kreyszig, E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and Sons (Asia) Ltd., Singapore, 2001.

**REFERENCE BOOKS:**

1. Grewal, B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics" Volume I, Fourth Revised Edition, S. Chand & Co., New Delhi, 2000.
3. Widder, D.V. "Advanced Calculus", Second Edition, Prentice Hall of India, New Delhi, 2000.

**UNIT I PLANE CURVES AND FREE HAND SKETCHING****12****Curves used in engineering practices:**

Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square, pentagon and circle - Drawing of tangents and normal to the above curves.

**Free hand sketching:**

Representation of Three Dimensional objects – Need for and importance of multiple views and their placement – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES****12**

General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations and location of traces – Projection of polygonal surface and circular lamina inclined to both reference planes.

**UNIT III PROJECTION OF SOLIDS AND SECTION OF SOLIDS****12**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method and change of reference plane (Auxiliary projection method) method.

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane – Obtaining true shape of section.

**UNIT IV DEVELOPMENT OF SURFACES AND INTERSECTION OF SOLIDS****12**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

Development of lateral surfaces of two Intersecting solids – prism & cylinder, cylinder & cylinder – Axis at right angles with no offset.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS****12**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

**Computer Aided Drafting: (Demonstration only)**

Demonstration of Computer Aided Drafting and dimensioning using appropriate software.

**TOTAL : 60 PERIODS****TEXT BOOKS:**

1. K.V. Natarajan “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006.
2. M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education, 2005.

**REFERENCE BOOKS:**

1. N.D. Bhatt “Engineering Drawing” Charotar publishing House 46<sup>th</sup> Edition, 2003.
2. K.R. Gopalakrishnana. “Engineering Drawing” (Vol. I & II) Subhas Publications – 1998.
3. Luzadder and Duff, “Fundamentals of Engineering Drawing” Prentice Hall of India Pvt Ltd, XI Edition - 2001.
4. K.Venugopal “Engineering Graphics”, New Age International (P) Limited, 2002.

## STANDARDS

1. IS10711 – 2001 Technical products Documentation – Size and Layout of Drawing sheets.
2. IS9609 (Parts 0 & 1) – 2001 Technical product Documentation – Lettering.
3. IS11669 – 1986 Dimensioning on Technical Drawings.
4. IS15021 (Parts 1-4) – 2001 Technical Drawings – Projection Methods.

YAE 912

## FUNDAMENTALS OF COMPUTING

L T P C

3 0 0 3

### UNIT I INTRODUCTION 9

Introduction – Characteristics of Computers – The Evolution of Computers – The Computer Generations - Classification of Computers - Basic Computer organization- Number Systems

### UNIT II COMPUTER ARITHMETIC AND SOFTWARE 9

Computer Codes – Computer Arithmetic –Binary Arithmetic – Addition –Subtraction- Multiplication-Division - Computer Software –Types of Software – Logical System Architecture – Software Development Steps.

### UNIT III PROBLEM SOLVING AND OFFICE AUTOMATION 9

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudocode - Application Software Packages- Word Processing – Spreadsheet – Graphics – Personal Assistance.

### UNIT IV INTRODUCTION TO C 9

Overview of C – Constants, Variables and Data Types – Operators and Expression –Managing Input and Output Operators – Decision Making and Branching – Decision Making and Looping.

### UNIT V FUNCTIONS AND POINTERS 9

Arrays – Handling of Character Strings – User-Defined Functions- Structures and Unions – Pointers – The Preprocessor – Developing a C Program: Some Guidelines.

**TOTAL : 45 PERIODS**

#### TEXT BOOKS:

1. Pradeep K.Sinha and Priti Sinha, “Computer Fundamentals: Concepts, Systems and Applications”, BPB Publications, 2003.
2. E.Balagurusamy, “Programming in ANSI C”, TMH, New Delhi, 2002.

#### REFERENCE BOOKS:

1. Allen B.Tucker et.al, “Fundamentals of Computing I”, TMH New Delhi, 1998.
2. V.Rajaraman, “Fundamentals of Computers”, Prentice-Hall of India, 2002.
3. Herbert Schidt, “C Made Easy”, McGraw-Hill.

**UNIT I            STATICS****15**

Introduction - Units and Dimensions - Laws of Mechanics – Parallelogram and triangular Law of forces – Vectorial representation of forces and moments – Vector operations of forces moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moments – Varignon's theorem - Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

**UNIT II            STRESSES & DEFLECTION OF BEAMS****15**

Shear force and bending moment diagrams for simply supported and cantilever beams – Bending stresses in straight beams – Shear Stresses in bending of beams with various cross sections – beams of uniform strength.            Double integration method – McCauley's method - Area moment method – Conjugate beam method.

**UNIT III           AEROSPACE MATERIALS****15**

Crystal solid structure and defects of Crystal structures- Mechanical properties of materials especially pure Metals & Alloys- High temperature properties of Metals & Alloys- Special materials and Super alloys- Aluminum, Titanium, Nickel and Cobalt based alloys

**UNIT IV           COMPOSITE MATERIALS****15**

Materials used for sandwich construction - Basic design concepts of sandwich construction - Failure modes of sandwich panels - Failure criteria for composites.

**TOTAL : 60 PERIODS****TEXT BOOKS:**

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2. Nash William – "Strength of Materials", TMH, 1998
3. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
4. Aircraft Materials & Processes by George F. Titterton
5. Advanced Composites by Sindy Foreman

**REFERENCE BOOKS:**

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5<sup>th</sup> edition), Laxmi publications (P) Ltd., New Delhi, 1995.
2. Dym C.L. and Shames I.H. – "Solid Mechanics", 1990.
3. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.

**UNIT I BASIC CONCEPTS AND PROPERTIES 9**

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

**UNIT II FLUID KINEMATICS 9**

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net.

**UNIT III FLUID DYNAMICS 9**

Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's  $\pi$  theorem- applications - similarity laws and models.

**UNIT IV INCOMPRESSIBLE FLUID FLOW 9**

Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseuille's) - Hydraulic and energy gradient - flow through pipes - Darcy -weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission

**UNIT V BOUNDARY LAYER 9**

Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

**TOTAL : 45 PERIODS****TEXT BOOKS:**

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi (7<sup>th</sup> edition), 1995.
3. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 1992.

**REFERENCE BOOKS:**

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5<sup>th</sup> edition), Laxmi publications (P) Ltd., New Delhi, 1995.
2. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5<sup>th</sup> Edition, New Delhi, 2003.
3. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 1998.
4. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2<sup>nd</sup> edition, 2004.

**OBJECTIVES**

To provide exposure to the students with hands on experience on various basic engineering practices in Mechanical, Electrical and Electronics Engineering.

