SCHEME and SYLLABI
OF
BACHELOR OF TECHNOLOGY (B.TECH)
AERONAUTICAL ENGINEERING
(3RD to 8TH SEMESTERS)

UNIVERSITY OF CALICUT
(2014 ADMISSION ONARDS)
## Aeronautical Engineering
### 2014 Scheme

### III SEMESTER B.Tech (Aeronautical Engg.)

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Marks</th>
<th>Duration (Hr)</th>
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**Note:**
For EN 14 302 Computer Programming in C, the end semester examination will be held by the University as a theory paper.

### IV SEMESTER B.Tech (Aeronautical Engg.)

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<tr>
<th>Code</th>
<th>Subject</th>
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SYLLABUS - B.Tech - Aeronautical Engineering - 2014
### V SEMESTER B.Tech (Aeronautical Engg.)

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# VII SEMESTER B.Tech (Aeronautical Engg.)

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# VIII SEMESTER B.Tech (Aeronautical Engg.)

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Total Credits =210
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<tr>
<td>AN14 606(A) Wind Tunnel techniques</td>
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<td>AN14 606(B) Theory of Elasticity</td>
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<td>AN14 606(C) Boundary Layer Theory</td>
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<td>AN14 606(D) High temperature materials</td>
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<td>AN14 704(A) Engine system and control</td>
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<tr>
<td>AN14 704(B) Theory of Plates and Shells(G)</td>
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<td>AN14 704(C) Production planning and control</td>
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<td>AN14 704(D) Aero Engine Repair and Maintenance</td>
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<td>AN14 705(A) Experimental aerodynamics</td>
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<td>AN14 705(B) Air traffic control and planning</td>
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<td>AN14 705(C) Fatigue and fracture (G)</td>
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<td>AN14 705(D) Helicopter Aerodynamics</td>
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<td>AN14 804(B) Satellite Technology (G)</td>
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<td>AN14 804(C) Industrial aerodynamics</td>
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<td>AN14 804(D) Structural Dynamics</td>
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<td>AN14 805(A) Combustion Technology (G)</td>
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<td>AN14 805(B) Refrigeration Engineering</td>
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<td>AN14 805(C) Helicopter Maintenance</td>
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<td>AN14 704(B) Theory of Plates and Shells(G)</td>
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<td>AN14 805(A) Combustion Technology (G)</td>
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EN14 301: ENGINEERING MATHEMATICS III  
(Common for all branches)

Teaching scheme  
3 hours lecture and 1 hour tutorial per week

Objective

1. To provide a quick overview of the concepts and results in complex analysis that may be useful in engineering.

2. To introduce the concepts of linear algebra and Fourier transform which are wealths of ideas and results with wide area of application.

Module 1: (13 hours)  

Module 2: (14 hours)  

Module 3: (13 hours)  

Module 4: (14 hours)  

Text Books

Module I:

Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc. Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.9

Module II:


Module III:

Bernael Kolman, David R Hill, Introductory Linear Algebra, An Applied First Course, Pearson Education.  
Sections: 6.1, 6.2, 6.3, 6.4, 6.8, Appendix.B.1

Module IV:

Reference books


**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)  
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.  
10% - Attendance and Regularity in the class

**University Examination Pattern**

**PART A:** Analytical/problem solving *SHORT questions*  
$8 \times 5$ marks = 40 marks

Candidates have to answer EIGHT questions out of TEN.  
There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving *DESCRIPTIVE questions*  
$4 \times 15$ marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
EN14 302 COMPUTER PROGRAMMING IN C  
(Common for all branches)

Teaching scheme
2 hours lectures and 1 hour lab per week

Credits: 3

Objectives
- To impart the basic concepts of computer and information technology
- To develop skill in problem solving concepts through learning C programming in practical approach.

Module 1 (8 hours)

Module 2 (9 hours)
Basic elements of C: Flow chart and algorithm – Development of algorithms for simple problems. Structure of C program – Operators and expressions – Procedure and order of evaluation – Input and Output functions, while, do-while and for statements, if, if-else, switch, break, continue, goto, and labels. Programming examples.

Module 3 (10 hours)

Module 4 (9 hours)

Text Books

Reference Books
University of Calicut

5. S. Kochan, Programming in C, CBS publishers & distributors

**Internal Continuous Assessment (Maximum Marks-50)**

- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**  
8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 303: COMPUTER ASSISTED MACHINE DRAWING

Teaching scheme

3 hours practical and 1 hour theory per week

Objective:

- To impart the fundamental concepts of machine drawing.
- To develop primary knowledge of working drawings.
- To produce orthographic drawing of different machine parts.
- To develop skill to produce assembly drawings.
- To develop skill to produce detailed drawings of machines parts from assembly drawing.
- To develop skill to produce drawings by using any standard CAD software.

Module 1 (8 hours - 1 Printout, 2 Drawing sheets)


Module 2 (16 Hrs. - 2 Printouts, 4 Drawing sheets)

- Tolerances and Fits - Limits and tolerances of machine parts - Hole system and shaft system of tolerances - Designation of fundamental deviation - Types of fits and their selection - Indication of dimensional tolerances and fits on simple machine parts – Geometrical tolerances - Recommended symbols - Indication of geometrical tolerances on simple machine parts - Surface roughness - Indication of surface finish on drawings - Preparation of shop floor drawings of simple machine parts.

