ST.PETER'S UNIVERSITY

ST.PETER'S INSTITUTE OF HIGHER EDUCATION AND RESAERCH

Chennai – 600 054.

B.E. (AERONAUTICAL ENGINEERING) PROGRAMME

Regulations and Syllabi

(Effective from 2008)

1. Eligibility:

(1) Candidates who passed the following Examination or any other equivalent Examination there to and who appeared for the entrance test conducted by the University or approved institutions wherever prescribed are eligible for admission to Four Year B.E. (Aeronautical Engineering) Programme.

Higher Secondary Examination with Mathematics, Physics and Chemistry conducted by the Government of Tamil Nadu or its equivalent in the relevant subjects.

(2) Candidates who passed Three Year Diploma in Technical Education in the concerned subject conducted by the Government of Tamil Nadu are eligible for admission to Second Year of Four Year B.E. (Aeronautical Engineering) Programme.

2. Duration: Four Years comprising 8 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. Medium: English is the medium of instruction and examination.

4. Weightage for Continuous and End Assessment: The weightage for Continuous Assessment (CA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. Credit System: Credit system be followed with 18 credits for each semester and each credit is equivalent to 25 hours of effective study provided in the Time Table.

6. Scheme of Examinations

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
108EHT01	Technical English – I	1	25	75	100
108MAT02	Mathematics – I	3	25	75	100
108PHT03	Engineering Physics – I	3	25	75	100
108CYT04	Engineering Chemistry – I	3	25	75	100
108EGT05	Engineering Graphics – I	3	25	75	100
108FCT06	Fundamentals of Computing – I	3	25	75	100
Practical					
108CLP01	Computer Practices Laboratory – I	1	25	75	100
108ELP02	Engineering Practices Laboratory – I	1	25	75	100
	Total	**18**	**200**	**600**	**800**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
208EHT01	Technical English – II	2	25	75	100
208MAT02	Mathematics – II	3	25	75	100
208PHT03	Engineering Physics – II	2	25	75	100
208CYT04	Engineering Chemistry – II	2	25	75	100
208EMT05	Engineering Mechanics	3	25	75	100
208EET06	Basic Electrical & Electronics Engineering	3	25	75	100
Practical					
208CLP01	Computer Practices Laboratory – II	1	25	75	100
208ELP02	Physics & Chemistry Laboratory – II	1	25	75	100
208DMP03	Computer Aided Drafting and Modelling Lab	1	25	75	100
	Total	**18**	**225**	**675**	**900**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
308AET01	Transforms And Partial Differential Equations	3	25	75	100
308AET02	Mechanics of Machines	3	25	75	100
308AET03	Aero Engineering Thermodynamics	3	25	75	100
308AET04	Fluid Mechanics and Machinery	2	25	75	100
308AET05	Solid Mechanics	2	25	75	100
308AET06	Elements of Aeronautics	2	25	75	100
Practical					
308AEP01	Strength of Materials Lab	1	25	75	100
308AEP02	Fluid Mechanics and Machinery Lab	1	25	75	100
308AEP03	Thermodynamics Lab	1	25	75	100
	Total	**18**	**225**	**675**	**900**

VI SEMESTER

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
408AET01	Numerical Methods	3	25	75	100
408AET02	Aerodynamics - I	2	25	75	100
408AET03	Aircraft Systems and Instruments	2	25	75	100
408AET04	Production Technology	2	25	75	100
408AET05	Aircraft Structures - I	3	25	75	100
408AET06	Propulsion-I	2	25	75	100
Practical					
408AEP01	Aircraft Structures Lab - I	1	25	75	100
408AEP02	Aerodynamics Lab	1	25	75	100
408AEP03	Aircraft Component Drawing	1	25	75	100
408AEP04	Manufacturing Technology Lab	1	25	75	100
	Total	**18**	**250**	**750**	**1000**

V SEMESTER

Code No.	COURSE TITLE	Credit	Marks		
THEORY			**CA**	**EA**	**Total**
508AET01	Control Engineering	2	25	75	100
508AET02	Environmental Science and Engineering	2	25	75	100
508AET03	Flight Dynamics	3	25	75	100
508AET04	Aircraft Structures - II	3	25	75	100
508AET05	Aerodynamics - II	3	25	75	100
508AET06	Propulsion II	2	25	75	100
PRACTICAL					
508AEP01	Aircraft Structures Laboratory - II	1	25	75	100
508AEP02	Propulsion Laboratory	1	25	75	100
508AEP03	CAD/CAM Laboratory	1	25	75	100
	TOTAL	**18**	**225**	**675**	**900**

VI SEMESTER

CODE NO.	COURSE TITLE	Credit	Marks		
THEORY			**CA**	**EA**	**Total**
608AET01	Principles of Management	2	25	75	100
608AET02	Finite Element Method	3	25	75	100
608AET03	Experimental stress Analysis	3	25	75	100
608AET04	Wind Tunnel Techniques	3	25	75	100
608AET05	High Temperature Materials	2	25	75	100
608AET06	Aircraft General Engineering and Maintenance Practices	2	25	75	100
PRACTICAL					
608AEP01	Aero Engine Laboratory	1	25	75	100
608AEP02	Aircraft Design Project - I	1	25	75	100
608AEP03	Airframe Laboratory	1	25	75	100
	TOTAL	**18**	**225**	**675**	**900**

VII Semester

CODE NO.	COURSE TITLE	Credit	Marks		
THEORY			**CA**	**EA**	**Total**
708AET01	Total Quality Management	2	25	75	100
708AET02	Avionics	3	25	75	100
708AET03	Computational Fluid Dynamics	3	25	75	100
708AET04	Vibrations and Elements of Aero Elasticity	3	25	75	100
708AET07	Airframe Maintenance and Repair	2	25	75	100
708AET08	Aero Engine Maintenance and Repair	2	25	75	100
PRACTICAL					
708AEP01	Aircraft Design Project - II	1	25	75	100
708AEP02	Aircraft Systems Laboratory	1	25	75	100
708AEP03	Avionics Laboratory	1	25	75	100
	TOTAL	**18**	**225**	**675**	**900**

VIII SEMESTER

CODE NO.	COURSE TITLE	Credit	Marks		
THEORY			**CA**	**EA**	**Total**
808AET01	Composite Materials and Structures	3	25	75	100
808AET04	Rockets and Missiles	4	25	75	100
808AET08	Engine Systems and Controls	4	25	75	100
PRACTICAL					
808AEP01	Project Work	7	25	65	100
	Viva voce			10	
	TOTAL	**18**	**100**	**300**	**400**

LIST OF ELECTIVE COURSES

Code No.	Course Title
Elective - I	
608AET06	Aircraft General Engineering and Maintenance Practices
608AET07	Theory of Elasticity
608AET08	Space Mechanics
608AET09	Heat Transfer
Elective – II & III	
708AET05	Helicopter Theory
708AET06	Industrial Aerodynamics
708AET07	Airframe Maintenance and Repair
708AET08	Aero Engine Maintenance and Repair
708AET09	Theory of Plates and Shells
708AET10	Fatigue and Fracture
Elective – IV & V	
808AET02	Hypersonic Aerodynamics
808AET03	Experimental Aerodynamics
808AET04	Rockets and Missiles
808AET05	Structural Dynamics
808AET06	Air Traffic Control and Planning
808AET07	Aircraft Production Planning and Control
808AET08	Engine Systems and Controls

7. Passing Requirements: The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it its specifically mentioned in the scheme of Examination.

8. Grading System: Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\ C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

Part B: 5 question with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

Registrar

10. Syllabus

108EHT01 - TECHNICAL ENGLISH – I

AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
1. To help students develop listening skills for academic and professional purposes.
2. To help students acquire the ability to speak effectively in English in real-life situations.
3. To inculcate reading habit and to develop effective reading skills.
4. To help students improve their active and passive vocabulary.
5. To familiarize students with different rhetorical functions of scientific English.
6. To enable students write letters and reports effectively in formal and business situations.

UNIT I
General Vocabulary - changing words from one form to another - Adjectives, comparative adjectives – Adverbs - Active and passive voice – Tenses - simple present, present continuous - Adverb forms – Nouns – compound nouns - Skimming and scanning - Listening and transfer of information – bar chart, flowchart - Paragraph writing, description – Discussing as a group and making an oral report on the points discussed, conversation techniques - convincing others.

Suggested activities:
1. Matching words & meanings - Using words in context – Making sentences.
2. Changing sentences from active to passive voice & vice versa.
3. Skimming, cloze exercises, exercises transferring information from text to graphic form – bar charts, flow charts.
4. Writing descriptions using descriptive words & phrases, and technical vocabulary.
5. Role play, conversation exercises, discussions, oral reporting exercises
   Any other related relevant classroom activity

UNIT II
Vocabulary – prefixes & suffixes – simple past tense - Spelling and punctuation – 'wh' Question forms - Scanning, inference - Listening & note-taking - Paragraph writing - comparison and contrast - Creative thinking and speaking.

Suggested Activities:
1. a. Vocabulary actiivities using prefixes and suffixes.
   b. Exercises using questions – asking & answering questions.
2. Scanning the text for specific information
3. Listening guided note-taking - Writing paragraphs using notes, giving suitable headings and subheadings for paragraphs. Using expressions of comparison and contrast.
4. Discussion activities and exploring creative ideas.
   Any other related relevant classroom activity

UNIT III
Tenses - simple past, simple future and past perfect - Reading in Context -Listening & note-taking – single line – Definitions – sequencing of sentences – instruction - Persuasive speaking.

Suggested activities:
1. a. Providing appropriate context for the use of tenses
2. Listening and note-taking
3. (a) Writing sentence definitions, instructions
   (b) Identifying the discourse links and sequencing jumbled sentences / writing instructions.
4. Speaking exercises, discussions, role play exercises using explaining, convincing and persuasive strategies

Any other related relevant classroom activity

UNIT IV

Modal verbs and Probability – Concord subject verb agreement – Correction of errors - Cause and effect expressions – Extended Definition - Speaking about the future plans.

Suggested activities:

1. a. Making sentences using modal verbs to express probability
   b. Gap filling using relevant grammatical form of words.
2. Writing extended definitions
3. Speaking - role play activities, discussions, extempore speaking exercises speculating about the future.
4. Any other related relevant classroom activity

UNIT V

'If' conditionals – Gerunds - Intensive reading - Speaking – Presentation of problems & solutions - Itinerary – planning for an industrial visit - Formal Letter writing – Letter to the editor, invititation letter, accepting, declining letter and permission letter.

Suggested activities:

1. a) Sentence completion exercises using 'If' conditionals.
   b) Gap filling exercises using gerunds and present participle forms
2. Reading comprehension exercises.
3. Role play, discussion, debating and speaking activities for stating, discussing problems and suggesting solutions.
4. Planning a tour, Writing a travel itinerary. Writing letters to officials and to the editor in formal/official contexts.
   Any other related relevant classroom activity

TEXT BOOK:

1. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 1 – 4 (Resources, Energy, Computer, Transport)

REFERENCES:

1. Meenakshi Raman and Sangeeta Sharma, 'Technical Communication English skills for Engineers', Oxford University Press, 2008.
2. Andrea, J. Rutherford, 'Basic Communication Skills for Technology', Second Edition, Pearson Education, 2007.
3.

Extensive Reading:

A.P.J.Abdul Kalam with Arun Tiwari, 'Wings of Fire' An Autobiography, University Press (India) Pvt. Ltd.,1999, 30th Impression 2007.

NOTE:

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

108MAT02 - MATHEMATICS – I

UNIT I MATRICES

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

UNIT III DIFFERENTIAL CALCULUS

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor's expansion – Maxima and Minima – Method of Lagrangian multipliers.

UNIT V MULTIPLE INTEGRALS Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates – Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral

TEXT BOOK:

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Third edition, Laxmi Publications(p) Ltd.,(2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 7th Edition, Pearson Education, (2007).
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

108PHT03 - ENGINEERING PHYSICS – I

UNIT I ULTRASONICS

Introduction – Production – magnetostriction effect - magnetostriction generator- piezoelectric effect - piezoelectric generator- Detection of ultrasonic waves properties – Cavitations - Velocity measurement – acoustic grating - Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications - Sonograms

UNIT II LASERS

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einsteins A and B coeffcients - derivation. Types of lasers – He-Ne, CO_2, Nd-YAG, Semiconductor lasers (homojunction & heterojunction) Qualitative Industrial Applications - Lasers in welding, heat treatment, cutting – Medical applications - Holography (construction & reconstruction).

UNIT III FIBER OPTICS & APPLICATIONS

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Double crucible technique of fibre drawing - Splicing, Loss in optical fibre – attenuation, dispersion, bending - Fibre optical communication system (Block diagram) - Light sources - Detectors - Fibre optic sensors – temperature & displacement - Endoscope.

UNIT IV QUANTUM PHYSICS

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

UNIT V CRYSTAL PHYSICS

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – NaCl, ZnS, diamond and graphite structures – Polymorphism and allotropy - Crystal defects – point, line and surface defects- Burger vector.

TEXT BOOKS:

1. R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi(2003)
2. M.N. Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics', S.Chand and company, Ltd., New Delhi, 2005.

REFERENCES:

1. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (2007)
2. Rajendran, V and Marikani A, 'Engineering Physics' Tata McGraw Hill Publications Ltd, III Edition, New Delhi, (2004).
3. Palanisamy, P.K., 'Engineering Physics' Scitech publications, Chennai, (2007).
4. Jayakumar. S, 'Engineering Physics', R.K. Publishers, Coimbatore, (2003).
5. Chitra Shadrach and Sivakumar Vadivelu, 'Engineering Physics', Pearson Education, New Delhi, (2007).