**I MECHANICAL ENGINEERING PRACTICE****20****Welding**

- (a) Preparation of arc welding of butt joints, lap joints and tee joints.
- (b) Gas welding practice.

**Basic Machining**

- (a) Simple Turning and Taper turning
- (b) Drilling practice

**Machine assembly practice**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise – production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.

**II ELECTRICAL ENGINEERING PRACTICE****20**

- a. Stair-case wiring
- b. Fluorescent lamp wiring
- c. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- d. Calibration of ammeter and voltmeter.
- e. Measurement of power using watt meter
- f. Measurement of energy using single phase energy meter.

**III ELECTRONICS ENGINEERING PRACTICE****20**Any **SIX** Experiments

- 1. (a) Study of Electronic components and equipment
  - (i) Resistor colour coding (ii) usage of CRO & Multimeter.
  - (b) Soldering of simple electronic components and checking the continuity.
  - (c) Assembling electronic components on a PCB.
- 2. Characteristics of PN & Zener Diodes.
- 3. Measurement of ripple factor for HWR & FWR.
- 4. Input and output characteristics of CE transistor.
- 5. Characteristics of JFET.
- 6. Applications of operational amplifier – Inverter, adder and subtractor.
- 7. Study of digital circuits – logic gates, adder and decade counter.

**TOTAL : 45 PERIODS**

**LIST OF EQUIPMENT AND COMPONENTS:  
(For a Batch of 30 Students)**

**Mechanical**

- |   |           |
|---|-----------|
| 1. Arc welding transformer with cables and holders                            | 5 Nos.    |
| 2. Welding booth with exhaust facility  | 5 Nos.    |
| 3. Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets.   |
| 4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.    | 2 Nos.    |
| 5. Centre lathe   | 2 Nos.    |
| 6. Hearth furnace, anvil and smithy tools                                     | 2 Sets.   |
| 7. Moulding table, foundry tools  | 2 Sets.   |
| 8. Study-purpose items: centrifugal pump, air-conditioner                     | One each. |

**Electrical**

- |   |          |
|---|----------|
| 1. Assorted electrical components for house wiring                  | 15 Sets  |
| 2. Electrical measuring instruments                                 | 10 Sets  |
| 3. Study purpose items: Iron box, fan and regulator, emergency lamp | One each |

**Electronics**

- |   |         |
|---|---------|
| 1. Soldering guns   | 10 Nos. |
| 2. Assorted electronic components for making circuits                 | 50 Nos. |
| 3. Small PCBs   | 10 Nos. |
| 4. Multimeters  | 10 Nos. |
| 5. Study purpose items: Telephone, FM radio, low-voltage power supply | 2 each. |

**YAE917**

**COMPUTER PRACTICE LAB**

**L T P C  
0 0 3 2**

**LIST OF EXPERIMENTS**

**UNIT I**

**a) Word Processing**

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing - flow Chart

**b) Spread Sheet**

5. Chart - Line, XY, Bar and Pie.
6. Formula - formula editor.
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
8. Sorting and Import / Export features.

## UNIT II Simple C Programming

9. Data types, Expression Evaluation, Condition Statements.
10. Functions, Recursion and parameter passing mechanisms.
11. Arrays

## UNIT III

12. Structures and Unions
13. Pointers and Functions
14. File Processing
15. Dynamic allocation & Linked List

**TOTAL : 45 PERIODS**

## HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

### Hardware

LAN System with 36 nodes (OR) Standalone PCs – 36 Nos.

1 Printer

### Software

OS – Windows / UNIX Clone

Application Package – Office suite

Compiler – C

**YMA009**

**MATHEMATICS - II**

**L T P C**

**3 1 0 4**

### UNIT I MULTIPLE INTEGRALS

**12**

Double integration\_ Cartesian and polar co-ordinates- change of order of integration- Area as a double integral – Triple integration in Cartesian co-ordinates- change of variables between Cartesian and polar co-ordinates and between Cartesian and cylindrical / spherical polar co-ordinates.

### UNIT II VECTOR CALCULUS

**12**

Gradient, divergence and curl – Line, surface and volume integrals – green's Gauss divergence and stroke theorems (with out proof) – Verification of the above theorems and evaluation of integrals using them.

### UNIT III ANALYTIC FUNCTIONS

**12**

Functions of a complex variable – analytic function- Necessary conditions – Cauchy- Riemann equations in Cartesian co-ordinates – Sufficient conditions (with out proof)- Properties of analytic function- determination of harmonic conjugate by Milne – Thomson method – conformal mapping –  $w = z + a$ ,  $az$ ,  $1/z$ ,  $z^2$  and bilinear transformation

### UNIT IV COMPLEX INTEGRATION

**12**

Statement and application of Cauchy's theorem and Cauchy's integral formula – Taylor and Laurent expansion – Singularities – Classification – Residues – Cauchy's residue theorem – Contour integration – Unit circle and semi circular contours (excluding poles on real axis)

**UNIT V LAPLACE TRANSFORM****12**

Laplace Transform- Sufficient conditions – Transforms of elementary functions – Basic properties – Inverse transforms – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Convolution theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations up to second order with constant coefficients.

**TOTAL : 60 PERIODS****TEXT BOOKS:**

1. Grewal. B.S., “ Higher Engineering Mathematics”, Thirty sixth edition, Khanna Publishers, Delhi, 2001
2. Kreyzig. E., “ Advanced Engineering Mathematics”, Eighth edition, John Wiley & sons ( Asia) Pte. Ltd., Singapore , 2001

**REFERENCE BOOK:**

1. Narayanan, S. Manicavachagom Pillay, T.K, and Ramaniah,G., “ Advanced Mathematics for Engineering students”, Volume I and III, S. Viswanathan (Printers and publishers) Pvt. Ltd., Chennai, 2002

**YAE921****APPLIED ENGINEERING MECHANICS****L T P C  
3 1 0 4****UNIT I BASICS & STATICS OF PARTICLES****12**

Introduction - Units and Dimensions - Laws of Mechanics – Parallelogram and triangular Law of forces – Vectorial representation of forces and moments – Vector operations of forces moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moments – Varignon’s theorem - Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

**UNIT II EQUILIBRIUM OF RIGID BODIES****12**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

**UNIT III PROPERTIES OF SURFACES AND SOLIDS****12**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle areas from integration – T section, I section, Angle section, Hollow section from primary simpler sections – second moments of plane area – Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow sections – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia - Mass moment of inertia – Derivation of mass moment of inertia for, prism, cylinder and sphere from first principle – Relation to area moments of inertia.