- Bearings - Solid journal bearings - Bushed bearings - Plummer block and footstep bearings - Types of rolling contact bearings - Conventional representation of ball and roller bearings - Assembly of radial and thrust type rolling contact bearings in housing. (Scaled drawings of machine parts or their assembly showing dimensional tolerance are to be prepared.)

Module 3 (30 Hrs. - 3 Printouts, 4 Drawing sheets)


- Assembly Drawings: Steam stop valve - Spring loaded safety valve – Blow-off-cock - Gate valve, Glob valve- Ball valve- Non return valve (Scaled drawings of assembled views are to be practiced).

Note:

- Drawing practical classes have to be conducted by using any standard CAD software and using drawing instruments in alternative weeks (3 Hours) preferably for each half of the students. Semester End examination (3 Hours) shall be conducted by using drawing instruments only.

- All drawing exercises mentioned above are for class work. Additional exercises where ever necessary may be given as home assignments.

SYLLABUS - B.Tech - Aeronautical Engineering - 2014
University of Calicut

References Books:

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University examination pattern

**Question I**  
Answer any one question out of two questions of 25 marks each from (a) and (b) sections of module I.  
\[ 1 \times 25 = 25 \text{ marks} \]

**Question II**  
Answer any one question out of two questions of two questions of 30 marks each from (a) and (b) sections of module II.  
\[ 1 \times 30 = 30 \text{ marks} \]

**Question III**  
Answer any one question out of two questions of two questions of 45 marks each from (a) and (b) sections of module III.  
\[ 1 \times 45 = 45 \text{ marks} \]

Total = 100 marks
AN14 304 MICROPROCESSORS AND APPLICATIONS

Teaching scheme

Credit: 4
3 hours lecture and 1 hour tutorial per week

Objective

- To give the principle and applications of microprocessors to the students

Module 1. (14 hours)


Module 2. (14 hours)


Module 3. (13 hours)

Microprocessors: Block Diagram of Microprocessors -Architecture of Intel 8085 -Importance of Data, Address and Control Buses -Instruction Formats -Addressing Modes and Types of Intel 8085 - Instruction Set For 8085 Development of Simple Language Assembly Programs -Architecture and Functioning of Processors like Z80, M6800 and Intel Family of 80 X86 Processors.

Module 4. (13 hours)

Microprocessor memory devices: RAM, ROM, EPROM -magnetic Bubble Memory -Floppy and Hard Disc -Interfacing of Memory Chips -CRT Terminals -Printers, Keyboards and their Interfacing - Parallel and Series Communication Synchronous and Asynchronous Data Transfer -DMA Data Transfer. APPLICATIONS: Microprocessor Applications in aerospace -Case study.

TEXT BOOKS


References


**Internal Continuous Assessment (Maximum Marks-50)**

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Attendance and Regularity in the class

**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 305: MECHANICS OF SOLIDS

Teaching scheme
4 hours lecture and 1 hour tutorial per week

Credits: 5

Objective

- To acquaint with the basic concepts of stress and deformation in solids.
- To practise the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

Module 1 (19 hours)


Module 2 (18 hours)


Axial force, shear force and bending moment: Diagrammatic conventions for supports and loading - axial force, shear force and bending moment in a beam – differential relations between load, shear force and bending moment - shear force and bending moment diagrams by direct and summation approach - use of singularity functions – elastic curve – point of inflection.

Module 3 (15 hours)


Module 4 (15 hours)


Compound stresses: Combined axial, flexural and shear loads – eccentric loading under tension/compression - kern of a section (rectangular and circular section) - combined bending and twisting loads.

Text Books


Reference Books


**Internal Continuous Assessment (Maximum Marks-50)**

<table>
<thead>
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<td>10%</td>
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NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS

**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. 
There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 306 METALLURGY AND MATERIAL SCIENCE

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objective:
- To impart knowledge on engineering materials, deformation of the crystals, equilibrium diagrams of selected alloy systems, heat treatment of steels, properties of steels, cast iron and other alloys, and its application

Module 3 (12 hours)

Module 2 (14 hours)

Module 3 (14 hours)

Module 4 (14 hours)

Text Books

Reference Books
**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)  
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.  
10% - Attendance and Regularity in the class  

**NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS**

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**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN.  
There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 307(P): MATERIAL TESTING LAB

Teaching scheme
3 hours practical per week

Objective
- To provide knowledge on the mechanical behaviour of materials.
- To acquaint with the experimental methods to determine the mechanical properties of materials.

List of experiments:
1. Standard tension test on mild steel using Universal Testing Machines and suitable extensometers
2. Stress-strain characteristics of brittle materials – cast iron
3. Spring test – open and closed coiled springs – determination of spring stiffness and modulus of rigidity
4. Determination of modulus of rigidity of wires
5. Hardness tests – Brinnell hardness, Rockwell hardness (B S C scales), Rockwell superficial hardness (N & T scales), and Vickers hardness
6. Impact test – Izod and Charpy
7. Bending test on wooden beams
8. Fatigue testing – study of testing machine
9. Photoelastic method of stress measurements (two dimensional problems)
10. Torsion test on mild steel rod
11. Shear test on mild steel rod

Reference Books
2. J. W. Dally, W. P. Railey, Experimental Stress Analysis, McGraw Hill

Internal Continuous Assessment (Maximum Marks-50)
50% - Lab Practical Tests
20% - Assignments
20% - Main Record
10% - Regularity in the class

Semester End Examination (Maximum Marks-100)
70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record
AN 14 308(P) PRODUCTION ENGINEERING LAB

Teaching Scheme

3 hours practical per week

Credits: 2

Objective
1. To acquaint the basics of lathe and accessories, shaping and slotting machine, planning machines
2. To learn about different tools used for different operations.
3. To impart training on plane turning, groove cutting, form turning, taper turning, facing and thread cutting.
4. To impart exercise involving production of flat surfaces, grooves and keyways.