108CYT04 - ENGINEERING CHEMISTRY – I

AIM

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES

- The student should be conversant with the principles water characterization and treatment of potable and industrial purposes.
- Principles of polymer chemistry and engineering applications of polymers
- Industrial applications of surface chemistry
- Conventional and non-conventional energy sources and energy storage devices and Chemistry of engineering materials

UNIT I WATER TECHNOLOGY

Characteristics – alkalinity – types of alkalinity and determination – hardness – types and estimation by EDTA method (problems); Domestic water treatment – disinfection methods (Chlorination, ozonation. UV treatment) – Boiler feed water – requirements – disadvantages of using hard water in boilers – internal conditioning (phosphate, calgon and carbonate conditioning methods) – external conditioning – demineralization process – desalination and reverse osmosis.

UNIT II POLYMERS AND COMPOSITES

Polymers-definition – polymerization – types – addition and condensation polymerization – free radical polymerization mechanism – Plastics, classification – preparation, properties and uses of PVC, Teflon, polycarbonate, polyurethane, nylon-6,6, PET- Rubber -vulcanization of rubber, synthetic rubbers – buty1 rubber, SBR, Composites – definition, types polymer matrix composites – FRP only.

UNIT III SURFACE CHEMISTRY

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms – adsorption of solutes from solution – role of adsorbents in catalysis, ion-exchange adsorption and pollution abatement.

UNIT IV NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES

Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only) – breeder reactor – solar energy conversion – solar cells – wind energy – fuel cells – hydrogen – oxygen fuel cell – batteries – alkaline batteries – lead–acid, nickel–cadmium and lithium batteries.

UNIT V ENGINEERING MATERIALS

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnesite and zirconia bricks, Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrication, liquid lubricants, - properties – viscosity index, flash and fire points, cloud and pour points, oilyness) – solid lubricants – graphite and molybdenum sulphide. Nanomaterials – introduction to nanochemistry – carbon nanotubes and their applications

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S. Dara "A text book of engineering chemistry" S.Chand & Co.Ltd., New Delhi (2006).

REFERENCES:

1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

108EGT05 - ENGINEERING GRAPHICS

AIM
To develop graphic skills in students.

OBJECTIVES
To develop in students graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

Concepts and conventions (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING

Curves used in engineering practices:
Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:
Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES
Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III PROJECTION OF SOLIDS
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS
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 method.

TEXT BOOKS:

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46th Edition, (2003).

REFERENCES:

1. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
5. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).
6. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).
7. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. Whenever the total number of candidates in a college exceeds 150, the University Examination in that college will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.

108FCT06 - FUNDAMENTALS OF COMPUTING AND PROGRAMMING

AIM :

To provide an awareness to Computing and Programming

OBJECTIVES :

- To enable the student to learn the major components of a computer system
- To know the correct and efficient ways of solving problems
- To learn to use office automation tools
- To learn to program in C

UNIT I INTRODUCTION TO COMPUTERS

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

UNIT II COMPUTER SOFTWARE

Computer Software –Types of Software – Software Development Steps – Internet Evolution - Basic Internet Terminology – Getting connected to Internet Applications.

UNIT III PROBLEM SOLVING AND OFFICE APPLICATION SOFTWARE

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudocode -Application Software Packages- Introduction to Office Packages (not detailed commands for examination).

UNIT IV INTRODUCTION TO C

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

UNIT V FUNCTIONS AND POINTERS

Handling of Character Strings – User-defined Functions – Definitions – Declarations - Call by reference – Call by value – Structures and Unions – Pointers – Arrays – The Preprocessor – Developing a C Program : Some Guidelines

TEXT BOOKS:

1. Ashok.N.Kamthane," Computer Programming", Pearson Education (India) (2008).
2. Behrouz A.Forouzan and Richard.F.Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks-Cole Thomson Learning Publications, (2007).

REFERENCES:

1. Pradip Dey, Manas Ghoush, "Programming in C", Oxford University Press. (2007).
2. Byron Gottfried, "Programming with C", 2nd Edition, (Indian Adapted Edition), TMH publications, (2006).
3. Stephen G.Kochan, "Programming in C", Third Edition, Pearson Education India, (2005).
4. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc., (2005).
5. E.Balagurusamy, "Computing fundamentals and C Programming", Tata McGraw-Hill Publishing Company Limited, (2008).
6. S.Thamarai Selvi and R.Murugan, "C for All", Anuradha Publishers, (2008).

108CLP01 - COMPUTER PRACTICE LABORATORY – I

LIST OF EXERCISES

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.

Simple C Programming *

9. Data types, Expression Evaluation, Condition Statements.
10. Arrays
11. Structures and Unions
12. Functions

* For programming exercises Flow chart and pseudocode are essential

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

Hardware

☐LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
☐Printers – 3 Nos.

Software

☐OS – Windows / UNIX Clone
☐Application Package – Office suite
☐Compiler – C

108ELP02 - ENGINEERING PRACTICES LABORATORY

OBJECTIVES

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

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

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

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.

(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

REFERENCES:

1. K.Jeyachandran, S.Natarajan & S, Balasubramanian, "A Primer on Engineering Practices Laboratory", Anuradha Publications, (2007).
2. T.Jeyapoovan, M.Saravanapandian & S.Pranitha, "Engineering Practices Lab Manual", Vikas Puplishing House Pvt.Ltd, (2006)
3. H.S. Bawa, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, (2007).
4. A. Rajendra Prasad & P.M.M.S. Sarma, "Workshop Practice", Sree Sai Publication, (2002).
5. P.Kannaiah & K.L.Narayana, "Manual on Workshop Practice", Scitech Publications, (1999).

SEMESTER EXAMINATION PATTERN

The Laboratory examination is to be conducted for Group A & Group B, allotting 90 minutes for each group, with a break of 15 minutes. Both the examinations are to be taken together in sequence, either in the FN session or in the AN session. The maximum marks for Group A and Group B lab examinations will be 50 each, totaling 100 for the Lab course. The candidates shall answer either I or II under Group A and either III or IV under Group B, based on lots.

Engineering Practices Laboratory
List of equipment and components
(For a Batch of 30 Students)

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

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. Power Tool: Angle Grinder	2 Nos
9. 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	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

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

PHYSICS LABORATORY – I

LIST OF EXPERIMENTS

1. (a) Particle size determination using Diode Laser
   (b) Determination of Laser parameters – Wavelength, and angle of divergence.
   (c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum – spectrometer grating.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of Hysteresis loss in a ferromagnetic material

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

CHEMISTRY LABORATORY – I

LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Determination of DO in water (Winkler's method)
4. Estimation of Chloride in Water sample (Argentometric)
5. Estimation of alkalinity of Water sample
6. Determination of molecular weight and degree of polymerization using viscometry.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

II SEMESTER

208EHT01 - TECHNICAL ENGLISH II

AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
1. To help students develop listening skills for academic and professional purposes.
2. To help students acquire the ability to speak effectively in English in real-life situations.
3. To inculcate reading habit and to develop effective reading skills.
4. To help students improve their active and passive vocabulary.
5. To familiarize students with different rhetorical functions of scientific English.
6. To enable students write letters and reports effectively in formal and business situations.

UNIT I
Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:
1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II
Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication -Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

Suggested activities:
1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III
Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .

Suggested activities:
1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object –verb / object – noun)
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

UNIT IV

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

UNIT V

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TEXT BOOK:

1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

REFERENCES:

1. P. K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication Skills', Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson Education, 2007.

Extensive Reading:

1. Robin Sharma**, '**The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

Note:

The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

208MAT02 - MATHEMATICS – II

UNIT I ORDINARY DIFFERENTIAL EQUATIONS

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelpipeds.

UNIT III ANALYTIC FUNCTIONS Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT IV COMPLEX INTEGRATION

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

UNIT V LAPLACE TRANSFORM Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions.

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TEXT BOOK:

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (p) Ltd., (2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics",Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3rd Edition, Pearson Education, (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7th Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

208PHT03 - ENGINEERING PHYSICS – II

UNIT I CONDUCTING MATERIALS

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications – magnetic recording and readout – storage of magnetic data – tapes, floppy and magnetic disc drives.

Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V MODERN ENGINEERING MATERIALS

Metallic glasses: preparation, properties and applications.

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

Nanomaterials: synthesis –plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling - properties of nanoparticles and applications.

Carbon nanotubes: fabrication – arc method – pulsed laser deposition – chemical vapour deposition - structure – properties and applications.

TEXT BOOKS:

1. Charles Kittel ' Introduction to Solid State Physics', John Wiley & sons, 7th edition, Singapore (2007)
2. Charles P. Poole and Frank J.Ownen, 'Introduction to Nanotechnology', Wiley India(2007) (for Unit V)

REFERENCES:

1. Rajendran, V, and Marikani A, 'Materials science'Tata McGraw Hill publications, (2004) New delhi.
2. Jayakumar, S. 'Materials science', R.K. Publishers, Coimbatore, (2008).
3. Palanisamy P.K, 'Materials science', Scitech publications(India) Pvt. LTd., Chennai, second Edition(2007)
4. M. Arumugam, 'Materials Science' Anuradha publications, Kumbakonam, (2006).

208CYT04 - ENGINEERING CHEMISTRY – II

AIM

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES

- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

UNIT I ELECTROCHEMISTRY

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox - Fe^{2+} vs dichromate and precipitation – Ag^{+} vs CI^{-} titrations) and conduct metric titrations (acid-base – HCI vs, NaOH) titrations,

UNIT II CORROSION AND CORROSION CONTROL

Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

UNIT III FUELS AND COMBUSTION

Calorific value – classification – Coal – proximate and ultimate analysis metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – catalytic cracking and methods-knocking – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG, Flue gas analysis – Orsat apparatus – theoretical air for combustion.

UNIT IV PHASE RULE AND ALLOYS

Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT V ANALYTICAL TECHNIQUES

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).

REFERENCES:

1. B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
2. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).

208EMT05 - ENGINEERING MECHANICS

OBJECTIVE

At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I BASICS & STATICS OF PARTICLES

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – 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

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III PROPERTIES OF SURFACES AND SOLIDS

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

UNIT IV DYNAMICS OF PARTICLES Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction.

Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TEXT BOOK:

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).

REFERENCES:

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

208CCT05 - CIRCUIT THEORY
(Common to EEE, EIE and ICE Branches)

UNIT I BASIC CIRCUITS ANALYSIS

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS:

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS

Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V ANALYSING THREE PHASE CIRCUITS

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Tata McGraw Hill publishers, 6th edition, New Delhi, (2002).
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, (2007).

REFERENCES:

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi (2001).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003)

208EDT05 - ELECTRIC CIRCUITS AND ELECTRON DEVICES
(For ECE, CSE, IT and Biomedical Engg. Branches)

UNIT I CIRCUIT ANALYSIS TECHNIQUES

Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

UNIT II TRANSIENT RESONANCE IN RLC CIRCUITS

Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

UNIT III SEMICONDUCTOR DIODES

Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

UNIT IV TRANSISTORS

Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V SPECIAL SEMICONDUCTOR DEVICES
(Qualitative Treatment only)

Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

TEXT BOOKS:

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata McGraw Hill, (2001)
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).

REFERENCES:

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis",Tata McGraw Hill, 6th Edition, 2002.
3. J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits",Tata McGraw Hill, 2nd Edition, 2008.

208EET06 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common to branches under Civil, Mechanical and Technology faculty)

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TEXT BOOKS:

1. V.N. Mittle "Basic Electrical Engineering",Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering",Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, (2002).
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, (2003).

208CMT06 BASIC CIVIL & MECHANICAL ENGINEERING
(Common to branches under Electrical and I & C Faculty)

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

UNIT II BUILDING COMPONENTS AND STRUCTURES

Foundations: Types, Bearing capacity – Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV I C ENGINES

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

REFERENCES:

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering",Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. (1999).
3. Seetharaman S. "Basic Civil Engineering", Anuradha Agencies, (2005).
4. Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).
5. Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000).

208CLP01 - COMPUTER PRACTICE LABORATORY – II

LIST OF EXPERIMENTS

1. UNIX COMMANDS

Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING

Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX

Dynamic Storage Allocation-Pointers-Functions-File Handling

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

☐1 UNIX Clone Server
☐33 Nodes (thin client or PCs)
☐Printer – 3 Nos.

Software

☐OS – UNIX Clone (33 user license or License free Linux)
☐Compiler - C

208PCP02 - PHYSICS LABORATORY – II

LIST OF EXPERIMENTS

1. Determination of Young's modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
4. Determination of viscosity of liquid – Poiseuille's method.
5. Spectrometer dispersive power of a prism.
6. Determination of Young's modulus of the material – uniform bending.
7. Torsional pendulum – Determination of rigidity modulus.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

CHEMISTRY LABORATORY – II

LIST OF EXPERIMENTS

1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using $BaCl_2$ vs Na_2SO_4
4. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

208DMP03 - COMPUTER AIDED DRAFTING AND MODELING LABORATORY

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

List of Equipments for a batch of 30 students:

1. Pentium IV computer or better hardware, with suitable graphics facility -30 No.
2. Licensed software for Drafting and Modeling. – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 No.

208ELP03 - ELECTRICAL CIRCUIT LABORATORY
(Common to EEE, EIE and ICE)

LIST OF EXPERIMENTS

1. Verification of ohm's laws and kirchoff's laws.
2. Verification of Thevemin's and Norton's Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits.

208CDP03 CIRCUITS AND DEVICES LABORATORY

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET
11. Characteristics of Diac and Triac.
12. Characteristics of Photodiode and Phototransistor.