**UNIT V POWER PLANTS USED IN AIRPLANES 10**  
Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995.

**REFERENCE BOOKS:**

1. Kermode, A.C., "Mechanics of flight", Longman Group, 1996.
2. Airframe and Powerplant Mechanics AIRFRAME HANDBOOK, Federal Aviation Administration, 2005

**YAE924 AEROSPACE MATERIALS & COMPOSITES L T P C  
3 0 0 3**

**UNIT I FERROUS AND NON FERROUS MATERIALS 9**  
Properties and uses of carbon steel, nickel steel, chromium steel, Aluminium, Copper, Zinc, Magnesium, Titanium and Molybdenum, chrome- molybdenum, chrome –vanadium alloys and its applications  
Properties of super alloys and its uses in aerospace, SAE numbering system

**UNIT II NON METALS 9**  
Classification of Plastics -Thermoplastics and thermosetting Classification of Resins- Natural resins, cellulose & Synthetic resins Manufacturing process of plastics

**UNIT III WOOD AND GLUE 9**  
General uses of wood- classification of wood, Structure and strength of wood, Types of wood and plywood used in aircraft industry, characteristics, defects and prevention. Glue and glueing, paints, Varnishes, Thinners and primers. Uses and storages. Procedure of painting

**UNIT IV FABRIC MATERIALS 9**  
Terms, Types of fabrics, defects, deterioration, procedure for testing the soundness of fabric materials, procedure of fabric covering. Dopes- Types, purpose and procedure for doping

**UNIT V COMPOSITE MATERIALS 9**  
Advantages of composite materials, Various utilization in Aircraft structure  
Composite structure, reinforcing fibres such as fiberglass, Aramid, Carbon, Boron & ceramic. Hybrids, Matrix materials, Prepregs materials, Filler materials, Honey comb. Application of composites in aerospace components and parts.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Aircraft General Engineering by Lalith Gupta, Himalaya Book House, Delhi
2. Workshop Technology- Vol I & II by Hajira Chowdhry, Media Promoters, Mumbai
3. Aircraft Material & Process by Titterton
4. Advanced Composite Materials by Lalith Gupta, Himalaya Book House, Delhi

**OBJECTIVE**

To develop the knowledge in testing the materials for hardness, fatigue, impact, tension and torsion.

**LIST OF EXPERIMENTS:**

1. Hardness test - a) Vickers b) Brinell c) Rockwell d) Shore
2. Tension test
3. Torsion test
4. Impact test – a) Izod b) Charpy
5. Fatigue test - a) Reverse plate bending b) Rotating Beam
6. Testing of springs
7. Block Compression Test

**TOTAL : 45 PERIODS****LIST OF EQUIPMENTS:**

(for a batch of 30 students)

Sl.No	Details of Equipments	Qty Required	For Experiments
1.	Vickers Hardness Testing Machine	1	1
2.	Brinell Hardness Testing Machine	1	1
3.	Rockwell Hardness Testing Machine	1	1
4.	Shore Hardness Testing Machine	1	1
5.	Universal Testing Machine	1	2,3,7
6.	Izod Impact Testing Machine	1	4
7.	Charpy Impact Testing Machine	1	4
8.	Fatigue tester- Rotating Beam	1	5
9.	Fatigue tester –Reverse plate bending	1	5

**OBJECTIVE**

To understand the fabrication, analysis and design of composite materials & structures.

**LIST OF EXPERIMENTS:**

1. Study of Stress – Strain relationship of composites
2. Determination of elastic constant of
3. Anisotropic material
4. Orthotropic material
5. Isotropic material
6. Study of laminates (single ply and multiply)
7. Study of sandwich construction
8. Study of Honey comb structure

**TOTAL : 45 PERIODS****LIST OF EQUIPMENTS:**

(for a batch of 30 students)

Sl.No	Details of Equipments	Qty Required	For Experiments
1	Universal Testing Machine ,5 ton capacity	1	1,2,3,4,5

**YAE931**

**FLIGHT MECHANICS AND PERFORMANCES**  
(Common to B.Sc – Aeronautical Science &  
B.Sc - Aircraft Maintenance Science)

**L T P C**  
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Physical properties of air - atmosphere, pressure, temperature, density and humidity. Bernoulli's principles and application of Newton's law of motion.

**UNIT II AIRFLOW AND AEROFOIL 9**

Aerofoil profile and terminology. Aerofoil in motion, angle of attack and factors contributing lift generation. Skin friction, Boundary layer, and Reynold's number. Drag type and its description. Relative wind , lift, drag and their relation; centre of pressure.

**UNIT III AIRFOIL AND ITS APPLICATION 9**

Aerofoil characteristics and symbols. Fundamental equation for lift and drag and L/D ratio. Shape and dimension of aerofoil. Aspect ratio of its effects. Mean aerodynamic chord and airflow control devices- wing flaps, leading edge flaps, slots, slats, spoilers and their aerodynamic characteristics.

**UNIT IV FORCES ACTING IN FLIGHT 9**

Lift and weight; Drag and thrust; Load and load factor. Longitudinal, lateral and directional stability. Fixed surfaces and movable aircraft controls and their function.

**UNIT V PERFORMANCE 9**

Aeroplane take off and climbing process. Factors affecting take off and climb. Minimum and maximum speed of horizontal flight. Effects of changes of engine power, altitude and weight. Directional, longitudinal and lateral stability and their control.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Kores & Rardon., " Aircraft Basic Science"
2. Khermode.A.C., " Mechanics of Flight"
3. William E.Wiesel "Space flight Dynamics", 2<sup>nd</sup> edn., Tata-McGraw-Hill Book Co., 2007.

**YAE941**

**AIRCRAFT ENGINES AND COMPONENTS**

**L T P C**  
**3 0 0 3**

**UNIT I PISTON ENGINES 9**

Development, classification and characteristics of piston engines. Description of Otto cycle, Carnot cycle, stroke, compression ratio and four stroke cycle. Principles of valve timing and engine firing order. Description of terms related to Piston engine/. Engine efficiencies, Power calculation and factors affecting engine performance.

**UNIT II ENGINE ASSEMBLIES 9**

Construction features of crank case, crank shaft, connecting rod, propeller shaft, cylinder, piston, valve and valve operating mechanism and their functions. Exhaust manifold and engine cooling. Supercharger and Turbo charger – system arrangement and principle of operation.

**UNIT III PROPELLER 9**  
Propeller theory, terms and definitions. Forces acting on propeller in flight. General description of fixed and variable pitch propeller. Propeller controls and operations of pitch changing mechanism. Description of wooden and composite blade propeller.