Experiments.
- Step cutting
- Tapper turning
- Eccentric turning
- Forming
- Knurling
- Tread cutting.
- Milling operation.
- Shaping and slotting operations

Internal Continuous Assessment (Maximum Marks - 50)
- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

Semester End Examination (Maximum Marks - 100)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
EN14 401: ENGINEERING MATHEMATICS IV  
(Common for ME, CE, PE, CH, BT, PT, AM, and AN)

Teaching scheme  
3 hours lecture and 1 hour tutorial per week

Credits: 4

**Objective**
- To provide a comprehensive introduction to those models and methods most likely to be encountered and used by students in their careers in engineering.
- To provide an introduction to some important partial differential equations

**Module 1: Probability Distributions (13 hours)**

**Module 2: Theory of Inference (14 hours)**

**Module 3: Series Solutions of Differential Equations (14 hours)**

**Module 4: Partial Differential Equations (13 hours)**
Introduction – Formation of PDE – Complete Solution – Equations solvable by direct integration – Linear PDE of First order, Lagrange’s Equation: Pp + Qq = R – Non-Linear PDE of First Order, F(p,q) =0 , Clairaut’s Form: z = px + qv + F(p,q) , F(z,p,q) =0 , F_1(x,q) = F_2(y,q) – Classification of Linear PDE”s – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables.

**Text Books**

**Module I:**
Richard A Johnson, CB Gupta, *Miller and Freund’s Probability and statistics for Engineers, 7e*, Pearson Education- Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7

**Module II:**

**Module III:**
Erwin Kreysig, *Advanced Engineering Mathematics, 8e*, John Wiley and Sons, Inc.- Sections: 4.1, 4.4, 4.5

**Module IV:**

SYLLABUS - B.Tech - Aeronautical Engineering - 2014
University of Calicut

Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.
Sections: 11.2, 11.3, 9.8 Ex.3, 11.5

Reference books


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
EN14 402 ENVIRONMENTAL SCIENCE
(Common for all branches)

Teaching scheme
Credits: 3
2 hours lecture and 1 hour tutorial per week

Objectives
- To understand the problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues
- To create awareness among the students to address these issues and conserve the environment in a better way.

Module 1 (8 hours)
The Multidisciplinary nature of environmental science. Definition-scope and importance-need for public awareness. Natural resources. Renewable and non-renewable resources: Natural resources and associated problems-forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects 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 over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.- Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources, Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Module 2 (8 hours)
Ecosystems-Concept of an ecosystem-structure and function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession- Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest ecosystem- Grassland ecosystem –Desert ecosystem-Aquatic ecosystem(ponds, streams, lakes, rivers, oceans , estuaries)
Biodiversity and its consideration Introduction- Definition: genetic, species and ecosystem diversity-Bio-geographical; classification of India –value of biodiversity; consumptive use, productive use, social ethical , aesthetic and option values Biodiversity at Global, national , and local level-India at mega –diversity nation- Hot spot of biodiversity-Threats to biodiversity: habitat loss, poaching of wild life, man , wild life conflicts – Endangered and endemic species of India-Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Module 3 (10 hours)
Environmental pollution Definition-Causes, effects and control measures of Air pollution- Water pollution –soil pollution-Marine pollution-Noise pollution-Thermal pollution-Nuclear hazards-Solid waste management: Causes, effects and control measures of urban and industrial wastes-Role of an individual in prevention of pollution. Pollution case studies-Disaster management: floods , earthquake, cyclone and landslides-Environmental impact assessment

Module 4 (10 hours)
Environment and sustainable development-Sustainable use of natural resources-Conversion of renewable energy resources into other forms-case studies-Problems related to energy and Energy auditing-Water conservation, rain water harvesting, water shed management-case studies-Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust-Waste land reclamation Consumerism and waste products-Reduce, reuse and recycling of products-Value education.
Text Books:
1. Daniels & Krishnaswamy, *Environmental studies*, Wiley India Pvt Ltd, 2009

References:
4. Education, 2012


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**Note:** Field work can be Visit to a local area to document environmental assets-river/forest/grass land/mountain or Visit to local polluted site-urban/rural/industrial/agricultural etc. or Study of common plants, insects, birds etc. or Study of simple ecosystems-pond, river, hill slopes etc. or mini project work on renewable energy and other natural resources, management of wastes etc.

University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN.  
There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 403 AIRCRAFT STRUCTURES-I

Teaching scheme
4 hours lecture and 1 hour tutorial per week

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.