SEMESTER III

308AET01 - TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches)

OBJECTIVES

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differtial Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

1. FOURIER SERIES

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identify – Harmonic Analysis.

2. FOURIER TRANSFORMS

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

3. PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

4. APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

5. Z -TRANSFORMS AND DIFFERENCE EQUATIONS

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z-transform.

TEXT BOOKS

1. Grewal, B.S, 'Higher Engineering Mathematics' 40th Edition, Khanna publishers, Delhi, (2007)

REFERENCES

1. Bali.N.P and Manish Goyal 'A Textbook of Engineering Mathematics', Seventh Edition, Laxmi Publications(P) Ltd. (2007)
2. Ramana.B.V. 'Higher Engineering Mathematics' Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2007).
4. Erwin Kreyszig 'Advanced Engineering Mathematics', Eighth edition-Wiley India (2007).

308AET02 - MECHANICS OF MACHINES
(Common to Automobile and Aeronautical)

OBJECTIVE

To expose the students the different mechanisms, their method of working, Forces involved and consequent vibration during working

1. MECHANISMS

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

2. FRICTION

Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

3. GEARING AND CAMS

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque - Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

4. BALANCING

Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method

5. VIBRATION 9+3

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi rotor systems – Geared shafts – Critical speed of shaft.

TEXT BOOKS

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co, New Delhi,2004.
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.

REFERENCES

1. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

308AET03 - AERO ENGINEERING THERMODYNAMICS

OBJECTIVE

To give a brief background of application of various laws of thermodynamics and its application in heat transfer, refrigeration and air-conditioning, jet propulsion system.

1. BASIC THERMODYNAMICS

Systems, Zeroth Law, First Law - Heat and work transfer in flow, Second law, Clausius statement - concept of entropy entropy change in non-flow processes.

2. AIR CYCLES

Otto, Diesel, Dual combustion and Brayton combustion cycles – Air standard efficiency - Mean effective pressure – Actual and theoretical PV diagrams of two stroke and four stroke IC Engines.

3. THERMODYNAMICS OF ONE DIMENSIONAL FLUID FLOW

Application of continuity, momentum and energy equations- Rankine cycle - Isentropic flow of ideal gases through nozzles - Simple jet propulsion system - Thrust rocket motor – Specific impulse.

4. REFRIGERATION AND AIR CONDITIONING

Principles of refrigeration, Air conditioning - Heat pumps - Vapour compression - Vapour absorption types - Coefficient of performance, Properties of refrigerants.

5. AIR COMPRESSORS

Classification and working principle of compressors (Descriptive Treatment). Isothermal and Isentropic efficiency of air compressors.

TEXT BOOKS

1. Rathakrishnan, E, "Fundamentals of Engineering Thermodynamics", Prentice – Hall, India, 2000
2. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hills Co., Ltd., Seventh Edn., 1993
3. Yunus A.Cengal. "Thermodynamics an Engineering Approach", Tata McGraw-Hill Co. Ltd., 3rd Edition, 2002.

REFERENCES

1. Mayhew, A. and Rogers, B., "Engineering Thermodynamics", Longman Green & Co. Ltd., London, E.L.B.S. Edition, 1990.
2. Van Wylen, G.J. and Sonntag, R.E., "Fundamentals of Classical Thermodynamics (S.I.Version)", Second Edition, 1986.
3. Bacon, D.H., "Engineering Thermodynamics", Butterworth & Co., London, 1989.
4. Saad, M.A., "Thermodynamics for Engineers", Prentice-Hall of India Pvt. Ltd., 1989.
5. Reynolds, "Thermodynamics", Int. Student Edn., McGraw-Hill Book Co., Ltd., 1990

308AET04 - FLUID MECHANICS AND MACHINERY
(Common to Aeronautical, Mechanical, Automobile & Production)

OBJECTIVES:

The student is introduced to the mechanics of fluids through a thorough understanding of the properties of the fluids. The dynamics of fluids is introduced through the control volume approach which gives an integrated under standing of the transport of mass, momentum and energy.
The applications of the conservation laws to flow though pipes and hydraulics machines are studied

I. INTRODUCTION

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equiation, energy equation, momentum equation and moment of momentum equation.

II. FLOW THROUG CIRCULAR CONDUITS

Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equaition. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.

III. DIMENSIONAL ANALYSIS

Dimension and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters.

IV. ROTO DYNAMIC MACHINES

Homologus units. Specific speed. Elementary cascade theory. Theory of turbo machines. Euler's equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines. Centrifugal pumps, turbines, performance curves for pumps and turbines.

V. POSITIVE DISPLACEMENT MACHINES

Recriprocating pumps, Indicator diagrams, Work saved by air vessels. Rotory pumps. Classification. Working and performance curves.

TEXT BOOKS:

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

REFERENCES:

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
2. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

308AET05 - SOLID MECHANICS

OBJECTIVE

To give brief descriptions on the behaviour of materials due to axial, bending and torsional and combined loads.

1. BASICS AND AXIAL LOADING

Stress and Strain – Hooke's Law – Elastic constants and their relationship– Statically determinate cases - statically indeterminate cases –composite bar. Thermal Stresses – stresses due to freely falling weight.

2. STRESSES IN BEAMS

Shear force and bending moment diagrams for simply supported and cantilever beams-Bending stresses in straight beams-Shear stresses in bending of beams with rectangular, I & T etc cross sections-beams of uniform strength

3. DEFLECTION OF BEAMS

Double integration method – McCauley's method - Area moment method – Conjugate beam method-Principle of super position-Castigliano's theorem and its application

4. TORSION

Torsion of circular shafts - shear stresses and twist in solid and hollow circular shafts – closely coiled helical springs.

5. BI AXIAL STRESSES

Stresses in thin circular cylinder and spherical shell under internal pressure – volumetric Strain. Combined loading – Principal Stresses and maximum Shear Stresses - Analytical and Graphical methods.

TEXT BOOKS

1. Nash William – "Strength of Materials", TMH, 1998
2. Timoshenko.S. and Young D.H. – "Elements of strength materials Vol. I and Vol. II"., T. Van Nostrand Co-Inc Princeton-N.J. 1990.

REFERENCES

1. Dym C.L. and Shames I.H. – "Solid Mechanics", 1990.

308AET06 - ELEMENTS OF AERONAUTICS

OBJECTIVE

To introduce the basic concepts of aerospace engineering and the current developments in the field.

1. AIRCRAFT CONFIGURATIONS

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

2. 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.

3. INTRODUCTION TO AERODYNAMICS

Aerodynanic forces on aircraft – classification of NACA aerofoils, aspect ratio, wing loading, Mach number,centre of pressure and aerodynamic centre-aerofoil characteristics-lift, drag curves.

4. INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS

General types of construction, Monocoque, semi-monocoque. Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

5. 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

TEXT BOOKS

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

REFERENCE

1. Kermode, A.C., "Flight without Formulae", McGraw-Hill, 1997.

308AEP01 - STRENGTH OF MATERIALS LABORATORY

OBJECTIVE

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

LIST OF EXPERIMENTS

1. Brinell Hardness test
2. Rockwell Hardness test
3. Tension test
4. Torsion test
5. Izod Impact test
6. Charpy Impact test
7. Reverse plate bending Fatigue test
8. Rotating Beam Fatigue test
9. Testing of springs
10. Block Compression Test

LIST OF EQUIPMENTS
(for a batch of 30 students)

Sl.No	Details of Equipments	Qty Required	For Experiments
1.	Hardness Testing Machine	1	1, 2
2.	Universal Testing Machine	1	1, 2, 3, 9, 10
3.	Impact Testing Machine	1	5, 6
4.	Fatigue tester- Rotating Beam	1	8
5.	Fatigue tester –Reverse plate bending	1	7

308AEP02 - FLUID MECHANICS AND MACHINERY LABORATORY
(Common to Aeronautical, Automobile, Mech & Prod)

OBJECTIVE

To study the flow measurement and the performance of fluid machinery

LIST OF EXPERIMENTS

1. Calibration of venturimeter
2. Pressure measurement with pitot static tube
3. Determination of pipe flow losses.
4. Verification of Bernoulli's theorem
5. Flow visualization by Heleshaw apparatus
6. Performance test on centrifugal pumps
7. Performance test on reciprocating pumps
8. Performance test on piston wheel turbine
9. Performance test on Francis turbine
10. Determination of Viscosity of a Fluid

LIST OF EQUIPMENTS
(for a batch of 30 students)

Sl.No	Details of Equipments	Qty Req.	Experiment No.
1.	Venturimeter setup	1	1,3
2.	Pipe friction set up	1	3
3.	Pitot tube set up	1	2,4
4.	Jet pump	1	6
5.	Submersible pump	1	6
6.	Centrifugal pump	1	6
7.	Reciprocating pump	1	7
8.	Pelton wheel turbine and Francis turbine	1	8,9
9.	Viscosity Meter	1	10
10.	Hele-shaw apparatus	1	5

308AEP03 - THERMODYNAMICS LABORATORY

OBJECTIVE

To enhance the basic knowledge in applied thermodynamics

LIST OF EXPERIMENTS

1. Performance test on a 4-stroke engine
2. Valve timing of a 4 – stroke engine and port timing of a 2 stroke engine
3. Determination of effectiveness of a parallel flow heat exchanger
4. Determination of effectiveness of a counter flow heat exchanger
5. Determination of heating value of a fuel
6. COP test on a vapour compression refrigeration test rig
7. COP test on a vapour compression air-conditioning test rig
8. Determination of specific heat of solid
9. Determination of Thermal Conductivity of solid.
10. Determination of Thermal Resistance of a Composite wall.

LIST OF EQUIPMENTS
(for a batch of 30 students)

Sl.No	Details of Equipments	Qty Req.	Experiment No.
1.	4 stroke twin cylinder diesel engine	1	1
2.	Cut section model of 4 stroke diesel engine and cut section model of 2 stroke petrol engine	1	2
3.	Parallel and counter flow heat exchanger test rig	1	3,4
4.	Bomb Calorimeter	1	5
5.	Vapour compression refrigeration test rig	1	6
6.	Vapour compression air-conditioning test rig	1	7
7.	Conductive Heat Transfer set up	1	9
8.	Composite wall	1	10

SEMESTER IV

408AET01 - NUMERICAL METHODS
(Common to Civil, Aero & EEE)

AIM

With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science, engineering and technology. This course gives a complete procedure for solving different kinds of problems occur in engineering numerically.

OBJECTIVES

At the end of the course, the students would be acquainted with the basic concepts in numerical methods and their uses are summarized as follows:

The roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.

When huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.

The numerical differentiation and integration find application when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.

Since many physical laws are couched in terms of rate of change of one/two or more independent variables, most of the engineering problems are characterized in the form of either nonlinear ordinary differential equations or partial differential equations. The methods introduced in the solution of ordinary differential equations and partial differential equations will be useful in attempting any engineering problem.

1. SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS

Solution of equation –Fixed point iteration: x=g(x) method - Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordon method– Iterative method - Gauss-Seidel method - Inverse of a matrix by Gauss Jordon method – Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

2. INTERPOLATION AND APPROXIMATION

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

3. NUMERICAL DIFFERENTIATION AND INTEGRATION

Differentiation using interpolation formulae –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulae – Double integrals using trapezoidal and Simpsons's rules.

4. INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

Single step methods: Taylor series method – Euler method for first order equation – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

5. BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

TEXT BOOKS

1. Veerarjan, T and Ramachandran, T. 'Numerical methods with programming in 'C' Second Editiion, Tata McGraw-Hill Publishing.Co.Ltd. (2007).
2. Sankara Rao K, 'Numerical Methods for Scientisits and Engineers' – 3rd editiion Printice Hall of India Private Ltd, New Delhi, (2007).

REFERENCE BOOKS

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004

408AET02 - AERODYNAMICS – I

OBJECTIVE

To understand the behaviour of airflow over bodies with particular emphasis on airfoil sections in the incompressible flow regime.

1. REVIEW OF BASIC FLUID MECHANICS

Continuity, momentum and energy equations.

2. TWO DIMENSIONAL FLOWS

Basic flows – Source, Sink, Free and Forced vortex, uniform parallel flow. Their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows.

3. GENERATION OF LIFT

Kutta Joukowski's theorem. Kutta condition. Blasius theorem.

4. AIRFOIL AND WING THEORY

Joukowski, Karman - Trefftz, Profiles - Thin aerofoil theory and its applications. Vortex line, Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations.

5. VISCOUS FLOW

Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum thickness, Flow over a flat plate, Blasins solution.

TEXT BOOKS

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998.

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 1985.
3. Clancey, L.J., "Aerodynamics", Pitman, 1986

408AET03 - AIRCRAFT SYSTEMS AND INSTRUMENTATION

OBJECTIVE

To describe the principle and working of aircraft systems and instruments

1. AIRPLANE CONTROL SYSTEMS

Conventional Systems - fully powered flight controls - Power actuated systems – Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology,

2. AIRCRAFT SYSTEMS

Hydraulic systems - Study of typical workable system - components - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification

3. ENGINE SYSTEMS

Fuel systems for Piston and jet engines, - Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

4. AUXILIARY SYSTEM

Basic Air cycle systems - Vapour Cycle systems, Evaporative vapour cycle systems - Evaporative air cycle systems - Fire protection systems, Deicing and anti icing systems.

5. AIRCRAFT INSTRUMENTS

Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators – TAS, EAS- Mach Meters - Altimeters - Principles and operation - Study of various types of engine instruments - Tachometers - Temperature gauges - Pressure gauges - Operation and Principles.

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
2. "General Hand Books of Airframe and Powerplant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administation, The English Book Store, New Delhi1995.

REFERENCES

1. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
3. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.