**UNIT IV TURBINE ENGINES 9**  
Principles of Jet propulsion, Types of gas turbine engines- turbojet, turbofan, turboprop engines and its differences in construction. Description of thrust and effect of altitude, ram air. Descriptions of factors affecting thrust and performances.

**UNIT V ENGINE SYSTEMS 9**  
Fuel system- types of fuel, fuel control units and their operation, lubrication system and lubricants, Construction features- air intake, compressor, diffuser, combustion chamber, turbine, exhaust system, after burner and thrust reverser.

**TOTAL : 45 PERIODS**

**TEXT BOOKS :**

1. Kroes Wild., " Aircraft Power Plants",
2. Magumdar. "Understanding of Aerospace propulsion systems"
3. W.R.Sears."Airplane and its components", 19

**YAR931 AIRFRAME MAINTENANCE L T P C  
3 0 0 3**

**OBJECTIVE:**

To study the maintenance aspect of airframe systems and rectification of snags

**UNIT I WELDING IN AIRCRAFT STRUCTURAL COMPONENTS 4**  
Equipments used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing.

**UNIT II SHEET METAL REPAIR AND MAINTENANCE 9**  
Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation – reverse technology.

**UNIT III PLASTICS AND COMPOSITES IN AIRCRAFT 9**  
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 IV AIRCRAFT JACKING, ASSEMBLY AND RIGGING 9**  
Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

**UNIT V REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM 9**  
 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. Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs)

**UNIT VI SAFETY PRACTICES 5**  
 Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble shooting - Theory and practices.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

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

**REFERENCE BOOKS :**

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

**YAR932 AIRCRAFT INSTRUMENTATION L T P C  
 3 0 0 3**

**UNIT I GENERALS 9**  
 Instruments displays- Circular scale, straight scale and digital. Description of operational range of markings, Instruments panel layout, International Standard atmosphere (ISA), Electronic displays and its configuration.

**UNIT II FLIGHT INSTRUMENTS 9**  
 Description of basic air data system and pitot-static probe. Probe heater arrangements and installation of pitot probes and static vents. Principle of operation of Altimeter, Vertical speed indicator, air speed indicator, and mach meter. Errors in altimeter and air speed indicator and their corrections. "Q" code setting of altimeter.

**UNIT III GYROSCOPIC INSTRUMENTS 9**  
 Principles and properties of Gyroscope-types and its use. Methods of operating rotors of gyroscope. Principle of operation of Directional gyro, Artificial horizon and turn & back indicator. Errors and their compensation.

**UNIT IV ENGINE INSTRUMENTS 9**  
 Principles of operation of engine RPM, manifold pressure, Fuel / oil pressure, Torque pressure, engine pressure ratio and fuel flow indicators and their sensor units. Principle of operation of Oil and air temperature gauges and their sensing units. Description of thermo-couple principle and operation of CHT and EGT gauges. Capacitance type fuel quantity indicating system and its operation.

**UNIT V AIRCRAFT COMPASSES****9**

Terrestrial magnetism; Magnetic variation, deviation and dip. Direct reading and remote reading compass – Principle of operation, constructional features and system layout. Compass error and compensation.

**TOTAL : 45 PERIODS****TEXT BOOKS:**

1. Pallet. E.H.J., "Aircraft Instruments and Integrated System", 1996.
2. Airframe Hand book – AC- 65- 15A-1994 (Chapter 14).

**YAR933****AIRCRAFT CONTROL ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

To understand the basic concepts of flight control systems.

**UNIT I INTRODUCTION****9**

Historical review-Simple pneumatic, hydraulic and thermal systems, Series and parallel systems, Analogies – Mechanical and electrical components, Development of flight control systems.

**UNIT II OPEN AND CLOSED LOOP SYSTEMS****9**

Feedback control systems – Block diagram representation of control systems, reduction of block diagrams, output to input ratios, Signal flow graph.

**UNIT III CHARACTERISITIC EQUATION AND FUNCTIONS****9**

Laplace transformation, Response of systems to different inputs viz. step input, impulse, ramp, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuits.

**UNIT IV CONCEPT OF STABILITY****9**

Necessary and sufficient conditions, Routh- Hurwitz criteria of stability, Root locus and bode techniques, concept and construction, frequency response.

**UNIT V SAMPLED DATA SYSTEMS****9**

Introduction of digital control system, digital controllers and digital PID controllers.

**TOTAL : 45 PERIODS****TEXT BOOKS:**

1. Ogato, "Modern Control Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi , 1998.
2. Gopal.M. "Control Systems – Principles and Design", Tata-McGraw Hill Publication, New delhi, 2000.

**REFERENCE BOOKS:**

1. Azzo, J.J.D. and Houpis. C.H., "Feedback Control System Analysis and Synthesis", McGraw Hill International, 3<sup>rd</sup> Ed, 1998.
2. Kuo.B.C., "Automatic Control Systems", , Prentice-Hall of India Pvt. Ltd., New Delhi , 1998.
3. Houpis.C.H., and Lamont.G.B., "Digital Control Systems", McGraw Hill Book co, New York, USA, 1995.
4. Naresh K. Sinha, "Control Systems", New age international Publishers, New Delhi.

**OBJECTIVE**

To study experimentally the load deflection characteristics structural materials under different types of loads.

**LIST OF EXPERIMENTS**

1. Determination of Young's modulus of steel using electronic extensometers
2. Determination of Young's modulus of aluminum using electronic extensometers
3. Determination of fracture strength and fracture pattern of ductile materials
4. Determination of fracture strength and fracture pattern of brittle materials
5. Preparation of Stress Strain curve for various engineering materials
6. Deflection of beams with various end conditions using Bend Test set up.
7. Verification of Maxwell's Reciprocal theorem & principle of superposition
8. Determination of buckling of metals using column test apparatus
9. Preparation of South – well's plot.
10. Preparation of Riveted Joints and testing for joint efficiency.

**TOTAL : 45 PERIODS**

**LIST OF EQUIPMENTS**

SL. NO.	EQUIPMENTS	QTY	EXPERIMENTS NO.
1.	Universal Testing Machine	1	1,2,3,4,5,10
2.	Mechanical Extensometer	1	1
3.	Electrical stain gauge	10	2
4.	Stain indicator	1	2
5.	Dial Gauges	12	3,4
6.	Beam Test set up with various end conditions	2	3,4
7.	Weight 1 Kg	10	3,4
8.	Weight 2 Kg	10	3,4
9.	Weight Pans	6	3,4
10.	Column Test Apparatus	1	5,6
11.	Rivet	30	10

**OBJECTIVE**

To study experimentally the aerodynamic forces on different bodies at low speeds.