MODULE 1 (18 hours)

MODULE 2 (16 hours)
Energy: Strain Energy due to axial, bending and Torsional loads -Castigliano's theorem -Maxwell's Reciprocal theorem, Unit load method -application to beams, trusses, frames, rings, etc. (Numerical problems included)

MODULE 3 (18 hours)
Columns: Columns with various end conditions -Euler's Column curve -Rankine's formula Column with initial curvature -Eccentric loading -South well plot -Beam column. (Numerical problems included)

MODULE 4 (15 hours)
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

REFERENCE

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS
University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8x 5 marks=40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks=60 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 404 THERMODYNAMICS AND THERMAL ENGINEERING

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objective

- To introduce fundamental concepts in thermodynamics, heat transfer, propulsion and refrigeration and air conditioning.

Module I (14 hours)


Module II (20 hours)

AIR CYCLE AND COMPRESSORS: Camot, Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure, Reciprocating compressors.


Module III (10 hours)


Module IV (10 hours)


(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

Text Books


REFERENCES

Internal Continuous Assessment (Maximum Marks 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

NOTE: PROBLEMS SHOULD BE ASKED FOR 50 MARKS

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 405 FLUID MECHANICS AND HYDRAULIC MACHINERY

TEACHING SCHEME Credits : 4
3 hours lecture and one hour tutorial per week.

OBJECTIVE:
To introduce the concepts of fluid statics viscosity and buoyancy. To make the student understand the basic laws namely, mass momentum and energy.

MODULE I (12 hours)


MODULE II (14 hours)


MODULE III (14 hours)

INCOMPRESSIBLE INVISCID FLOW : Euler”s equations of motion – Bernoulli”s equations – Applications – Methods of pressure measurement – Flow measurement – Orifice plate – Venturi meter – Irrotational flow – Stream function and velocity potential – Laplace equation – Elementary plane flows

MODULE IV (14 hours)

INCOMPRESSIBLE VISCOUS FLOW : Fully developed laminar flow between infinite parallel plates – Laminar and turbulent flow through pipes – Velocity profiles – Energy considerations in pipe flow – Calculation of head loss Pipe flow problems – Hydraulic and energy grade lines – Moody”s diagram.

TEXT BOOKS

REFERENCE BOOKS
Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 406 ELEMENTS OF AERONAUTICS

Teaching scheme
3 hours lecture and 1 hour tutorial per week

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

Module 1 (14 hours)

Historical evaluation: Early airplanes, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

Aircraft configurations: Components of an airplane and their functions. Different types of flight vehicles, classifications. Conventional control, Powered control, Basic instruments for flying. Typical systems for control actuation.

Module 2 (16 hours)

Introduction to principles of flight: Physical properties and structure of the atmosphere-International Standard Atmosphere-Temperature, pressure and altitude relationships, Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag - Drag polars of vehicles from low speed to high speeds - Aerofoils, Mach number, Manoeuvres.

Module 3 (12 hours)

Introduction to airplane structures and materials: General types of construction, Monocoque, semi-monocoque and geodesic construction, Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminum alloy, titanium, stainless steel and composite materials.

Module 4 (12 hours)

Power plants used in airplanes: Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

Text book

Reference

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
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University of Calicut

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN 14 407(P) FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

Teaching Scheme

3 hours practical per week

LIST OF EXPERIMENTS
1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

LIST OF EQUIPMENT (for a batch of 30 students)
1. Orifice meter setup
2. Venturi meter setup
3. Rotameter setup
4. Pipe Flow analysis setup
5. Centrifugal pump/submergible pump setup
6. Reciprocating pump setup
7. Gear pump setup
8. Pelton wheel setup
9. Francis turbine setup
10. Kaplan turbine setup

Quantity: one each.

Internal Continuous Assessment (Maximum Marks-50)
- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

Semester End Examination (Maximum Marks-100)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
AN14 408(P) AIRCRAFT STRUCTURES LAB-I

Teaching scheme
3 hours practical per week

Credits: 2

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 materials
4. Determination of fracture strength and fracture pattern of brittle materials
5. Stress Strain curve for various engineering materials.
6. Deflection of beams with various end conditions.
7. Verification of Maxwell's Reciprocal theorem & principle of superposition
8. Column -Testing
9. South -well's plot.
10. Riveted Joints

Internal Continuous Assessment (Maximum Marks-50)
- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

Semester End Examination (Maximum Marks-100)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
AN14 501 AIRCRAFT STRUCTURES –II

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective
- To study the behavior of various aircraft structural components under different types of loads.

Module 1 (11 hours)
Unsymmetrical bending: Bending stresses in beams of unsymmetrical sections - Bending of symmetric sections with skew loads.

Module 2 (11 hours)
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.

Module 3 (12 hours)

Module 4 (20 hours)
Buckling of plates: Rectangular sheets under compression, Local buckling stress of thin walled sections, Crippling stresses by Needham's and Gerard's methods, Thin walled column strength. Sheet stiffener panels. Effective width, inter rivet and sheet wrinkling failures.
Stress analysis in wing and fuselage: Procedure - Shear and bending moment distribution for semi cantilever and other types of wings and fuselage, thin webbed beam. With parallel and non parallel flanges, Shear resistant web beams, Tension field web beams (Wagner's).

Text book

References

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class.