408AET04 - PRODUCTION TECHNOLOGY
(Common to Aeronautical & Automobile)

OBJECTIVE

The components such a piston, connecting rod, crankshaft, engine block, front axle, frame, body etc., are manufactured by various types of production processes involving casting, welding, machining, metal forming, powder metallurgy, etc. hence Engineering students must study this course production technology.

1. CASTING

Casting types, procedure to make sand mould, types of core making, moulding tolls, machine moulding, special moulding processes-co_2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects.

2. WELDING

Classification of welding processes. Principles of Oxyacetylene gas welding. A.C. metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermic welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

3. MACHIINING

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines.

General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma are machining, Electron beam machining and Laser beam machining.

4. FORMING AND SHAPING OF PLASTICS

Types of plastics-characteristics of the forming and shaping processes-Moulding of Thermoplastics-working principles and typical applications of Injection moulding-Plunger and screw machines-Blow moulding-Rotational moulding-Film moulding-Extrusion-typical industrial applications-Thermoforming-processing of thermosets-working principles and typical applications-compression moulding-Transfer moulding-Bonding of thermoplastics-Fusion and solvent methods-Induction and Ultrasonic methods.

5. METAL FORMING AND POWDER METALLURGY

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy-Principal steps involved advantages. Disadvantages and limitations of powder metallurgy.

TEXT BOOK:

1. Harija choudry, Elements of workshop Technology, vol. I and II Media promoters and publishers pvt., Ltd., Mumbai, 2001.

REFERENCES:

1. R. K. Jain and S. C. Gupta, production Technology, Khanna Publishers. 16th Edition, 2001.
2. H. M. T. production technology-Hand book, Tata Mc Graw-Hill, 2000.
3. Roy. A. Linberg, process and materials of manufacturing technology, PHI, 2000.
4. M. Adithan and A. B. Cupta, manufacturing technology, New Age, 1996.
5. Serope Kalpajian, Steven R. Schimid, Manuyfacturing Engineering and Technology, Pearson Education, Inc.2002 (second Indian Reprint)

408AET05 - AIRCRAFT STRUCTURES – I

OBJECTIVE

To study different types of beams and columns subjected to various types of loading and support conditions with particular emphasis on aircraft structural components.

1. STATICALLY DETERMINATE STRUCTURES

Analysis of plane Truss-Method of joints-3 D Truss-Plane frames-Composite beam.

2. STATICALLY INDETERMINATE STRUCTURES

Propped Cantilever- Fixed-Fixed beams-Clapeyron's Three Moment Equation - Moment Distribution Method.

3. ENERGY METHODS

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

4. COLUMNS

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

5. FAILURE THEORY

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

TEXT BOOK

1. Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993.
2. Bruhn.E.F."Analysis and design of flight vehicle structures" Tri set of offset company, USA,1973.

REFERENCE

1. Timoshenko, S., "Strength of Materials", Vol. I and II, Princeton D. Von Nostrand Co, 1990.

408AET06 - PROPULSION – I

OBJECTIVE

To understand the principles of operation and design of aircraft and spacecraft power plants.

1. FUNDAMENTALS OF GAS TURBINE ENGINES

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

2. SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES

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

3. COMBUSTION CHAMBERS

Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders – Numerical problems.

4. NOZZLES

Theory of flow in isentropic nozzles – nozzles and choking – Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under – expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust reversal.

5. COMPRESSORS

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

TEXT BOOKS

1. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1989.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
3. "Rolls Royce Jet Engine" – Third Edition – 1983.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 1999.

408AEP01 - AIRCRAFT STRUCTURES LAB –I

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 mechanical extensometers.
2. Determination of Young's modulus of aluminum using electrical extensometers
3. Determination of fracture strength and fracture pattern of ductile and brittle materials
4. Determination of forces in statically indeterminate force system.
5. Deflection of beams with various end conditions.
6. Verification of Maxwell's Reciprocal theorem & principle of superposition
7. Column – Testing
8. South – well's plot.
9. Testing of Riveted Joints.
10. Determination of membrane stresses in a thin cylinder under internal pressure.

LIST OF EQUIPMENTS
(for a batch of 30 students)

Sl. No.	Equipments	Qty	Experiments No.
1.	Universal Testing Machine	1	1,2,3, 9
2.	Mechanical Extensometer	1	1
3.	Electrical strain gauge	10	2, 4, 10
4.	Hinged bar suspended by two wires of different materials.	1	4
5.	Strain indicator	1	2, 4, 10
6.	Dial Gauges	12	5, 6
7.	Beam Test set up with various end conditions	2	5, 6
8.	Column Test Apparatus	1	7, 8
9.	Thin walled pressure vessel	1	10

408AEP02 - AERODYNAMICS LABORATORY

OBJECTIVE

To familiarize the students in basic aerodynamics and use of wind tunnels.

LIST OF EXPERIMENTS

1. Generation of lift and tip vortices.
2. Flow visualization in water flow channel
3. Flow visualization in smoke tunnel
4. Plot of RPM Vs test section velocity in a subsonic wind tunnel.
5. Pressure distribution over circular cylinder.
6. Pressure distribution over airfoil and estimation of C_L and $C_{D.}$
7. Force measurement using wind tunnel balance.
8. Mach number distribution in nozzle of supersonic wind tunnel.
9. Use of Schlieren system to visualize shock.
10. Use of Shadow graph system to visualize shock.

LIST OF EQUIPMENT
(for a batch of 30 students)

Sl. No.	Items	Quantity	Experiment No.
1.	Blower, Balance, and small aspect ratio model	1 each.	1
2.	Water flow channel & models	1 set	2
3.	Subsonic wind tunnel	1 No.	3, 4,5,6,7
4.	Smoke apparatus and rake	1 each.	3
5.	Manometer, Pitot-Static tube	1 No.	4,5,6
6.	Circular cylinder and Aerofoil pressure distribution models	1 each	5,6
7.	Wind tunnel strain gauge balance	1 No.	7
8.	Supersonic wind tunnel, Mercury manometer	1 No.	8,9,10
9.	Schlieren system and Shadow graph system	1 No.	9,10
10.	Sharp nosed and Blunt nosed models	1 No. each	9,10

408AEP03 - AIRCRAFT COMPONENT DRAWING

OBJECTIVE

To introduce the concept of design of basic structural components and to draft both manually and using modelling package.

LIST OF EXERCISES

1. Design and Drafting of riveted joints
2. Design and Drafting of welded joints.
3. Design and Drafting Control Components Cam
4. Design and Drafting Control Components Bell Crank
5. Design and Drafting Control Components Gear
6. Design and Drafting Control Components Push-pull rod
7. Three view diagram of a typical aircraft
8. Layout of typical wing structure.
9. Layout of typical fuselage structure.
10. Layout of Control System

LIST OF EQUIPMENT
(for a batch of 30 students)

Sl.No	Equipments	Quantity	Experiments No.
1	Drawing Boards, Drafting machines	30	1, 5

408AEP04 - MANUFACTURING TECHNOLOGY LABORATORY
(Common to Aeronautical & Automobile)

LIST OF EXPERIMENTS

1. LATHE

1.1 Facing, plain turning and step turning
1.2 Taper turning using compound rest.
1.3 Taper turning using taper turning attachment
1.4 Single start V thread, cutting and knurling
1.5 Boring and internal thread cutting.

2. SHAPER AND SLOTTER

2.1. Machining a V- block (in a Shaper)
2.2. Machining hexagonal shape (in a Shaper)
2.3. Machining internal key-way (in a slotter)

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

5. GRINDING

5.1 Cylindrical Grinding Exercise

LIST OF EQUIPMENTS
(For A Batch Of 30 Students)

1.	Centre Lathe with accessories	5No.
2.	Shaping Machine	2 No.
3.	Slotting Machine	1 No.
4.	Radial Drilling Machine	2No.
5.	Upright Drilling Machine	2No.
6.	Milling Machine	2No.
7.	Cylindrical Grinding Machine	1 No.

V SEMESTER
508AET01 - CONTROL ENGINEERING

OBJECTIVE
To understand the basic concepts of flight control system.

UNIT1. INTRODUCTION
Historical review - Simple pneumatic, hydraulic and thermal systems, Series and parallel systems, Analogies - Mechanical and electrical components, Development of flight control systems, Servos and synchros.

UNIT2. OPEN AND CLOSED LOOP SYSTEMS
Feedback control systems – Block diagram representation of control systems, Reduction of block diagrams, Output to input ratios, Signal flow graph, Mason's Gain Formula.

UNIT3. CHARACTERISTIC EQUATION AND FUNCTIONS
Lap lace 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 circuit.

UNIT4. CONCEPT OF STABILITY
Necessary and sufficient conditions, Routh – Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response, Nyquist plot, M,N Circles

UNIT5. SAMPLED DATA SYSTEMS
Introduction to digital control system, Digital Controllers and Digital PID Controllers.

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 C.H. Houpis, "Feed back control system analysis and synthesis", McGraw – Hill International, 3rd Edition, 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

508AET02 - ENVIRONMENTAL SCIENCE AND ENGINEERING

OBJECTIVE:

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT1. ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT2. ENVIRONMENTAL POLLUTION

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 – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT3. NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT4. SOCIAL ISSUES AND THE ENVIRONMENT

From 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 – role of non-governmental organization-environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT5. HUMAN POPULATION AND THE ENVIRONMENT

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.

Text Books:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

Reference Books

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

508AEP03 - FLIGHT DYNAMICS

OBJECTIVE

To study the performance of airplanes under various operating conditions and the static and dynamic response of aircraft for both voluntary and involuntary changes in flight conditions

UNIT1. CRUISING FLIGHT PERFORMANCE

International Standard Atmosphere - Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag –estimation of parasite drag co-efficient by proper area method- Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines . Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required

UNIT2. MANOEUVERING FLIGHT PERFORMANCE

Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.

UNIT3. STATIC LONGITUDINAL STABILITY

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic balancing.

UNIT4. LATERAL AND DIRECTIONAL STABILITY

Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

UNIT5. DYNAMIC STABILITY

Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional. dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

Text Books

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, NY, 1988.
2. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2004.
3. Mc Cornick. W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1979.

Reference Books

1. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, NY, 1982.
2. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
3. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., "Aeroplane Aero dynamics", Third Edition, Issac Pitman, London, 1981.
4. Mc Cornick B. W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1995.

508AEP04 - AIRCRAFT STRUCTURES – II

OBJECTIVE

To study the behaviour of various aircraft structural components under different types of loads.

UNIT1. UNSYMMETRICAL BENDING

General, Principal axis and neutral axis methods- bending stresses in beams of symmetric sections with skew loads- bending stresses in beams of unsymmetrical sections.

UNIT2. SHEAR FLOW IN OPEN SECTIONS

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

UNIT3. SHEAR FLOW IN CLOSED SECTIONS

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

UNIT4. BUCKLING OF PLATES

Rectangular sheets under compression, local buckling stress of thin walled section-Crippling stresses by Needham's and Gerard's methods, Thin walled column strength-sheet stiffener panels-Effective width.

UNIT5. STRESS ANALYSIS IN WING AND FUSELAGE

Shear resistant web beams-Tension field web beams(Wagner's) – Shear and bending moment distribution for cantilever and semi-cantilever types of beams-loads on aircraft –lift distribution-V-n diagram-Gust loads

Text Books

1. Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw–Hill, N.Y., 2007.
2. Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 2007.

Reference Books

1. Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, 1985.
2. Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw-Hill, 1993.

508AET05 - AERODYNAMICS - II

OBJECTIVE

To understand the behaviour of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows.

UNIT1. ONE DIMENSIONAL COMPRESSIBLE FLOW

Energy, Momentum, continuity and state equations, velocity of sound, adiabatic steady state flow equations, Flow through convergent- divergent passage, Performance under various back pressures.

UNIT2. NORMAL, OBLIQUE SHOCKS

Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak and detached shocks,

UNIT3. EXPANSION WAVES, RAYLEIGH AND FANNO FLOW

Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion, waves. Method of Characteristics Two dimensional supersonic nozzle contours. Rayleigh and Fanno Flow.

UNIT4. DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS

Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert affine transformation relations for subsonic flows, Linearised two dimensional supersonic flow theory, Lift, drag pitching moment and center of pressure of supersonic profiles.

UNIT5. TRANSONIC FLOW OVER WING

Lower and upper critical Mach numbers, Lift and drag divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule.

Text Book

1. Rathakrishnan, E., "Gas Dynamics", Prentice Hall of India, 2003.

REFERENCE BOOKS

1. Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.
2. Zucrow, M.J. and Anderson, J.D., "Elements of gas dynamics", McGraw-Hill Book Co., New York, 1989.
3. Anderson Jr., D., – "Modern compressible flows", McGraw-Hill Book Co., New York 1999.

508AET06 PROPULSION – II

OBJECTIVE

To study in detail about gas turbines, ramjet, fundamentals of rocket propulsion and chemical rockets

UNIT1. AIRCRAFT GAS TURBINES

Impulse and reaction blading of gas turbines – Velocity triangles and power output – Elementary theory – Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance – Limiting factors in gas turbine design- Overall turbine performance – Methods of blade cooling – Matching of turbine and compressor – Numerical problems.

UNIT2. RAMJET PROPULSION

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

UNIT3. FUNDAMENTALS OF ROCKET PROPULSION

Operating principle – Specific impulse of a rocket – internal ballistics- Rocket nozzle classification – Rocket performance considerations – Numerical Problems.