**LIST OF EXPERIMENTS**

1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoils.
4. Pressure distribution over cambered airfoils & thin airfoils.
5. Force measurement-using wind tunnel balancing set up.
6. Force measurement on symmetric airfoil.
7. Force measurement on cambered airfoil.
8. Flow over a flat plate at different angles of incidence
9. Flow visualization studies in low speed flows over cylinders
10. Flow visualization studies in low speed flows over airfoil with different angle of incidence

**TOTAL : 45 PERIODS**

**LIST OF EQUIPMENT**

SL.NO.	ITEMS	QUANTITY	EXPERIMENT NO.
1.	Wind Tunnel test section size around 300 x 300 mm with test section flow speed of 70 m/s.	1 No.	1, 2,3,4,5
2.	Wings of various airfoil sections (Symmetrical & cambered airfoils)	2 Nos. each	3, 4
3.	Angle of incidence changing mechanism	1 No.	3, 4
4.	Multiple Manometer stands with 20 – 30 manometer tubes	4 Nos.	2,3,4
5.	U-Tube Manometer	1 No.	1,2,3,4
6.	Static Pressure Probes	4 Nos.	1,2,3,4
7.	Total Pressure Probest	4 Nos.	1,2,3,4
8.	Pitot-Static Tubes	4 Nos.	1,2,3,4
9.	Wooden Models of Three Dimensional bodies (eg. Cylinder etc.,)	2 Nos. each	2
10.	Wind Tunnel balances (3 or 5 or 6 components)	1 No.	5
11.	Pressure Transducers with digital display	1 No.	1,2,3,4
12.	Hele-Shaw apparatus, Smoke Tunnel, Water flow channel	1 each	6,7,8

**OBJECTIVES**

- To create an awareness on the various environmental pollution aspects and issues.
- To educate the ways and means to manage waste, Social issues and Global warming.
- To impart some fundamental knowledge on human welfare measures.

**UNIT I ENVIRONMENTAL POLLUTION 9**

Definition – causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards .

**UNIT II WASTE MANAGEMENT 9**

Solid waste management: causes, effects and control measures of urban and industrial wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

**UNIT III SOCIAL ISSUES AND THE ENVIRONMENT 9**

Unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – environmental ethics: issues and possible solutions – climate change,

**UNIT IV GLOBAL WARMING 9**

Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, wasteland reclamation – consumerism and waste products – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation – public awareness

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – case studies.

**TOTAL : 45 PERIODS****TEXT BOOKS:**

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson education Pvt., Ltd., second edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. jr., "Environmental Science", Wadsworth publishing co.
3. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science.
4. Trivedi R.K. and P.K. Goel, "Introduction to air pollution", Techno-science publications.

**REFERENCES :**

1. Bharucha erach, "The Biodiversity of India", Mapin publishing Pvt. Ltd., Ahmedabad India.
2. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.
4. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.

<b>UNIT I</b>	<b>ELEMENTS OF HELICOPTER AERODYNAMICS</b>	<b>9</b>
Configurations based on torque reaction – Jet rotors and compound helicopters – Methods of control – Collective and cyclic pitch changes – Lead – Lag and flapping hinges.		
<b>UNIT II</b>	<b>IDEAL ROTOR THEORY</b>	<b>9</b>
Hovering performance – Momentum and simple blade element theories – Figure of merit – Profile and induced power estimation – Constant chord and ideal twist rotors.		
<b>UNIT III</b>	<b>POWER ESTIMATES</b>	<b>9</b>
Induced, profile and parasite power requirements in forward flight – Performance curves with effects of altitude – Preliminary ideas on helicopter stability.		
<b>UNIT IV</b>	<b>LIFT, PROPULSION AND CONTROL OF VTOL AIRCRAFT</b>	<b>9</b>
Various configurations – Propeller, rotor, ducted fan and jet lift – Tilt wing and vectored thrust – Performance of VTOL aircraft in hover, transition and forward motion.		
<b>UNIT V</b>	<b>GROUND EFFECT MACHINES</b>	<b>9</b>
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.		

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Gessow, A., and Myers G.C., Aerodynamics of Helicopter, Macmillan & Co., N.Y. 1987

**REFERENCE BOOKS:**

1. McCormick, B.W., Aerodynamics of V/STOL Flight, Academic Press, 1987.
2. Johnson, W., Helicopter Theory, Princeton University Press, 1980.
3. McCormick, B.W., Aerodynamics, Aeronautics & Flight Mechanics John Wiley, 1995.
4. Gupta, L Helicopter Engineering, Himalayan Books, 1996.
5. A.R.S. Bramwell, George Done, and David Bamford. Bramwell's Helicopter Dynamics, second Edition.
6. John Seddon and Simon Newman, University of Southampton Basic Helicopter Aerodynamics, second Edition.

**YAE955**

**AIRCRAFT COMMUNICATION AND NAVIGATION**

**L T P C  
3 0 0 3**

**UNIT I GENERAL 9**

Description of radio waves, frequency and wave length, frequency bands and types of waves, Types of antenna and its functions. Functions of transmitter and receiver.

**UNIT II COMMUNICATION SYSTEM 9**

Description and theory of operation of High Frequency (HF), Very High Frequency (VHF) and satellite communication. Selcol Decoder and its functions, Block box. Testing of communication system operation.

**UNIT III NAVIGATION SYSTEM 9**

Description, theory of operation of Automatic direction finder (ADF), Radio magnetic Indicator, VHF Omni Range (VOR) – Instrument landing system (ILS), Distance measuring equipment, marker Beacons and function of its various units. Principle of operation of Inertial Navigation system, Global Positioning system (GPS), Doppler Navigation system and their advantages.

**UNIT IV RADIO EQUIPMENT (OPERATIONS) 9**

Description, theory of operation of Traffic Alert and Collision Avoidance System, Radar Altimeter, Emergency Location transmitter, and mode A,C, and 'S' transponders. Installation features of radio equipment.

**UNIT V RADAR SYSTEM 9**

Radar and its application. Description of Radar Bands, Flat plate antenna, Wave guide and Radomes. Types of Indicators (Display). Principles of operation of weather radar and its associated units. Safety precaution around a radar installation

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Thomas K. Eismen, "Aircraft Electricity & Electronics", 1956
2. Mike Tooley., David Wyatt, "Aircraft Communication & navigation systems", amazon books, 2005

**YAE951**

**AVIATION LEGISLATION**

**L T P C  
3 0 0 3**

**UNIT I 9**

Indian Aircraft Act 1934 and Aircraft rules related to registration, airworthiness, maintenance and operation of aircraft. Civil Aviation requirements – Sections and their subjects, procedures of issues and its revision.