SYLLABUS - B.Tech - Aeronautical Engineering - 2014
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*Maximum Total Marks: 100*
AN14 502 AERODYNAMICS –I

Teaching scheme

4 hours lecture and 1 hour tutorial per week

Credits: 5

Objective

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

Module 1 (11 hours)

Two Dimensional Flows: Continuity, momentum and energy equations. 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

Module 2 (18 hours)


Module 3 (19 hours)

Airfoil and Wing Theory: Thin aerofoil theory and its applications. Vortex line, Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations. Boundary Layer, displacement, energy and Momentum thickness, Flow over a flat plate, Blasins solution.

Module 4 (19 hours)

Characteristics of high speed aerofoils: 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, Tip effects.

Text books


References


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class.

SYLLABUS - B.Tech - Aeronautical Engineering - 2014
**University Examination Pattern**

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 503 PROPULSION –I

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (12 hours)


Module 2 (12 hours)


Module 3 (14 hours)


Module 4 (16 hours)


Text books


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AN14 504 FLIGHT DYNAMICS

Teaching scheme

Credits: 4

3 hours lecture and 1 hour tutorial per week

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

Module 1 (14 hours)

Aircraft performance in un-accelerated flight: Performance of airplane in level flight - Power available and power required curves- Maximum speed in level flight - Conditions for minimum drag and power required - 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) (Numericals should be done on each case)

Module 2 (14 hours)

Aircraft performance in accelerated flight: Turning performance (Turning rate turn radius). Bank angle and load factor - Limitations of pull up and push up diagrams and load factor, take off and landing performances. (Numericals should be done on each case)

Module 3 (13 hours)

Longitudinal stability: Degree of freedom of rigid bodies in space - Static and dynamic stability - 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-Determination of neutral points and maneuver points from flight test. Dynamic Longitudinal stability Equation of motion Stability derivatives characteristics equation of stick fixed case Modes and stability criterion.

Module 4 (13 hours)

Lateral and directional stability: Dihedral effect- Lateral control-cross 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 Effect of freezing the stick Brief description of lateral and directional. Dynamic stability Spiral, Divergence, Dutch, roll, autorotaton and spin

Text Book


References

1. Etkin B., Dynamics of flight stability and control, John wiley 1982

**Internal Continuous Assessment (Maximum Marks-50)**

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Attendance and Regularity in the class

**NOTE:** PROBLEMS SHOULD BE ASKED FOR 30 MARKS

**University Examination Pattern**

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN.  
There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 505 AIR FRAME MAINTENANCE AND REPAIR

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objective:
- To study the maintenance aspect of airframe systems and rectification of snags

Module 1 (14 hours)
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 - NDT. Testing Riveted repair design, Damage investigation - reverse technology.

Module 2 (13 hours)
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.

Module 3 (13 hours)
Aircraft jacking, assembly and rigging

Module 4 (14 hours)
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 pressurization 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)
Safety practices
Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting Theory and practices.

Text book

References
### Internal Continuous Assessment *(Maximum Marks-50)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Attendance and Regularity in the class

### University Examination Pattern

<table>
<thead>
<tr>
<th>PART A: Analytical/problem solving SHORT questions</th>
<th>8x 5 marks=40 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.</td>
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</table>

<table>
<thead>
<tr>
<th>PART B: Analytical/Problem solving DESCRIPTIVE questions</th>
<th>4x 15 marks=60 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two questions from each module with choice to answer one question.</td>
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</tr>
</tbody>
</table>

*Maximum Total Marks: 100*
AN14 506 AIRCRAFT SYSTEMS, INSTRUMENTATION AND APPLICATIONS

Teaching scheme

2 hours lecture and 1 hour tutorial per week

Objective

- To describe the principle and working of aircraft systems and instruments

Module 1 (9 hours)

Airplane control systems: Conventional Systems -Power assisted and fully powered flight controls - Power actuated systems - Engine control systems -Push pull rod system, flexible push full rod system -Components -Modern control systems - fly by wire systems -Auto pilot system, Communication and Navigation systems - Instrument landing system.

Module 2 (9 hours)


Module 3 (9 hours)

Engine Systems: Fuel systems for Piston and jet engines, -Components of multi cylinder engines. Lubricating systems for piston and jet engines -Starting and Ignition systems -Typical examples for piston and jet engines.

Module 4 (9 hours)

Auxilliary system: Basic Air cycle systems -Vapour Cycle systems, Boost-Strap air cycle system - Evaporative vapour cycle systems -Evaporative air cycle systems -Oxygen systems -Fire protection systems, Deicing and anti icing systems.

Aircraft instruments


Text books


References

Internal Continuous Assessment (*Maximum Marks* 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**

8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**

4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 507(P) AERODYNAMICS LABORATORY

Teaching scheme
3 hours practical per week

Credits: 2

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

List of experiments
1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth cylinder.
3. Pressure distribution over rough cylinder.
4. Pressure distribution over symmetric airfoils.
5. Pressure distribution over cambered airfoils & thin airfoils
6. Lift and drag estimation on symmetric aerofoil at various angle of attack.
7. Lift and drag estimation on unsymmetric aerofoil at various angle of attack.
8. Lift and drag estimation on flat plate at various angle of attack.