UNIT4. CHEMICAL ROCKETS

Solid propellant rockets – Selection criteria of solid propellants – Important hardware components of solid rockets – Propellant grain design considerations – Liquid propellant rockets – Selection of liquid propellants – Thrust control in liquid rockets – Cooling in liquid rockets – Limitations of hybrid rockets – Relative advantages of liquid rockets over solid rockets- Numerical Problems.

UNIT5. ADVANTAGES OF PROPULSION TECHNIQUES

Electric rocket propulsion – Ion propulsion techniques – Nuclear rocket – Types – Solar sail- Preliminary Concepts in nozzleless propulsion.

Text Books

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edn., 1993.
2. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.

Reference Books

1. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., "Gas Turbine Theory", Longman Co., ELBS Ed., 1989.
2. Gorden, C.V., "Aero thermodynamics of Gas Turbine and Rocket Propulsion", AIAA Education Series, New York, 1989.
3. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi, 1988.

508AEPO1 - AIRCRAFT STRUCTURES LAB – II

OBJECTIVE

To experimentally study the unsymmetrical bending of beams, find the location of shear centre , obtain the stresses in circular discs and beams using photoelastic techniques, calibration of photo – elastic materials and study on vibration of beams.

LIST OF EXPERIMENTS

1. Unsymmetrical bending of beams
2. Shear centre location for open sections
3. Shear centre location for closed sections
4. Constant strength beam
5. Flexibility matrix for cantilever beam
6. Beam with combined loading
7. Calibration of Photo- elastic materials
8. Stresses in circular discs and beams using photoelastic techniques
9. Vibrations of beams
10. Wagner beam – Tension field beam

LIST OF EQUIPMENT
(for a batch of 30 students)

Sl.No.	Name of the Equipment	Qty	Experiments Number
1	Beam Test set –up	2	1, 2, 3,4
2	Unsymmetrical sections like 'Z' sections	2	1, 2, 3
3	Channel section and angle section	2	1, 2, 3
4	Dial gauges	12	1, 2, 3
5	Weights 1Kg	10	1, 2, 3
6	Weights 2 Kg	10	1, 2, 3
7	Beam Test Set – up	2	3, 4
8	Strain indicator and strain gauges	One set	4,5,6
9	Photo – elastic apparatus	1	7,8
10	Amplifier	2	9
11	Exciter	2	9
12	Pick – up	2	9
13	Oscilloscope	2	9
14	Wagner beam	1	10
15.	Hydraulic Jack	1	10

508AEP02 - PROPULSION LABORATORY

OBJECTIVE

To understand the basic concepts and carryout experiments in Aerospace Propulsion.

LIST OF EXPERIMENTS

1. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)
2. Study of an aircraft jet engine (Includes study of assembly of sub systems, various components, their functions and operating principles)
3. Study of forced convective heat transfer over a flat plate.
4. Study of free convective heat transfer over a flat plate
5. Cascade testing of a model of axial compressor blade row.
6. Study of performance of a propeller.
7. Determination of heat of combustion of aviation fuel.
8. Combustion performance studies in a jet engine combustion chamber.
9. Study of free jet.
10. Study of wall jet.

LIST OF EQUIPMENTS
(for a batch of 30 students)

Sl.No	Equipments	Qty	Experiments No.
1	Piston engines	2	1
2	Jet Engine /Engine model	1	2
3	Forced Convective apparatus	1	3
4	Free Convective apparatus	1	4
5	Axial compressor blade row model with pressure tapping	1	5
6	Watertube manometers (20 tubes)	2	5,8,9
7	Subsonic wind tunnel	1	4
8	Propeller model static and total pressure probes	4	8,9
9	2-D travers in mechanism	2	8
10.	Freejet test setup	1	9
11.	Aluminium plates with deflection mechanisms	1	10

508AEP03 - CAD / CAM LABORATORY

OBJECTIVE

To teach and train the students in the lab about the design and drafting of aero components

LIST OF EXPERIMENTS

1. Scaling, rotation, translation, editing, dimensioning – Typical CAD command structure.
2. Wire frame modeling – surface modeling
3. Solid Modeling
4. Taper Turning – Straight Interpolation
5. Taper Turning – Circular Interpolation
6. Incremental programme G 90 operation.
7. Mirroring.
8. Incremental Programme G 91 operation
9. Absolute Programme G 90 operation
10. Absolute Programme G 91 operation

LIST OF EQUIPMENT
(for a batch of 30 students)

Sl.No.	Name of the Equipment	Quantity	Experiment No.
1	Computer nodes	30	1 to 7
2	Pro-E – 2001, 2002 – CAD Packages	30 licenses	1 to 7
3	ANSYS- 7, STAR – CD	30 licenses	1 to 7
4	UPS	1	1 to 7

SEMESTER VI
608AET01 - PRINCIPLES OF MANAGEMENT
(Common to all Branches)

OBJECTIVE
Knowledge on the principles of management is essential for all kinds of people in all kinds of organizations. After studying this course, students will be able to have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling. Students will also gain some basic knowledge on international aspect of management.

UNIT1. HISTORICAL DEVELOPMENT
Definition of Management – Science or Art – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organisation.

UNIT2. PLANNING
Nature & Purpose – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies & Planning Premises- Forecasting – Decision-making.

UNIT3. ORGANISING
Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD – Managerial Effectiveness.

UNIT4. DIRECTING
Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication.

UNIT5. CONTROLLING
System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and Preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management.

Text Books

1. Harold Kooritz & Heinz Weihrich "Essentials of Management", Tata McGraw-Hill, 1998
2. Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003.

Reference Books

1. Tripathy PC And Reddy PN, "Principles of Management", Tata McGraw-Hill, 1999.
2. Decenzo David, Robbin Stephen A, "Personnel and Human Reasons Management", Prentice Hall of India, 1996
3. JAF Stomer, Freeman R. E and Daniel R Gilbert, "Management", Pearson Education, Sixth Edition, 2004.
4. Fraidoon Mazda, "Engineering Management", Addison Wesley, 2000.

608AET02 - FINITE ELEMENT METHOD

OBJECTIVE
To introduce the concept of numerical analysis of structural components

UNIT1. INTRODUCTION
Review of basic analysis – Stiffness and Flexibility matrix for simple cases – Governing equation and convergence criteria of finite element method.

UNIT2. DISCRETE ELEMENTS
Bar, Frame, beam elements – Application to static, dynamic and stability analysis.

UNIT3. CONTINUUM ELEMENTS
Various types of 2-D-elements Application to plane stress, plane strain and axisymmetric problems.

UNIT4. ISOPARAMETRIC ELEMENTS
Applications to two and three-dimensional problems.

UNIT5. FIELD PROBLEM
Applications to other field problems like heat transfer and fluid flow.

Text Book

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India, Third Edition, 2003.

Reference Books

1. Reddy J.N. "An Introduction to Finite Element Method", McGraw-Hill, 2000.
2. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw-Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.

608AET03 - EXPERIMENTAL STRESS ANALYSIS

OBJECTIVE

To bring awareness on experimental method of finding the response of the structure to different types of load.

UNIT1. MEASUREMENTS

Principles of measurements, Accuracy, Sensitivity and range of measurements.

UNIT2. EXTENSOMETERS

Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT3. ELECTRICAL RESISTANCE STRAIN GAUGES

Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheastone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT4. PHOTOELASTICITY

Two dimensional photo elasticity, Concept of light – photoelastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials. Introduction to three dimensional photo elasticity.

UNIT5. NON – DESTRUCTIVE TESTING

Fundamentals of NDT, Radiography, ultrasonic, magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique, Fundamentals of brittle coating methods, Introduction to Moiré techniques, Holography, ultrasonic C- Scan, Thermograph, Fiber – optic Sensors.

Text Books

1. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra,K.,"Experimental Stress Analysis", Tata McGraw-Hill, New Delhi, 1984.

Reference Books

2. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw-Hill Inc., New York, 1998.
3. Hetyenyi, M., "Hand book of Experimental Stress Analysis", John Wiley and Sons Inc., New York, 1972.
4. Pollock A.A., "Acoustic Emission in Acoustics and Vibration Progress", Ed. Stephens R.W.B., Chapman and Hall, 1993.

608AET04 - WIND TUNNEL TECHNIQUES

OBJECTIVE

To introduce the basic concepts of measurement of forces and moments on models during the wind tunnel testing.

UNIT1. PRINCIPLES OF MODEL TESTING

Buckingham Theorem – Non-Dimensional Numbers –Scale Effect Types of Similartes.

UNIT2. WIND TUNNELS

Classification – Special problems of Testing in Subsonic, Transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT3. CALIBRATION OF WIND TUNNELS

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.

UNIT4. WIND TUNNEL MEASUREMENTS

Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances.

UNIT5. FLOW VISUALIZATION

Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.

Text Book

1. Rae, W.H. and Pope, A. "Low Speed Wind Tunnel Testing", John Wiley Publication, 1984.

Reference Book

1. Pope, A., and Goin, L., "High Speed wind Tunnel Testing", John Wiley, 1985.

608AET05 - HIGH TEMPERATURE MATERIALS

OBJECTIVE

To learn damage mechanism and failure of components of elevated temperatures

UNIT1. CREEP
Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

UNIT2. DESIGN FOR CREEP RESISTANCE
Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT3. FRACTURE
Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT4. OXIDATION AND HOT CORROSION
Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT5. SUPERALLOYS AND OTHER MATERIALS
Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

Text Books

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
2. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

Reference Books

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.

608AEP01 - AERO ENGINE

OBJECTIVE

To introduce the knowledge of the maintenance and repair of both piston and jet aero engines and the procedures followed for overhaul of aero engines.

1. Stripping of a piston engine
2. Engine (Piston Engine) - cleaning, visual inspection, NDT checks.
3. Piston Engine Components - dimensional checks.
4. Piston – Engine reassembly.
5. Propeller Pitch Setting
6. Stripping of a jet engine
7. Jet Engine – identification of components & defects.
8. Jet Engine – NDT checks and dimensional checks
9. Jet Engine – reassembly.
10. Engine starting procedures.

LIST OF EQUIPMENTS
(for a batch of 30 students)

Sl.No	Equipments	Qty	Experiments No.
1	Piston Engines	2	1,2,3,4
2	Jet Aero 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 DTI	2 each	3,5,8
6	NDT Equipments (Defectoscope, Dyepenetrant method, Hot oil Chalk Method	1 each	2,8

608AEP02 - AIRCRAFT DESIGN PROJECT – I

OBJECTIVE
To introduce and develop the basic concept of aircraft design.

Each student is assigned with the design of an Airplane (or Helicopter or any other flight vehicle), for given preliminary specifications. The following are the assignments to be carried out:

EXPERIMENTS

1. Comparative configuration study of different types of airplanes
2. Comparative study on specification and performance details of aircraft
3. Preparation of comparative data sheets
4. Work sheet layout procedures
5. Comparative graphs preparation and selection of main parameters for the design
6. Preliminary weight estimations, selection of main parameters,
7. Power plant selection, Aerofoil selection, Wing tail and control surfaces
8. Preparation of layouts of balance diagram and three view drawings
9. Drag estimation
10. Detailed performance calculations and stability estimates

LIST OF EQUIPMENTS
(for a batch of 30 students*)*

Sl.No.	Name of the Equipment	Quantity	Experiments Number
1	Engineering Drawing Board	30	3
2	Engineering Drawing Instruments	30	3

608AEP03 - AIRFRAME LAB

OBJECTIVE

To give training on riveting, patchwork, welding and carpentry

LIST OF EXPERIMENTS

1. Aircraft wood gluing
2. Welded patch repair by TIG, MIG, PLASMA ARC.
3. Welded patch repair by MIG
4. Welded patch repair by plasma Arc
5. Fabric Patch repair
6. Riveted patch repairs.
7. Repair of composites
8. Repair of Sandwich panels.
9. Sheet metal forming.
10. Control cable inspection and repair.

LIST OF EQUIPMENT
(for a batch of 30 students)

Sl.No.	Name of the Equipment	Quantity	Experiment No.
1	Shear cutter pedestal type	1	4,6
2	Drilling Machine	1	4,5,6
3	Bench Vices	1	1,5,6
4	Radius Bend bars	1	2,3
5	Pipe Flaring Tools	1	9
6	Carbide Gas Plant	1	4
7	MIG Weld Plant	1	3
8	TIG Weld Plant	1	2

SEMESTER VII
708AET01 - TOTAL QUALITY MANAGEMENT
(Common to all branches)

OBJECTIVE

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
- To understand the statistical approach for quality control.
- To create an awareness about the ISO and QS certification process and its need for the industries.

UNIT1. INTRODUCTION

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

UNIT2. TQM PRINCIPLES

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

UNIT3. STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT4. TQM TOOLS

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

UNIT5. QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

Text Book

1. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.

Reference Books

1. James R.Evans & William M.Lidsay, "The Management and Control of Quality", (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S. "Total Quality Management", Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 1996.
5. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991

708AET02 - AVIONICS

OBJECTIVE

To introduce the basic concepts of navigation & communication systems of aircraft.

UNIT1. INTRODUCTION TO AVIONICS

Need for Avionics in civil and military aircraft and space systems – Integrated Avionics and Weapon system – Typical avionics sub systems – Design and Technologies.

UNIT2. PRINCIPLES OF DIGITAL SYSTEMS

Digital Computers – Microprocessors – Memories

UNIT3. DIGITAL AVIONICS ARCHITECTURE

Avionics system architecture–Data buses MIL–STD 1553 B–ARINC 429–ARINC 629.

UNIT4. FLIGHT DECK AND COCKPITS

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

UNIT5. INTRODUCTION TO AVIONICS SYSTEMS

Communication Systems - Navigation systems - Flight control systems - Radar electronic warfare - Utility systems Reliability and maintainability - Certification.