**UNIT II 9**

Type of certificate, Type of approval, Modification and concession- Description and applicability. Log book and its recording

**UNIT III 9**

Registration of Aircraft- Category, procedure and validity. Registration markings, identification plate and change of ownership. Certificate of airworthiness – requirements for issue, renewal and validity.

**UNIT IV** **9**  
Approval of organization- categories, minimum requirements for grant of approval, validity, manuals, Quality control procedures and documentations

**UNIT V** **9**  
Fuel, Oil and Lubricants – quality control during storage and supply. Documentation and responsibility of vendors. Fueling equipment and its requirements. Precaution and Procedure of aircraft fueling.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Aircraft Manual of India
2. Civil Aviation Policy, Govt. of India, April, 2000
3. Civil Aviation requirements Sec. II ( as per latest compilation)

**REFERENCES:**

1. Civil Aviation Policy (CAP – 459) Part – I, basic

**YAR942** **AERO ENGINE MAINTENANCE AND REPAIR** **L T P C**  
**3 0 0 3**

**OBJECTIVE:**

To study the basic concepts of the maintenance and repair of both piston and jet aero engines and the procedures followed for overhaul of aero engines.

**UNIT I** **CLASSIFICATION OF PISTON ENGINE COMPONENTS** **9**

Types of piston engines – Principles of operation – Function of components – Materials used – Details of starting the engines – Details of carburation and injection systems for small and large engines – Ignition system components – Spark plug details – Engine operating conditions at various altitudes – Maintenance and inspection check to be carried out.

**UNIT II** **INSPECTIONS OF PISTON ENGINES** **9**

Inspection and maintenance and trouble shooting – Inspection of all engine components – Daily and routine checks – Overhaul procedures – Compression testing of cylinders – Special inspection schedules – Engine fuel, control and exhaust systems – Engine mount and super charger – Checks and inspection procedures.

**UNIT III** **INSPECTIONS OF PISTON ENGINES** **9**

Symptoms of failure – Fault diagnostics – Case studies of different engine systems – I: Tools and equipment requirements for various checks and alignment during overhauling – Tools for inspection – Tools for safety and for visual inspection – Methods and instruments for non destructive testing techniques – Equipment for replacement of part and their repair. Engine testing: Engine testing procedures and schedule preparation – Online maintenance.

**UNIT IV** **CLASSIFICATION OF JET ENGINE COMPONENTS** **9**

Types of jet engines – Principles of operation – Functions of components – Materials used – Details of starting and operating procedures – Gas turbine engine inspection & checks – Use of instruments for online maintenance – Special inspection procedures : Foreign Object Damage – Blade damage – etc.

Maintenance procedures of gas turbine engines – Trouble shooting and rectification procedures – Component maintenance procedures – Systems maintenance procedures.

Gas turbine testing procedures – test schedule preparation – Storage of Engines – Preservation and de-preservation procedures.

## **UNIT V OVERHAUL PROCEDURES**

**9**

Engine Overhaul procedures – Inspections and cleaning of components – Repairs schedules for overhaul – Balancing of Gas turbine components. Trouble Shooting - Procedures for rectification – Condition monitoring of the engine on ground and at altitude – engine health monitoring and corrective methods.

**TOTAL : 45 PERIODS**

### **TEXT BOOKS:**

1. KROES & WILD, "Aircraft Power plants", 7<sup>th</sup> Edition – McGraw Hill, New York, 1994.
2. A.W. Morley, "Advanced Aero Engine Testing"

### **REFERENCE BOOKS:**

1. TURBOMECA, "Gas Turbine Engines", The English Book Store, New Delhi, 1993.
2. UNITED TECHNOLOGIES PRATT & WHITNEY, "The Aircraft Gas turbine Engine and its Operation", (latest edition) The English Book Store, New Delhi.

**YAE958**

**AVIONICS LABORATORY**

**L T P C  
0 0 3 2**

### **OBJECTIVE**

This laboratory is divided into three parts to train the students to learn about basic digital electronics circuits, programming with microprocessors, design and implementation of data buses in avionics with MIL – Std. 1553B and remote terminal configuration and their importance in different applications in the field of Avionics.

### **LIST OF EXPERIMENTS**

#### **DIGITAL ELECTRONICS**

1. Addition/Subtraction of binary numbers.
2. Multiplexer/ Demultiplexer Circuits.
3. Encoder/Decoder Circuits.
4. Timer Circuits, Shift Registers, Binary Comparator Circuits.

#### **MICROPROCESSORS**

1. Addition and Subtraction of 8-bit and 16-bit numbers.
2. Sorting of Data in Ascending & Descending order.
3. Sum of a given series with and without carry.
4. Greatest in a given series & Multi-byte addition in BCD mode.
5. Interface programming with 4 digit 7 segment Display & Switches & LED's.
6. 16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave by Digital to Analog Converter.

#### **AVIONICS DATA BUSES**

1. Study of Different Avionics Data Buses.
2. MIL-Std – 1553 Data Buses Configuration with Message transfer.
3. MIL-Std – 1553 Remote Terminal Configuration.

**TOTAL : 45 PERIODS**

**OBJECTIVE:**

To introduce the knowledge of both piston and turbine engine test procedures.

1. Testing of magneto timings of a aircraft piston engine
2. Pressure testing of spark plugs.
3. Valve clearance practices of piston engine cylinders.
4. Study of propeller pitch setting mechanism.
5. Study of propeller blade pitch angle measurement
6. Study of compressor in Turbine engine
7. Study of different configuration of Turbine engines
8. Study of engine starting procedures.
9. Ground running of aircraft.
10. Continuity and insulation checks of aircraft engine wiring using test meters

**TOTAL : 45 PERIODS**

**LIST OF EQUIPMENTS:**

(for a batch of 30 students)

Sl.No	Equipments	Qty	Experiments No.
1	Piston Engines	2	1,2,3,4
2	Turbine Engines	2	6,7,8,9
3	Propeller pitch setting stand	1	5
4	Aircraft with serviceable stand	1	1 to 10
5	Precision instruments (Vernier Caliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector and Feeler gauge)	2 each	3,5,8
6	Electrical measurement and check instruments, multimeter etc.	2 each	2,8

**UNIT I****12**

Introduction to location and clamping devices, Definition of Jigs and fixtures. Jigs and Fixtures for use on machine tool, Jigs and fixtures for Welding and Jigs and Fixtures for aircraft assembly. Classification of Jigs and Fixtures Machining Jigs and Fixture, Assembly Jigs and Fixture, Miscellaneous Jigs and Fixtures and Inspection Jigs and Fixtures

**UNIT II MACHINE TOOL JIGS AND FIXTURES****11**

Jigs and Fixture design and applications. Jig bushing, Drilling jig. Sawing and Filing Fixtures, lathe Fixtures, Broaching Fixture, Bopring Fixture, Grinding Fixture and Milling Fixture