Internal Continuous Assessment (Maximum Marks-50)
50% - Lab Practical Tests
20% - Assignments
20% - Main Record
10% - Regularity in the class

Semester End Examination (Maximum Marks-100)
70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record
AN14 508(P) AIRCRAFT STRUCTURES, REPAIR AND MAINTENANCE LAB –II

Teaching scheme
3 hours practical per week

Objective
- To experimentally study the unsymmetrical bending of beams, find the location of shearcentre, obtain the stresses in circular discs and beams using photo elastic techniques, calibration of photo-elastic materials and study on vibration of beams.
- To give training on riveting, patchwork, welding and carpentry

List of experiments

Structures:
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 photo elastic techniques

Repair & Maintenance
1. Aircraft wood gluing
2. Welded patch repair by TIG, MIG, PLASMA ARC
3. Fabric Patch repair
4. Riveted patch repairs.
5. Repair of composites and sandwich panels

Internal Continuous Assessment (Maximum Marks -50)
50% - Lab Practical Tests
20% - Assignments
20% - Main Record
10% - Regularity in the class

Semester End Examination (Maximum Marks -100)
70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record
AN14 601 AERODYNAMICS –II

Teaching scheme
3 hours lecture and 1 hour tutorial per week

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

Module 1 (10 hours)
One dimensional compressible flow: Energy, Momentum, continuity and state equations, velocity of sound, adiabatic steady state flow equations, Flow through converging, diverging passages, Performance under various back pressures.

Module 2 (17 hours)

Module 3 (12 hours)
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.

Module 4 (15 hours)
Introduction to hypersonic aerodynamics: Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

Textbook

Reference
**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Attendance and Regularity in the class

**NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS**

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**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**

8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**

4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 602 PROPULSION –II

Teaching scheme

4 hours lecture and 1 hour tutorial per week

Objective

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

Module 1. (16hours)


Module 2.(16hours)


Module 3. (16hours)

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.

Module 4 (6hours)

Advanced propulsion techniques: Arc jet-Resisto jet-Hall effect thrusters-Electric rocket propulsion -Ion propulsion techniques - Nuclear rocket -Types -Solar sail-Preliminary Concepts in nozzle less propulsion.

Textbooks


References


Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 603 AVIONICS

Teaching scheme
2 hours lecture and 1 hour tutorial per week

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

Module 1 (9 hours)
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.

Module 2 (9 hours)
Principles of digital systems: DIGITAL AVIONICS ARCHITECTURE
Avionics system architecture - Data buses MIL-STD 1553 B-ARINC 429-ARINC 629, AFDX.

Module 3 (9 hours)
Flight deck and cockpit: 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

Module 4 (9 hours)

Textbooks

References
## Internal Continuous Assessment *(Maximum Marks-50)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Attendance and Regularity in the class.

## University Examination Pattern

### PART A: Analytical/problem solving SHORT questions

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

### PART B: Analytical/Problem solving DESCRIPTIVE questions

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 604 FINITE ELEMENT METHOD

Teaching scheme

Credits: 5

4 hours lecture and 1 hour tutorial per week

Objective

- To acquaint with basic concepts of finite element formulation methods.
- To practise finite element methodologies through simple structural and heat transfer problems.

Module 1 (16 hours)

Introduction, basic concepts, engineering applications FEM. Comparison with other methods of analysis. General procedure of FEM. Discretisation of Domain, types of elements, interpolation polynomials. Solid and structural mechanics, basic equations stresses and equilibrium, boundary conditions, strain displacement relations, stress-strain relations, temperature effects, vonmises stress.

Module 2 (17 hours)


Module 3 (17 hours)


Module 4 (17 hours)

Introduction to higher order elements- two dimensional problems, constant strain triangles, iso-parametric representation- element stiffness, force terms, stress calculation, temperature effects, orthotropic materials. Axisymmetric solids subjected to axisymmetric loading.

Test book:


References:

1. Introduction to finite elements in engineering, Thirupathi R.Chandrupatla and Ashok Belegundu, Pearson Education (2012)
Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS

University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 605 COMPUTER INTEGRATED MANUFACTURING

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective

- To gain knowledge on how computers are integrated at various levels of planning and manufacturing.
- To understand the flexible manufacturing system and to handle the product data and various Software used for manufacturing.

Module 1. (14 hours)


Module 2. (14 hours)


Module 3. (10 hours)


Module 4. (16 hours)


Textbook


References


Internal Continuous Assessment (Maximum Marks: 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 606: ELECTIVE 1

<table>
<thead>
<tr>
<th>List of Electives 1</th>
<th>credit : 4</th>
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</thead>
<tbody>
<tr>
<td>AN14 606(A)</td>
<td>Wind Tunnel techniques</td>
</tr>
<tr>
<td>AN14 606(B)</td>
<td>Theory of Elasticity</td>
</tr>
<tr>
<td>AN14 606(C)</td>
<td>Boundary Layer Theory</td>
</tr>
<tr>
<td>AN14 606(D)</td>
<td>High temperature materials</td>
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</tbody>
</table>

AN 14 606(A) WIND TUNNEL TECHNIQUES

Teaching scheme
Credits: 4
3 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (14 hours)


Module 2 (13 hours)


Module 3 (14 hours)

Wind tunnel measurements: Pressure and velocity measurements - Force measurements - Three component and six component balances - Internal balances.

Module 4 (13 hours)

Flow visualization: Smoke and Tuft grid techniques - Dye injection special techniques - Optical methods of flow visualization.