Text Books

1. Malcrno A.P. and Leach, D.P., "Digital Principles and Application", Tata McGraw-Hill, 1990.
2. Gaonkar, R.S., "Microprocessors Architecture – Programming and Application", Wiley and Sons Ltd., New Delhi, 1990.

Reference Books

1. Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R., "Digital Avionic Systems", Prentice Hall, Englewood Cliffs, N.J., USA., 1987.
3. Brain Kendal, "Manual of Avionics", The English Book HOuse, 3rd Edition, New Delhi, 1993

708AET03 - COMPUTATIONAL FLUID DYNAMICS

OBJECTIVE

To study the flow of dynamic fluids by computational methods

UNIT1. FUNDAMENTAL CONCEPTS

Introduction - Basic Equations of Fluid Dynamics - Incompressible In viscid Flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations -_ Elliptic, Parabolic and Hyperbolic equations - Well posed problems - discretization of partial Differential Equations -Transformations and grids - Explicit finite difference methods of subsonic, supersonic and viscous flows.

UNIT2. PANEL METHODS

Introduction – Source panel method – Vortex panel method – Applications.

UNIT3. DISCRETIZATION

Boundary layer Equations and methods of solution -Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation --Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems - Further advantages of upwind differencing.

UNIT4. FINITE ELEMENT TECHNIQUES

Finite Element Techniques in Computational Fluid Dynamics; introduction - Strong and Weak Formulations of a Boundary Value Problem - Strong formulation - Weighted Residual Formulation - Galerkin Formulation - Weak Formulation - Variational Formulation - Piecewise defined shape functions - Implementation of the FEM - The Solution Procedure.

UNIT5. FINITE VOLUME TECHNIQUES

Finite Volume Techniques - Cell Centered Formulation - ~ Lax - Vendoroff Time Stepping - Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy -. Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques - Central and Up-wind Type Discretizations - Treatment of Derivatives.

Text Book

1. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Vols. I and II, Springer - Verlag, Berlin, 1988.

Reference Books

1. John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer – Verlag, Berlin, 1992
2. Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II. John Wiley & Sons, New York, 1988.
3. Klaus A Hoffmann and Steve T. Chiang. "Computational Fluid Dynamics for Engineers", Vols. I & II Engineering Education System, P.O. Box 20078, W. Wichita, K.S., 67208 – 1078 USA, 1993.
4. Anderson, Jr.D., "Fundamentals of Aerodynamics", McGraw-Hill, 2000.

708AET04 - VIBRATIONS AND AEROELASTICITY

OBJECTIVE

To study the dynamic behaviour of different aircraft components and the interaction among the aerodynamic, elastic and inertia forces

UNIT1. BASIC NOTIONS

Simple harmonic motion – Terminologies – Newton's Law – D' Alembert's principle – Energy Methods

UNIT2. SINGLE DEGREE OF FREEDOM SYSTEMS

Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Vibration measuring instruments.

UNIT3. MULTI DEGREES OF FREEDOM SYSTEMS

Two degrees of freedom systems – Static and Dynamic couplings vibration absorber- Principal co-ordinates, Principal modes and orthogonal condition – Eigen value problems.

Hamilton's principle- Lagrangean equation and application – Vibration of elastic bodies- Vibration of strings- Longitudinal, Lateral and Torsional vibrations.

UNIT4. APPROXIMATE METHODS

Rayleigh's and Holzer Methods to find natural frequencies.

UNIT5. ELEMENTS OF AEROELASTICITY

Concepts – Coupling – Aero elastic instabilities and their prevention – Basic ideas on wing divergence, loss and reversal of aileron control – Flutter and its prevention.

Text Books

1. TIMOSHENKO S., "Vibration Problems in Engineering"– John Wiley and Sons, New York, 1993.
2. FUNG Y.C., "An Introduction to the Theory of Aeroelasticity" – John Wiley & Sons, New York, 1995.

Reference Books

1. BISPLINGHOFF R.L., ASHELY H and HOGMAN R.L., "Aeroelasticity" – Addision Wesley Publication, New York, 1983.
2. TSE. F.S., MORSE, I.F., HUNKLE, R.T., "Mechanical Vibrations", – Prentice Hall, New York, 1984.
3. SCANLAN R.H. & ROSENBAUM R., "Introduction to the study of Aircraft Vibration & Flutter", John Wiley and Sons. New York, 1982.
4. BENSON H.TONGUE, "Principles of Vibration", Oxford University Press, 2000.

708AEP01 - AIRCRAFT DESIGN PROJECT – II

OBJECTIVE

To enhance the knowledge in continuation of the design project given in project–I

Each student is assigned with work in continuation of the design project – I. The following assignments are to be carried out.

LIST OF EXPERIMENTS

1. V-n diagram for the design study
2. Gust and maneuverability envelopes
3. Critical loading performance and final V-n graph calculation
4. Structural design study – Theory approach
5. Load estimation of wings
6. Load estimation of fuselage.
7. Balancing and Maneuvering loads on tail plane, Aileron and Rudder loads.
8. Detailed structural layouts
9. Design of some components of wings, fuselage
10. Preparation of a detailed design report with CAD drawings.

LIST OF EQUIPMENTS
(for a batch of 30 students)

S.No.	Items	Quantity	Experiment No.
1.	Drawing Board	30	4 and 5
2.	Drawing Instrument	20	4 and 5

708AEP02 - AIRCRAFT SYSTEM LABORATORY

OBJECTIVE

To train the students "ON HAND" experience in maintenance of various air frame systems in aircraft and rectification of common snags.

LIST OF EXPERIMENTS

1. Aircraft "Jacking Up" procedure
2. Aircraft "Levelling" procedure
3. Control System "Rigging check" procedure
4. Aircraft "Symmetry Check" procedure
5. "Flow test" to assess of filter element clogging
6. "Pressure Test" To assess hydraulic External/Internal Leakage
7. "Functional Test" to adjust operating pressure
8. "Pressure Test" procedure on fuel system components
9. "Brake Torque Load Test" on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.

LIST OF EQUIPMENTS
(for a batch of 30 students)

S.No.	Items	Quantity	Experiment No.
1.	Serviceable aircraft with all above systems	1	1,2,3,4,5,6,7,8,9,10
2.	Hydraulic Jacks (Screw Jack)	5	1,2,4,8
3.	Trestle adjustable	5	1,2,4,8
4.	Spirit Level	2	8
5.	Levelling Boards	2	8
6.	Cable Tensiometer	1	8
7.	Adjustable Spirit Level	1	8
8.	Plumb Bob	1	8

708AEP03 - AVIONICS LABORATORY

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.

LIST OF EQUIPMENT
(for a batch of 30 students)

S.No.	Details of Equipments	Quantity	Experiment Nos.
1.	Adder/Subtractor Binary bits Kit	6	1
2	Timer Kit	6	1
3	Encoder Kit	6	3
4	Decoder Kit	6	3
5	Comparator Kit	6	4
6	Multiplexer Kit	6	2
7	Demultiplexer Kit	6	2
8	Shift Registers Kit	6	4
9	Electronic Design Experimeter	6	6,7,9,10
10	Microprocessor 8085 Kit	9	5,6,7,8,9,10
11	4 Digit 7 Segment Display	3	6
12	Switches & LED's Circuit	3	6
13	16 Channel AD Converter	6	10,9
14	Digital to Analog Converter	6	10
15	Cathode Ray Oscilloscope	3	9,10
16	Regulated Power Supply (5V DC)	9	1, 2,3,4
17	MIL-Std 1553B Setup with Remote Terminal	1	12,13
18	Computers	2	11,12,13

VIII SEMESTER

808AET01 - COMPOSITE MATERIALS AND STRUCTURES

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

UNIT1. STRESS STRAIN RELATION
Introduction- Advantages and application of composite materials, reinforcements and matrices – Generalised Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

UNIT2. METHODS OF ANALYSIS
Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties. Experimental characterization of lamina.

UNIT3. LAMINATED PLATE
Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.

UNIT4. SANDWICH CONSTRUCTIONS
Basic design concepts of sandwich construction -Materials used for sandwich construction - Failure modes of sandwich panels.

UNIT5. FABRICATION PROCESS
Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

Text Books

1. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
2. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.

Reference Books

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

808AEP02 PROJECT WORK
(Common to all Branches)

OBJECTIVE

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

Each student shall finally produce a comprehensive report covering back round information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

The continuous assessment shall be made as prescribed by the regulation (of St.Peter's University Regulations 2008 for B.E., B.Tech. programmes)

608AET06 - THEORY OF ELASTICITY

OBJECTIVE

To understand the theoretical concepts of material behaviour with particular emphasis on their elastic property

UNIT1. ASSUMPTIONS IN ELASTICITY

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium.

UNIT2. BASIC EQUATIONS OF ELASTICITY

Strain – displacement relations, Stress – strain relations, Lame's constant – cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle.

UNIT3. PLANE STRESS AND PLANE STRAIN PROBLEMS

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two-dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams, etc.

UNIT4. POLAR COORDINATES

Equations of equilibrium, Strain displacement relations, Stress – strain relations, Axi – symmetric problems, Kirsch, Michell's and Boussinesque problems.

UNIT5. TORSION

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, The semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

Text Book

1. Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw–Hill Ltd., Tokyo, 1990.

Reference Book

1. Enrico Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall New Jersey, 1991.
2. Wng, C.T., "Applied Elasticity", McGraw–Hill Co., New York, 1993.
3. Sokolnikoff, I.S., "Mathematical Theory of Elasticity", McGraw–Hill New York, 1978.

608AET07 AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES

OBJECTIVE

To teach the students about the basic concepts of aircraft general engineering and maintenance practices.

UNIT1. AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT

Mooring, jacking, levelling and towing operations – Preparation – Equipment - precautions – Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Ground power units.

UNIT2. GROUND SERVICING OF VARIOUS SUB SYSTEMS

Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

UNIT3. MAINTENANCE OF SAFETY

Shop safety – Environmental cleanliness – Precautions.

UNIT4. INSPECTION

Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data Sheets – ATA specifications.

UNIT5. AIRCRAFT HARDWARE, MATERIALS, SYSTEMS PROCESSES

Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc.) – American and British systems of specifications – Threads, gears, bearings, etc. – Drills, tapes & reamers. – identification of all types of fluid line fittings. Materials, metallic and non-metallic - Plumbing Connectors - Cables – Swaging procedures, tests, Advantages of swaging over splicing.

Text Book

1. KROES WATKINS DELP, "Aircraft Maintenance and Repair" – McGraw-Hill, New York 1993.

Reference Book

1. A & P MECHANICS, "Aircraft hand Book" – F. A. A. Himalayan Book House, New Delhi, 1996.
2. A & P MECHANICS, "General hand Book" – F. A. A. Himalayan Book House, New Delhi, 1996.

608AET08 - SPACE MECHANICS

OBJECTIVE

To study the basic concepts of orbital Mechanics with particular emphasis on interplanetary trajectories

UNIT1. BASIC CONCEPTS

The Solar System – References Frames and Coordinate Systems – The Celestial Sphere – The Ecliptic – Motion of Vernal Equinox – Sidereal Time – Solar Time – Standard Time – The Earth's Atmosphere.

UNIT2. THE GENERAL N-BODY PROBLEM

The many body Problem – Lagrange – Jacobian Identity –The Circular Restricted Three Body Problem – Libration Points- Relative Motion in the N-body Problem –Two –Body Problem – Satellite Orbits – Relations Between Position and Time – Orbital Elements.

UNIT3. SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS

General Aspects of satellite Injections – Satellite Orbit Transfer –Various Cases – Orbit Deviations Due to Injection Errors – Special and General Perturbations – Cowell's Method – Encke's Method – Method of vibrations of Orbital Elements – General Perturbations Approach.

UNIT4. INTERPLANETARY TRAJECTORIES

Two Dimensional Interplanetary Trajectories –Fast Interplanetary Trajectories – Three Dimensional Interplanetary Trajectories – Launch if Interplanetary Spacecraft –Trajectory about the Target Planet.

UNIT5. BALLISTIC MISSILE TRAJECTORIES AND MATERIALS

The Boost Phase – The Ballistic Phase –Trajectory Geometry- Optimal Flights – Time of Flight – Re – entry Phase – The Position of the Impact Point – Influence Coefficients. Space Environment – Peculiarities – Effect of Space Environment on the Selection of Spacecraft Material.

Text Book

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 1984.

Reference Book

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
2. Van de Kamp, P., "Elements of Astromechanics", Pitman, 1979.
3. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

608AET09 - HEAT TRANSFER

OBJECTIVE

To introduce the concepts of heat transfer to enable the students to design components subjected to thermal loading.

UNIT1. HEAT CONDUCTION

Basic Modes of Heat Transfer – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces – Unsteady state.

Heat Conduction: Lumped System Analysis – Heat Transfer in Semi infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.

UNIT 2. CONVECTIVE HEAT TRANSFER

Introduction – Free convection in atmosphere free convection on a vertical flat plate – Empirical relation in free convection – Forced convection – Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations, application of numerical techniques in problem solving.

UNIT 3. RADIATIVE HEAT TRANSFER

Introduction to Physical mechanism – Radiation properties – Radiation shape factors – Heat exchange between non – black bodies – Radiation shields.

UNIT 4. HEAT EXCHANGERS

Classification – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method.

UNIT 5. HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING

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

Text Books

1. Yunus A. Cengel., "Heat Transfer – A practical approach", Second Edition, Tata McGraw-Hill, 2002.
2. Incropera. F.P.and Dewitt.D.P. " Introduction to Heat Transfer", John Wiley and Sons – 2002.