**UNIT III ASSEMBLING JIGS AND FIXTURES 11**  
Jigs and fixtures for gas and arc welding assemblies, Jigs and Fixtures for Resistance welding assemblies, Jigs and Fixtures for Riveted and Bolted assemblies, Erection of Assembly jigs. Mechanical Tooling Dock

**UNIT IV INSPECTION JIGS AND FIXTURES 11**  
Inspection of machining Jigs and Fixtures, Interchangeability of Jigs and Fixtures, Universal Jigs and Fixture design. Optical alignment Fixture, Optical Tooling Dock, Miscellaneous Fixtures and Inspection fixtures.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Jigs and Fixture, Grant Hiram, 2006, Tata Mc,Hill, New Delhi.
2. Aircraft Production Toolings- Jigs and Fixture Design and Applications, By Rajagopalan.N & Jankiraman.S, HAL, Bangalore , 1968

**REFERENCE BOOKS:**

1. Elements of Workshop technology, Hajra Choudhary.S.K., 1980, Sulthan Chand & Co., New Delhi

**YAE954 MODELING & SIMULATION L T P C  
3 0 0 3**

**UNIT I INTRODUCTION 9**  
System and its model, simulation, basic nature of simulation, numerical sequential simulation, simulation for engineers and scientist, simulation in soft sciences, simulation for business, simulation of a pure pursuit problem and business inventory problem.

**UNIT II SIMULATION IN CONTINUOUS SYSTEM 9**  
Types of system, continuous system, discrete system, continuous dynamic system and examples, integration formula, Runge-Kutta integration formula, analog versus digital simulation, block diagram, examples of various systems.

**UNIT III SIMULATION IN DISCRETE SYSTEMS 9**  
Fixed time step versus event to event model, random numbers, generation of random numbers, simulating randomness, tests for randomness, frequency test, non uniformly distributed random numbers, inverse transformation method, exponential distribution function, rejection method, normal distribution, multiple sources of randomness, Monte- Carlo computation versus Stochastic simulation

**UNIT IV SIMULATION OF BUSINESS SYSTEMS 9**  
Simulation of queueing systems, queueing theory, simple models, simulation of more general queues, arrival and service pattern, network model of a project, analysis and critical path computation, resource allocation and cost considerations, simple inventory control and forecasting.

**UNIT V SIMULATION LANGUAGES****9**

Classification of simulation languages, types of simulation languages, SIMSCRIPT, GPSS, SIMULA, MATLAB AND SIMULINK, factors in selecting simulation languages.

**TOTAL : 45 PERIODS****TEXT BOOK:**

1. System Simulation with Digital Computer by Narsingh deo, Prentice-Hall of India private Limited, New Delhi, 2001,

**REFERENCE BOOKS :**

1. Tthe art of simulation by Tocher .K.D. Van nostrand co., Princeton, N.J., 1963.
2. Computer simulation model by Smith.J Hafner publishing company, New york, N.Y, 1968.

**YAR952****FLIGHT PERFORMANCE & MEASUREMENTS****L T P C  
3 0 0 3****UNIT I GENERAL****9**

Flight performance of the aircraft along its flight path with defined flight plan, maintenance of altitude, velocity and LLA, Atmospheric conditions for safe flight

**UNIT II TAKE-OFF PERFORMANCE****9**

Take-off performance, take off- load, Minimum velocity estimation for varying load take-off, Minimum runway length estimation for the different aircraft load factor and environment conditions, aborted take-off conditions and safety considerations

**UNIT III CLIMBING AND CRUISING PERFORMANCE****9**

Atmospheric conditions favouring the climbing performance of air craft. Characteristic velocity of aircraft and climb performance chart, Correction factor required for steady climbing performance, earliest level flight performance achievement

**UNIT IV GLIDING AND TURNING PERFORMANCE****9**

Aircraft characteristic on gliding performance, Minimum banking characteristic of the aircraft,

**UNIT V LANDING PERFORMANCE****9**

Landing phases of the aircraft, Safe velocity required for landing approach, ILS for landing support, over shoot management of aircraft landing , rapid taxi runway maneuvering

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Fundamentals of Flight, Shevel, 1989, Prentice Hall
2. Flight Mechanics of High – Performance aircraft, Nguyen X. Vinh,1993, Cambridge Aerospace Series4, Cambridge University Press.
3. Airplane Performance Stability and Control, C.D. Perkins and R.E.Hage,1949, John Wiley & Sons.
4. Elements of Airplane Performance, G.J.J. Ruigrok,1990, Delft University Press, Delft, The Netherlands

**REFERENCE BOOKS:**

1. Airplane flight dynamics and automatic controls, Part I and II, Jan Roskam,1979, Roskam Aviation and Engineering Corporation
2. Design of Machine Elements, M.F.Spott, 6<sup>th</sup> Edition, Prentice-Hall, USA

<b>UNIT I</b>	<b>GENERAL</b>	<b>12</b>
Review of flight mechanics, Dynamic of an aircraft relative to the reference co-ordinate located on the aircraft center of gravity. Forces and moments acting on the aircraft Equilibrium of the forces and moments acting on the aircraft, aircraft equation of motion and aircraft static stability.		
<b>UNIT II</b>	<b>NAVIGATION</b>	<b>11</b>
Basic concepts of navigation process with guidance circumference related to control circumference, Determination of position and motion of an aircraft through measurements of a respective geometric configuration relative to reference.		
<b>UNIT III</b>	<b>CONTROL</b>	<b>11</b>
Basic linear system and classical control theory. Mathematical model representation of dynamic system. Understanding of open and closed loop system, feed back application, Stability analysis, dynamic analysis at frequency domain and time domain. Feed back gain design with root locus method and application of flight control systems.		
<b>UNIT IV</b>	<b>GUIDANCE</b>	<b>11</b>
Primary functions in flight attitude control(auto pilot), Stability augmentation system (SAS), Control Augmentation system (CAS) longitudinal and lateral directional modes of flight. Satellite based navigation concept such as GPS application and the basic concept of inertial navigation, Required Navigation Procedure		

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Avionics Navigation Systems, M.Kayton, W. Fried
2. Flight Mechanics of High – Performance aircraft, Nguyen X. Vinh,1993, Cambridge Aerospace Series4, Cambridge University Press.
3. Understanding GPS Principle and Applications, E.D. Kaplan, Artech House

**REFERENCE BOOKS:**

1. Airplane Performance Stability and Control, C.D. Perkins and R.E.Hage,1949, John Wiley & Sons.

**UNIT I            AIRCRAFT INSTRUMENTATION AND EQUIPMENTS            9**

Requirements for different type of aircraft operations. Viz. day/night/ high altitude/over water etc. Requirement with regard to installation of Cockpit Voice Recorder(CVR), Flight Data Recorder(FDR), Ground Proximity Warning System(GPWS), Traffic Collision Avoidance System(TCAS), Emergency Locator Transmitter(ELT), First aid and Physician kits and their use. Test equipments and its calibration requirements.