Textbook


Reference

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN 14 606(B) THEORY OF ELASTICITY

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (13 hours)

Assumptions in elasticity: Definitions-notations and sign conventions for stress and strain, Equations of equilibrium.

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.

Module 2 (14 hours)

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.

Module 3 (14 hours)

Polar coordinates: Equations of equilibrium, Strain displacement relations, Stress -strain relations, Axi -symmetric problems, Kirsch, Michell's and Boussinesque problems.

Module 4 (13 hours)

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.

Textbook


References


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8x 5 marks = 40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 606(C) BOUNDARY LAYER THEORY

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

PRE-REQUISITE: Basics of fluid mechanics.

OBJECTIVES:

- To make the student understand the importance of viscosity and boundary layer in fluid flow. To introduce the theory behind laminar and turbulent boundary layers.

Module 1 (13 hours)

FUNDAMENTAL EQUATIONS OF VICOUS FLOW

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non-dimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

Module 2 (14 hours)

SOLUTIONS OF VICOUS FLOW EQUATIONS

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

Module 3 (13 hours)

LAMINAR BOUNDARY LAYER EQUATIONS

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation-similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold’s analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

Module 4 (14 hours)

TURBULENT BOUNDARY LAYER

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modeling.

TEXT BOOKS


REFERENCE BOOKS

**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Attendance and Regularity in the class

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**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**  
8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 606(D) HIGH TEMPERATURE MATERIALS

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

OBJECTIVE
To learn damage mechanism and failure of components of elevated temperatures

Module 1 (10 HOURS)

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, temperatures and strain rate.

Module 2 (10 HOURS)

DESIGN FOR CREEP RESISTANCE (10 HOURS).
Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

Module 3 (10 HOURS)

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

Module 4 (24 HOURS)

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.

SUPER ALLOYS AND OTHER MATERIALS.
Iron base, Nickel base abd 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


REFERENCES


# Internal Continuous Assessment (Maximum Marks-50)

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Attendance and Regularity in the class

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## University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks=40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks=60 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 607(P) AVIONICS LABORATORY

Teaching scheme
3 hours practical per week

Credits: 2

Objective

- 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.
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.

Internal Continuous Assessment (Maximum Marks-50)
- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

Semester End Examination (Maximum Marks-100)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
AN14 608(P): MINI PROJECT

Teaching scheme
3 hours practical per week

Credits: 2

Objectives
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a model.
- For enabling the students to gain experience in organisation and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year

In this practical course, each group consisting of three/four members is expected to design and develop a moderately complex system with practical applications; this should be a working model. The basic concepts of product design may be taken into consideration while designing the project.

Internal continuous assessment will be carried out by the Guide. End Semester evaluation of individual student will be carried out by a committee consisting of minimum three faculty members. Students have to submit a report on the mini project and demonstrate the mini project before the evaluation committee.

<table>
<thead>
<tr>
<th>Internal Continuous Assessment by the Guide (Maximum marks - 50)</th>
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<tbody>
<tr>
<td>40% - Design and development</td>
</tr>
<tr>
<td>30% - Final result and Demonstration</td>
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<tr>
<td>20% - Report</td>
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<tr>
<td>10% - Regularity in the class</td>
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<tr>
<th>Semester End Examination (Maximum Marks-100)</th>
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</thead>
<tbody>
<tr>
<td>60% - Demonstration and Presentation of mini project</td>
</tr>
<tr>
<td>30% - Viva voce</td>
</tr>
<tr>
<td>10% - Final Report</td>
</tr>
</tbody>
</table>
AN14 701 CONTROL ENGINEERING

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective

- To understand the basic concepts of flight control systems.

Module 1. (14 hours)

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

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.

Module 2. (12 hours)

Characteristic Equation and Functions: Laplace transformation, Response of systems to different inputs viz., Step input, impulse, ramp, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

Module 3. (15 hours)

Concept of stability: Necessary and sufficient conditions, Routh – Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

Module 4. (13 hours)

Sampled Data Systems: Introduction to digital control system, Digital Controllers and Digital PID Controllers.

Text books


References


Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  \(8 \times 5\text{ marks}=40\text{ marks}\)

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  \(4 \times 15\text{ marks}=60\text{ marks}\)

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 702 COMPOSITE MATERIALS AND STRUCTURES

Teaching scheme

Credits: 4

3 hours lecture and 1 hour tutorial per week

Objective

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

Module I (14 hours)

Stress strain relation


Module 2 (14 hours)

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.

Module 3 (13 hours)

Laminated plates

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

Module 4 (13 hours)

Sandwich constructions


Text books


References


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
### University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8x 5 marks = 40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4x 15 marks = 60 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 703 VIBRATION AND AERO ELASTICITY

Teaching scheme  
2 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (11 hours)

Module 2 (12 hours)

Module 3. (16 hours)
Multi degrees of freedom systems: Two degrees of freedom systems - Static and Dynamic couplings vibration absorber - Principal coordinates, 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.

Module 4 (15 hours)
Approximate methods: Rayleigh's and Holzer Methods to find natural frequencies. ELEMENTS OF AERO ELASTICITY Concepts - Coupling - Aero elastic instabilities and their prevention - Basic ideas on wing divergence, loss and reversal of aileron control - Flutter and its prevention.