Reference Books

1. Lienhard, J.H., "A Heat Transfer Text Book", Prentice Hall Inc., 1981.
2. Holman, J.P. "Heat Transfer", McGraw-Hill Book Co., Inc., New York, 6th Edn., 1991.
3. Sachdeva, S.C., "Fundamentals of Engineering Heat & Mass Transfer", Wiley Eastern Ltd., New Delhi, 1981.
4. Mathur, M. and Sharma, R.P. "Gas Turbine and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1988.

608AET10 VIBRATION AND NOISE CONTROL

OBJECTIVES:

The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT1. BASICS OF VIBRATION

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT2. BASICS OF NOISE

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT3. AUTOMOTIVE NOISE SOURCES

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT4. CONTROL TECHNIQUES

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT5. SOURCE OF NOISE AND CONTROL

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

Text Books

1. Singiresu S.Rao - "Mechanical Vibrations" - Pearson Education, ISBM –81-297-0179-0 - 2004.
2. Kewal Pujara "Vibrations and Noise for Engineers", Dhanpat Rai & Sons, 1992.

Reference Books

1. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" - Second edition - SAE International - ISBN 0-7680-0403-9 – 1999.
2. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, ISBN 0750-5044-3 - 2004
3. John Fenton - "Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, ISBN 1-86058-073- 1998.

608AET11 UNCONVENTIONAL MANUFACTURING PROCESSES

OBJECTIVE:
To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

UNIT1. INTRODUCTION
Unconventional machining Process – Need – classification – Brief overview .

UNIT2. MECHANICAL ENERGY BASED PROCESSES
Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.

UNIT3. ELECTRICAL ENERGY BASED PROCESSES
Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNIT 4. CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES
Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchantsmaskant-techniques of applying maskants-Process Parameters – Surface finish andMRR-Applications. Principles of ECM-equipments-Surface Roughness and MRRElectrical circuit-Process Parameters-ECG and ECH - Applications.

UNIT5. THERMAL ENERGY BASED PROCESSES
Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

Text Books

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi (2007).

Reference Books

1. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York (1987).
2. Mc Geough, "Advanced Methods of Machining" Chapman and Hall, London (1998).
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., New Delhi ,8th Edition,2001.

708AET05 - HELICOPTER THEORY

OBJECTIVE
To study the procedure adapted to the maintenance of helicopter.

UNIT1. HELICOPTER FUNDAMENTAL
Basic directions – Ground handling, bearing – Gears.

UNIT 2. MAIN ROTOR SYSTEM
Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping –Electronic balancing – Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.

UNIT 3. MAIN ROTOR TRANSMISSIONS
Engine transmission coupling – Drive shaft – Maintenance clutch – Free wheeling units – Spray clutch – Roller unit – Torque meter – Rotor brake – Maintenance of these components – vibrations – Mounting systems – Transmissions.

UNIT 4. POWER PLANTS & TAIL ROTORS
Fixed wing power plant modifications – Installation – Different type of power plant maintenance.
Tail rotor system – Servicing tail rotor track – System rigging.

UNIT 5. AIRFRAMES AND RELATED SYSTEMS
Fuselage maintenance – Airframe Systems – Special purpose equipment.

Text Book

1. JEPPESEN, "Helicopter Maintenance", Jeppesons and Sons Inc., 2000.

Reference Book

1. "Civil Aircraft Inspection Procedures", Part I and II, CAA, English Book House, New Delhi, 1986.
2. LARRY REITHMIER, "Aircraft Repair Manual", Palamar Books Marquette, 1992.

708AET06 - INDUSTRIAL AERODYNAMICS

OBJECTIVE:
To familiarize the learner with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

UNIT1. ATMOSPHERIC BOUNDARY LAYER
Atmospheric circulation-Local winds-Terrain types-Mean velocity profiles-Power law and logarithm law- wind speeds-Turbulence profiles-Roughness parameters-simulation techniques in wind tunnels

UNIT2. BLUFF BODY AERODYNAMICS
Boundary layers and separation-Two dimensional wake and vortex formation-Strouhal and Reynolds numbers-Separation and reattachments-Power requirements and drag coefficients of automobiles-Effects of cut back angle-aerodynamics of trains.

UNIT3. WIND ENERGY COLLECTORS
Horizontal and vertical axis machines-energy density of different rotors-Power coefficient-Betz coefficient by momentum theory.

UNIT4. BUILDING AERODYNAMICS
Pressure distribution on low rise buildings-wind forces on buildings-Environmental winds in city blocks-special problems of tall buildings-building codes-ventilation and architectural aerodynamics

UNIT5. FLOW INDUCED VIBRATIONS
Vortex shedding, lock & effects of Reynolds number on wake formation in turbulent flows - across wind galloping-wake galloping-along wind galloping of circular cables-oscillation of tall structures and launch vehicles under wind loads-stall flutter.

Reference Books

1. Scorer R.S "Environmental Aerodynamics", Ellis Harwood Ltd, England, 1978
2. Sovran, M(ed) "Aerodynamic drag mechanism of bluff bodies and road vehicles", Plenum Press, N.Y, 1978
3. Sachs P "Wind Forces in Engineering", Pergamon Press, 1988
4. Blevins R.D "Flow Induced Vibrations", Van Nostrand, 1990
5. Calvert N.G "Wind Power Principles", Charles Griffin & Co London, 1979

708AET07 - AIRFRAME MAINTENANCE AND REPAIR

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

UNIT1.WELDING IN AIRCRAFT STRUCTURAL COMPONENTS
Equipments used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing.

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

UNIT2. PLASTICS AND COMPOSITES IN AIRCRAFT
Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes.Inspection and Repair of composite components – Special precautions – Autoclaves.

UNIT3. AIRCRAFT JACKING, ASSEMBLY AND RIGGING
Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT4. REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM
Trouble shooting and maintenance practices – Service and inspection. – Inspection and maintenance of landing gear systems. – Inspection and maintenance of air-conditioning and pressurisation system, water and waste system. Installation and maintenance of Instruments – handling – Testing – Inspection. Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs)

UNIT5. SAFETY PRACTICES
Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble shooting - Theory and practices.

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

708AET08 - AERO ENGINE MAINTENANCE AND REPAIR

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.

UNIT1. CLASSIFICATION OF PISTON ENGINE COMPONENTS

Types of piston engines – Principles of operation – Function of components – Materials used – Details of starting the engines – Details of carburetion 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.

UNIT2. INSPECTIONS OF PISTON ENGINES

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.

UNIT3. OVERHAULING OF PISTON ENGINES

Symptoms of failure – Fault diagnostics – Case studies of different engine systems – l: 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.

UNIT4. CLASSIFICATION OF JET ENGINE COMPONENTS

12 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.

UNIT5. OVERHAUL PROCEDURES

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.

Text Book

1. KROES & WILD, "Aircraft Power plants", 7th Edition – McGraw Hill, New York, 1994.

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.

708AET10 - THEORY OF PLATES AND SHELLS

OBJECTIVE

To study the behaviour of the plates and shells with different geometry under various types of loads.

UNIT1. CLASSICAL PLATE THEORY

Classical Plate Theory – Assumptions – Differential Equation – Boundary Conditions.

UNIT2. PLATES OF VARIOUS SHADES

Navier's Method of Solution for Simply Supported Rectangular Plates – Leavy's Method of Solution for Rectangular Plates under Different Boundary Conditions. Governing Equation – Solution for Axi-symmetric loading – Annular Plates – Plates of other shapes.

UNIT 3. EIGEN VALUE ANALYSIS

Stability and free Vibration Analysis of Rectangular Plates.

UNIT4. APPROXIMATE METHODS

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT5. SHELLS

Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

Text Book

1. Timoshenko, S.P. Winowsky. S., and Kreger, "Theory of Plates and Shells", McGraw-Hill Book Co. 1990.
2. T. K. Varadan and K. Bhaskar, "Theory of Plates and Shells",1999, Narosa .

Reference Books

1. Flugge, W. "Stresses in Shells", Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw-Hill Book Co. 1986

708AET10 - FATIGUE AND FRACTURE

OBJECTIVE

To study the concepts of estimation of the endurance and failure mechanism of Components

UNIT1. FATIGUE OF STRUCTURES

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT2. STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques - Cumulative damage - Miner's theory - Other theories.

UNIT3. PHYSICAL ASPECTS OF FATIGUE AND FRACTURE

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces - Strength and stress analysis of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT4. FATIGUE DESIGN ANDTESTINIG

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

UNIT5. FUNDAMENTALS OF FAILURE ANALYSIS

Common causes of failure. Principles of failure analysis. Fracture mechanics approach to failure problems. Techniques of failure analysis. Service failure mechanisms - ductile and brittle fracture, fatigue fracture, wear failures, fretting failures, environment induced failures, high temp. failure. Faulty heat treatment and design failures, processing failures (forging, casting, machining etc.),

Text Books

1. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pe/gamon press. Oxford, 1983.

Reference Books

1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983
3. Subra suresh, "Fatigue of materials" , II edition, 1998.
4. T. L. Anderson, "Fracture mechanics: Fundamentals and applications", III edition, 2004.

708AET11 - THERMAL TURBOMACHINES

AIM:
To instruct the importance of the principles of various turbomachines.

OBJECTIVE:
To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT1. PRINCIPLES
Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

UNIT2. CENTRIFUGAL FANS AND BLOWERS
Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

UNIT3. CENTRIFUGAL COMPRESSOR
Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

UNIT4. AXIAL FLOW COMPRESSOR
Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

UNIT5. AXIAL AND RADIAL FLOW TURBINES
Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

Text Book

1. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.

Reference Books

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., Fluid Mechanics and Thermodynamics of Turbomachinery, Pergamon Press, 1990.
4. Shepherd, D.G., Principles of Turbomachinery, Macmillan, 1969.
5. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
6. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
7. Gopalakrishnan .G and Prithvi Raj .D, A Treatise on Turbomachines, Scifech Publications (India) Pvt. Ltd., 2002.

708AET12 - PURCHASING AND MATERIALS MANAGEMENT

UNIT1. FUNCTIONS OF MATERIALS MANAGEMENT
Introduction to materials management – objectives – Organization – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT2. PURCHASING MANAGEMENT
Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations - Insurance and claims managements

UNIT3. STORES MANAGEMENT
Store function – Location – Layout – Stock taking – Materials handling – codification – Inventory pricing – MIS for stores management

UNIT4. MATERIALS PLANNING
Forecasting - ABC analysis – Materials requirements planning - Inventory systems – Quantity – periodic – Deterministic models – Aggregate planning – JIT.

UNIT5. INVENTORY MANAGEMENT
Basic EOQ Model – Discount Model - Finite Production – Lot size under constraints – Application of O.R. Techniques in Materials Management.

Text Book

1. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and Cases, Tata McGraw Hill, 1996.

Reference Books

1. Gopalakrishnan P.Handbook of Materials Management, Prentice Hall of India, 1996.
2. Guptha P.K. and Manmohan, Problems in Operations Research, Sultan Chand & Sons, 1994
3. R. Kesavan, C.Elanchezhian and T.Sundar Selwyn, Engineering Management, Eswar Press 2005

708AET13 - NON-DESTRUCTIVE TESTING METHODS

AIM:
To impart knowledge on Non Destructive Testing procedures.

UNIT1. NON-DESTRUCTIVE TESTING: AN INTRODUCTION
Introduction to various non-destructive methods- Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

UNIT2. LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods – Applications
Principle of MPT, Magnetising technical and procedure used for testing a component , Equipment used for MPT , Applications

UNIT3. EDDY CURRENT TESTING AND ACOUSTIC EMISSION TESTING
Principles, Instrumentation for ECT, Various Techniques – High sensitivity Techniques, Single, Multi and high frequency ECT, Applications
Principle of AET,AE signal parameters, Applications.

UNIT4. ULTRASONIC TESTING
Principle, Ultrasonic transducers, Inspection Methods – Normal Incident Pulse-echo Inspection, Through - transmission Testing, angle Beam Pulse-echo testing, Techniques for Normal Beam Inspection, Ultrasonic Flaw detection Equipment, Modes of display – A-scan, B-Scan & C- Scan- Applications

UNIT 5. RADIOGRAPHY, COMPARISON AND SELECTION OF NDTMETHODS
Basic principle, Effect of radiation on Film, Radiographic imaging – Inspection Techniques – Single wall single image, Double wall Penetration & Multiwall Penetration technique – Comparison and selection of various NDT techniques

Text Book

1. Baldev raj, T Jeyakumar, M. Thavasimuthu "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002

Reference Books

1. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.
2. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002
3. www.**ndt**.**net**
4. Baldev Raj and B.Venkataraman, "Practical Radiology", Narosa Publishing House, 2004
5. Birchan.B, "Non-Destructive Testing", Oxford, London, 1975

808AET02 - HYPERSONIC AERODYNAMICS

OBJECTIVE:
To present the basic ideas of hypersonic flow and the associated problem areas.

UNIT 1. FUNDAMENTALS OF HYPERSONIC AERODYNAMICS
Introduction to hypersonic aerodynamics-differences between hypersonic aerodynamics and supersonic aerodynamics-concept of thin shock layers-hypersonic flight pathshypersonic similarity parameters-shock wave and expansion wave relations of in viscid hypersonic flows.

UNIT2.SIMPLE SOLUTION METHODS FOR HYPERSONIC IN VISCID FLOWS
Local surface inclination methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

UNIT3. VISCOUS HYPERSONIC FLOW THEORY
Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self similar boundary layers-solution methods for non self similar boundary layersaerodynamicheating.

UNIT4. VISCOUS INTERACTIONS IN HYPERSONIC FLOWS
Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions-hypersonic viscous interaction similarity parameter-introduction to shock wave boundary layer interactions.