**UNIT II            LICENSING OF PERSONNEL            9**

Aircraft Maintenance Engineers, Pilots & Flight Engineers, Categories, condition for issue/ renewal and privileges. Issue renewal of approval, authorization and certificate of competency – Validity and privileges.

**UNIT III          AIRCRAFT MAINTENANCE AND CERTIFICATION            9**

Type of maintenance, defect recording, rectification, analysis, investigation and documentation. Certificates related to maintenance, fitness for flight and special flight permits. Weighment of aircraft and preparation of weight schedule.

**UNIT IV          TEST FLIGHT AND PERFORMANCE EVALUATION            9**

Requirements for test flight, test flight data and evaluation of climb performance. Qualification and experience of pilots carrying out test flight.

**UNIT V          AIRCRAFT OPERATION            9**

Crew Composition, Flight Manual, Documents to be carried, Check list, Minimum Equipments list. Aerodrome & Air traffic services. Airport Fire Station. Aircraft incidents and accidents – reporting and investigation. Requirements on exit row seating in passenger aircraft and operation manual for all operations. Requirement of aero mobile and RTR licence for use and operation of radio equipment.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Aircraft Manual India.
2. C.A.R.Sec – II

**OBJECTIVE**

This laboratory is divided into parts to train the students to learn about basic Aircraft systems, its circuits, and remote control configuration and their importance in different applications in the Aircraft operation and maintenance.

**LIST OF EXPERIMENTS**

1. Study of difference between hydraulic and pneumatic systems and its circuits.
2. Study of system components such as supply sources, seals, regulators and fluid lines etc.
3. Hands on practice of Flaring and bending of fluid lines in aluminum and steel
4. Experiment on Elongation check on control chain
5. Construction of simple Trans –Receiver circuits
6. Calibration of pressure gauges by dead weight tester
7. Study of pressurisation and air conditioning systems in Aircrafts
8. Study of pneumatic and thermal anti icing and de-icing systems
9. Study of fuel supply system, components and their functions
10. Calibration of fuel filling and replenishing of fuel tanks

**TOTAL : 45 PERIODS****LIST OF EQUIPMENTS****(FOR A BATCH OF 30 STUDENTS)**

SL.NO	EQUIPMENTS	QTY	EXPERIMENTS NO.
1	Piston Engine aircraft	1	1,2
2	Turbine Engine aircraft	1	9, 10
3	Aircraft with serviceable stand	1	7,8,9
5	Precision instruments (Vernier Caliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector, Dead weight tester and Feeler gauge)	2 each	3, 4, 6
6	Electrical measurement and check instruments, multimeter etc.	2 each	5

**LIST OF EXPERIMENTS:**

1. Hands on practice of Engine crank shaft alignment check
2. Removal of aero engine cylinder from the crankcase
3. Installation of aero engine cylinder in the crank case
4. Aero engine cylinder compression check
5. Verification of cylinder barrel roundness by using cylinder bore gauge
6. Removal and fitment of CHT gauge
7. Calibration of DR Compass and to find out co-efficient A, B, and C errors (synthetic)
8. Carryout insulation and bonding test with the help of test equipments
9. Serviceability check of aircraft batteries
10. Ground run test of overhauled aircraft

**TOTAL : 45 PERIODS****LIST OF EQUIPMENTS:****(for a batch of 30 students)**

Sl.No	Equipments	Qty	Experiments No.
1	Piston Engine aircraft	1	1,2,10
2	Turbine Engine aircraft	1	10
3	Aircraft with serviceable stand	1	7,8,9
5	Precision instruments (Vernier Caliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector, Dead weight tester and Feeler gauge)	2 each	3, 4, 5, 6
6	Electrical measurement and check instruments, multimeter etc.	2 each	9

**UNIT I GENERAL**

Modeling Techniques and reliability estimation of engineering system and components

**UNIT II STATISTICS AND PROBABILITY****11**

Review of Statistics and probability theory. Reliability concepts and failure rate, reliability test

**UNIT III SYSTEM RELIABILITY****11**

Reliability data analysis, Redundant system reliability and system reliability- availability – maintainability analysis

**UNIT IV DESIGN RELIABILITY****11**

Basic principles of maintenance management and reliability, Design reliability, analyse reliability of a system

**TOTAL : 45 PERIODS****TEXT BOOKS:**

1. Introduction to Reliability Engineering, E.E.Lewis, 1995, John Willey and Sons
2. Reliability for Engineers, Michael Beasley, 1991, McMillan Education Limited, Hongkong

**REFERENCE BOOKS:**

1. Reliability, Maintainability and Risk, by David J. Smith, 1993, Butterworth-Heinemann



**UNIT III      WORK STUDY AND QUALITY CONTROL      9**

Method study- steps and recording, steps to examine method study and ergonomic considerations. Time study and work sampling. Quality control- need and definition, classification of quality control techniques, process capability and variations. Classification of measurement data. Total Quality Management- scope and fundamental factors affecting quality.

**UNIT IV      MAINTENANCE PLANNING      9**

Maintenance objectives, types of maintenance and replacement of machine. Maintenance crew size and simulation of maintenance system. Reliability , reliability improvement and reliability program. Failure modes, effects and analysis. Information system for maintenance management- computerized information system and system design

**UNIT V      MATERIALS MANAGEMENT AND INVENTORY SYSTEM      9**

Material management and its components. Inventory control and inventory decisions. Models of inventory (brief discussion only). Implementation of purchase inventory model. Fixed order quantity and periodic review system. Purchasing management and its aspects. Stores management and accounting

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Production and Operation Management by R. Panneerselvam

**YAR963**

**PROJECT WORK**

**L T P C  
0 0 12 6**

Students in batches not more than four in number are to prepare a project report after carrying out an on the spot study of the activities related to aircraft and its maintenance including operation, based on the knowledge acquired during the course of instructions in the college. A total of 3 weeks will be earmarked during the final semester for this purpose followed by one week for the preparation and submission of the project report. The student shall obtain a certificate for the bonafide work done by him/ her from the organization chosen for the study and submit the same along with the project report.

While the internal assessment of the project report will be made after conducting a Viva-Voce examination of each student, the external examiner appointed by the university will evaluate the report and allot marks accordingly.