UNIT 5. INTRODUCTION TO HIGH TEMPERATURE EFFECTS
Nature of high temperature flows-chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

Text Books:

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dyanmics", Mc. Graw hill Series, New York, 1996.

Reference Books:

1. John. D. Anderson. Jr ., "Modern compressible flow with historical perspective", Mc. Graw Hill Publishing Company, New York, 1996.\
2. John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington. D.C., 1994.

808AET03 - EXPERIMENTAL AERODYNAMICS

OBJECTIVES:
To present the measurement techniques involved in aerodynamic testing.

UNIT1. WIND TUNNEL TESTING
Low speed wind tunnels-estimation of energy ratio and power required supersonic win tunnels-calculation of running time and storage tank requirements.

UNIT2. EXPERIMENTS IN SUBSONIC WIND TUNNELS
Estimation of flow angularity and turbulence factor-calculation of CL and CD on aero foils from pressure distribution- CD from wake survey-Test section average velocity using traversing rakes-span wise load distribution for different taper ratios of wing

UNIT3. EXPERIMENTS IN HIGH SPEED TUNNELS
Mach number estimation in test section by pressure measurement and using a wedge – preliminary estimates of blowing and running pressures, nozzle area ratios, mass flow for a given test section size and Mach number-starting problem and starting loads.

UNIT4. MEASUREMENT TECHNIQUES
Hot wire anemometer and laser Doppler anemometer for turbulence and velocity measurements-Use of thermocouples and pyrometers for measurement of static and total temperatures-Use of pressure transducers, Rotameters and ultrasonic flow meters.

UNIT5. SPECIAL PROBLEMS
Pitot-static tube correction for subsonic and supersonic Mach numbers-boundary layer velocity profile on a flat plate by momentum-integral method -Calculation of CD from wall shear stress-Heating requirements in hypersonic wind tunnels-Re-entry problems.

Reference Books

1. Rae W.H and Pope. A "Low speed wind tunnel testing" John Wiley Publication, 1984
2. Pope. A and Goin. L "High speed wind tunnel testing" John Wiley, 1985
3. Rathakrishnan. E "Instrumentation, Measurement and Experiments in Fluids", CRC Press, London, 2007

808AET04 - ROCKETS AND MISSILES

OBJECTIVE
To introduce basic concepts of design and trajectory estimation of rocket and missiles

UNIT1. ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD
One Dimensional and Two Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields – description of Vertical, Inclined and Gravity Turn Trajectories – Determination of range and Altitude Simple Approximations to Burnout Velocity.

UNIT2. STAGING AND CONTROL OF ROCKETS AND MISSILES
Multistaging of rockets – Vehicle Optimization – Stage Separation Dynamics – Separation Techniques. Rocket Thrust Vector Control Methods.

UNIT 3. AERODYNAMICS OF ROCKETS AND MISSILES
Airframe Components of Rockets and Missiles – Forces Acting on a Missile While Passing Through Atmosphere – Classification of Missiles – methods of Describing Aerodynamic Forces and Moments – Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces – Drag Estimation.

UNIT 4. ROCKET PROPULSION SYSTEMS
Ignition System in rockets – types of Igniters – Igniter Design Considerations – Design Consideration of liquid Rocket Combustion Chamber, Injector Propellant Feed Lines, Valves, Propellant Tanks Outlet and Helium Pressurized and Turbine feed Systems – Propellant Slash and Propellant Hammer – Elimination of Geysering Effect in Missiles – Combustion System of Solid Rockets.

UNIT5. MATERIALS FOR ROCKETS AND MISSILES
Selection of Materials – Special Requirements of Materials to Perform under Adverse Conditions.

Text Books

1. Sutton, G.P., et al., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 1993.

Reference Books

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

808AET05 - STRUCTURAL DYNAMICS

UNIT1.FORCE DEFLECTION PROPERTIES OF STRUCTURES
Constraints and Generalized coordinates-Virtual work and generalized forces-Force-Deflection influence functions-stiffness and flexibility methods.

UNIT2. PRINCIPLES OF DYNAMICS
Free and forced vibrations of systems with finite degrees of freedom-Damped oscillations-D" Alembert's principle-Hamilton's principle-Lagrangean equations of motion and applications.

UNIT3. NATURAL MODES OF VIBRATION
Equation of motion for free vibrations solution of Eigen value problems-Normal coordinates and orthogonality relations.

UNIT4. ENERGY METHODS
Rayleigh's principle-Rayleigh-Ritz method-Coupled natural modes-Effect of rotary inertia and shear on lateral vibrations of beams-Natural vibrations of plates.

UNIT5. APPROXIMATE METHODS
Approximate methods of evaluating the Eigen frequencies and the dynamics response of continuous systems-Matrix methods of dynamic stress analysis.

Text Books

1. F. S. Tse, I. E. Morse and H. T. Hinkle, "Mechanical Vibration", Prentice Hall of India Pvt. Ltd, New Delhi, 1988.
2. W. C. Hurty and M. F. Rubinstein, "Dynamics of Structures", Prentice Hall of India Pvt. Ltd, New Delhi, 1987.

Reference Books

1. R. K. Vierck, "Vibration Analysis" 2nd Edition, Thomas Y. Crowell & Co Harper & Row Publishers, New York, U.S.A. 1989.
2. S. P. Timoshnko ad D. H. Young, "Vinration Problems in Engineering", John Willey & Sons Inc., 1984.
3. von Karman and A. Biot, "Mathematical Methods in Engineering", McGraw-Hill Book Co., New York, 1985.

808AET06 - AIR TRAFFIC CONTROL AND PLANNING

OBJECTIVE

To study the procedure of the formation of aerodrome and its design and air traffic control.

UNIT1. BASIC CONCEPTS

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

UNIT2. AIR TRAFFIC SERVICES

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

UNIT 3. FLIGHT INFORMATION ALERTING SERVICES, COORDINATION, EMERGENCY PROCEDURES AND RULES OF THE AIR

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

UNIT4. AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

UNIT 5. VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES

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

Text Book

1. AIP (India) Vol. I & II, "The English Book Store", 17-1, Connaught Circus, New Delhi.

Reference Books

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

808AET07 - AIRCRAFT PRODUCTION PLANNING AND CONTROL

OBJECTIVE:
To understand the various components and functions of production planning and control such as product planning, product scheduling and inventory control.

UNIT1. INTRODUCTION:
Factors affecting planning-Forecasting information necessary for pre-planning-sources of information-Methods of forecasting-aircraft components requiring overhaul-repairmodifications-premature-failures-project planning-estimates of plant, machinery, buildings, manpower, materials, spare parts, time, and cost estimates.

UNIT2. MATERIALS, MACHINES AND PROCESSES:
Production engineering knowledge necessary for Planning, machine tools and processes.-Materials including aircraft materials and their processing-Spare parts required for overhaul and maintenance-Ground handling equipment-testing of components and aircraft overhaul-standards for acceptance after overhaul.

UNIT3. EQUIPMENT AND TOOLS:
Pre-planning required for provision of special tools, jigs, fixtures and test equipment required for overhaul and maintenance-types and description of major test equipment.

UNIT4. PRODUCTION PLANNING:
Production planning function of routing, estimating and scheduling –LOB-CPM and PERT. Queuing theory, sequencing in jobs, shop scheduling, assembly line balancingcharts and graphs.

UNIT5. PRODUCTION CONTROL:
Production control functions of dispatching, progressing and evaluation-Activities of progressing-shop procedures-maintenance of critical data statistics of evaluation control charts.

Text Books

1. Thomas. L. "Production planning and control" Mc Graw Hill, 1985.
2. Jain. K. C. and Aggarwal. L. N. "Production planning and control and Industrial Management, Khanna publishers, 1990.

Reference Books

1. Buffa. E. S. and Sarin. R. K. "Modern production / operations management"8th ed, John Willey and sons, 2000.
2. MacNiece. E. H. "Production forecasting, planning and control", John Willey, 1986.
3. Mages. J. F. "Production planning and Inventory control", McGraw Hill, 1990.

808AET08 - ENGINE SYSTEM AND CONTROL

OBJECTIVE

To give an exposure to the different systems in Aircraft Engines and the methodologies as well as instruments used for engine controls & indication.

UNIT1. ENGINE CONSTRUCTION

Layout – Piston Engine – Turbo Prop-Gas Turbine Engines – Modular concept. Oil System – Fuel systems – Heat Management system of Gas Turbine Engines. Lubricants and Fuel used – Engine Materials – Compressor, Turbine, Frames and Casting etc.

UNIT2. ENGINE SYSTEMS

Air System and Pneumatics – Engine controls – FADEC Fire Protection System – Ignition and Starting system – Engine Anti-icing system.

UNIT 3. MAINTENANCE & INSPECTION

Maintenance aspects of Gas Turbine Engines – Preventive condition (performance) Monitoring – Boroscopic Inspection – On wing Trim Balance – Test bed overhaul.

UNIT4. CONTROL INSTRUMENTS

Engine sensors – Basic construction – Processing signals – Analog and Digital Indication – Scaling – Monitoring of Instruments / Indicators.

UNIT5. ENGINE INSTRUMENTS

Primary instruments – RPM, Fuel flow, Exhaust Gas Temperature, Thrust parameters – Secondary Instruments – Vibration indicator, Oil Pressure and Oil Temperature indictor, Nacelle Temp. Indicator.

Text Books

1. Aircraft Instruments – E H J Pallett, Pitman & Co., 1993
2. Aircraft Gas Turbine Engine Technology – Irwin E Treager, English Book Stores, New Delhi
3. Aircraft Gas Turbine and Operation – PRATT AND WHITENY, United Technologies, English Book Stores, New Delhi

Reference Books

1. "General Hand Book of Airframe and Power Plant" US Department of Transportation, FAA, English Book Stores, New Delhi
2. Turbo Mache of Gas Turbine, English Book Stores, New Delhi
3. Aircraft Gas Turbine Guide, P&W Publications, English Book Stores, New Delhi Rolls Royce, The Jet Engine, Rolls Royce Ltd., III Edition, 1983

808AET09 - FUNDAMENTALS OF NANOSCIENCE

UNIT1. INTRODUCTION

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT2. PREPARATION METHODS

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT3. PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT4. PREPARATION ENVIRONMENTS

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT 5. CHARECTERISATION TECHNIQUES

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

Text Books

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

Reference Books

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

808AET10 - MAINTENANCE ENGINEERING

OBJECTIVES:

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT 1. PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT2. MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT3. CONDITION MONITORING

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

UNIT4. REPAIR METHODS FOR BASIC MACHINE ELEMENTS

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT5. REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

Text Books

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995

Reference Books

1. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
2. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
3. Armstrong, "Condition Monitoring", BSIRSA, 1988.
4. Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996.
5. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996.

808AET11 - RELIABILITY ENGINEERING

OBJECTIVES:

- To stress the importance of reliability in Engineering and products also the
- concept of maintability, failure modes and testing methods**.**

UNIT1. CONCEPTS OF RELIABILITY, SYSTEM AND MODELS

Definition of reliability – reliability Vs quality-reliability function-MTTF – hazard rate function- bathtub curve – derivation of the reliability function-constant failure rate model – time dependent failure models. Weibull distribution – normal distribution – the lognormal distribution. Serial configuration – parallel configuration – combined series parallel systems – system structure function, minimal cuts and minimal paths – Markov analysis – load sharing systems, standby system, degraded systems, three state devices – covariate models, static models, dynamic models, physics of failure models

UNIT2. DESIGN FOR RELIABILITY AND MAINTAINABILITY

Reliability design process – system effectiveness – economic analysis and life cycle cost – reliability allocation – optimal, Arinc, Agree, - Design methods – parts and material selection, derating, stress-strength analysis – failure analysis – identification of failure mode – determination of causes – assessment of effects – classification of seventy – computation of critically index – corrective action – system safety and FTA. Analysis of downtime – the repair time distribution – stochastic point processes – system repair time – reliability under preventive maintenance – state dependent systems with repair – MTTR-mean system downtime – MTR – MH/OH – cost model – fault isolation and self diagnostics – repair Vs replacement – replacement model – proactive, preventive, predictive maintenance – maintenance and spares provisioning – maintainability prediction and demonstration – concepts and definition of availability.

UNIT3. OPTIMIZATION OF SYSTEM RELIABILITY

Optimization techniques for system reliability with redundancy – heuristic methods applied to optimal system reliability- redundancy allocation by dynamic programming – reliability optimization by non linear programming.

UNIT4. THE ANALYSIS OF FAILURE DATA AND RELIABILITY TESTING

Data collection – empirical methods – ungrouped and grouped complete, censored data – static life estimation – test time calculation – burn in testing, acceptance, sequential, binomial testing – accelerated life testing – ther acceleration models – experimental design – reliability growth process – idealized growth curve – various growth models – identifying failure and repair distributions.

UNIT5. PACKAGING AND TRANSPORTATION FOR RELIABILITY

Objectives – preservation-packaging – transportation and subsequent storage – reliability and the customer - Purchase of equipment – installation – commissioning a new system – reliability prediction and control – reliability management – the people concerned with reliability, coordination, training

Text Book

1. Charles E. Ebling, "An introduction to Reliability and Maintainability Engg", Tata McGraw-Hill, 2000.

Reference Books

1. Patrick D T o'connor, "Practical Reliability Engineringt", John-Wiley and Sons inc, 2002.
2. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002
3. Way kuo, Rajendra Prasad V, Frank A and Tillman, ching- lai Hwang "Optimal Reliability Design and Applciations", Cambridge University Press P ltd., 2001.
4. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.
5. Oleg Vinogradov, "Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 1991.