Textbooks


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS
University Examination Pattern

**PART A: Analytical/problem solving SHORT questions** 8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions** 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 704: ELECTIVE II

List of Electives II

<table>
<thead>
<tr>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>AN14 704(A)</td>
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<tr>
<td>AN14 704(B)</td>
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<tr>
<td>AN14 704(C)</td>
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<tr>
<td>AN14 704(D)</td>
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</tbody>
</table>

AN14 704(A) ENGINE SYSTEM AND CONTROL

Teaching scheme

3 hours lecture and 1 hour tutorial per week

OBJECTIVE

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

Module 1 (10 HOUR)


Module 2 (12 HOUR)


Module 3 (10 HOUR)


Module 4 (22 HOUR)


TEXT BOOKS

3. Aircraft Gas Turbine and Operation – PRATT AND WHITENY, United Technologies, English Book Stores, New Delhi

REFERENCES

2. Turbo Mache of Gas Turbine, English Book Stores, New Delhi

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 704(B) THEORY OF PLATES AND SHELLS(G)

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (13 hours)


Module 2 (14 hours)


Module 3 (14 hours)


Module 4 (13 hours)

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

Textbook


References


Internal Continuous Assessment (Maximum Marks - 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 704(C) PRODUCTION PLANNING AND CONTROL

Teaching scheme  Credits: 4
3 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (8 HOURS)

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

Module 2 (14 HOURS)

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.

Module 3 (12 HOURS)

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.

Module 4 (20 HOURS)

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

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:


REFERENCES:

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 704(D) AERO ENGINE REPAIRS AND MAINTENANCE

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objective

- To make the students to familiarize with the Aircraft engine maintenance procedure and practice.

Module 1 (16 Hours)

Classification of piston engines - Principles of operation - Function of components - Materials used - Details of starting the engines - carburetion and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction. Exhaust and cooling system - Maintenance and inspection check to be carried out. 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.

Propeller theory - operation, construction assembly and installation -Pitch change mechanism- Propeller axie system - Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

Module 2 (11 Hours)


Module 3 (17 Hours)

Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors- turbines-exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance- permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures- Foreign Object Damage - Blade damage.

Module 4 (10 Hours)

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

REFERENCES:

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 705: ELECTIVE III

List of Electives III

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>AN14 705(A)</td>
<td>Experimental aerodynamics</td>
</tr>
<tr>
<td>AN14 705(B)</td>
<td>Air traffic control and planning</td>
</tr>
<tr>
<td>AN14 705(C)</td>
<td>Fatigue and fracture (G)</td>
</tr>
<tr>
<td>AN14 705(D)</td>
<td>Helicopter Aerodynamics</td>
</tr>
</tbody>
</table>

AN14 705(A) EXPERIMENTAL AERODYNAMICS

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Objective:

- To present the measurement techniques involved in aerodynamic testing.

Module 1 (10 HOURS)

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.

Module 2 (12 HOURS)

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

Module 3 (16 HOURS)

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.

Module 4 (16 HOURS)

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.

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
References:

Internal Continuous Assessment (Maximum Marks-50)

| 60% | Tests (minimum 2) |
| 30% | Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc. |
| 10% | Attendance and Regularity in the class |

University Examination Pattern

PART A: Analytical/problem solving SHORT questions

- Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with a total of TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions

- Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 705(B) AIR TRAFFIC CONTROL AND PLANNING

Teaching scheme
3 hours lecture and 1 hour tutorial per week

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

Module 1 (8 HOURS)

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 83 setting procedures - Establishment, designation and identification of units providing ATS - Division of responsibility of control.

Module 2 (12HOURS)

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

Module 3 (10 HOURS)


Module 4 (24 HOURS)


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

Internal Continuous Assessment (Maximum Marks - 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN 14 705(C) FATIGUE AND FRACTURE(G)

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objective

- To study the concepts of estimation of the endurance and failure mechanism of components

Module 1 (13 hours)


Module 2 (14 hours)

Statistical aspects of fatigue behavior: 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.

Module 3 (14 hours)


Module 4 (13 hours)

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

Text books


References


Internal Continuous Assessment (Maximum Marks 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions 8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions 4x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 705(D) HELICOPTER AERODYNAMICS

Teaching scheme
3 hours lecture and 1 hour tutorial per week

PRE-REQUISITE: Basics of Aerodynamics

OBJECT:ve:
- To introduce the concepts of ideal rotor theory and ground effect machines. To make the student understand the theory behind hovercrafts and VTOL and STOL aircrafts.

Module 1 (12 HOUR)

ELEMENTS OF HELICOPTER AERODYNAMICS : Configurations based on Torque reaction – Jet rotors and compound helicopters – Methods of Control, rotor blade pitch control, Collective pitch and Cyclic pitch – Lead – Lag and flapping hinges

Module 2 (12 HOUR)

IDEAL ROTOR THEORY : Hovering performance – Momentum and simple blade element theories – Figure of merit – Profile and induced power estimation – Constant Chord and ideal twist rotors.

Module 3 (12 HOUR)

POWER ESTIMATES : Induced, profile and parasite power requirements in forward flight – Performance curves with effects of altitude – Preliminary ideas on helicopter stability.

Module 4 (18 HOUR)

LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT : Various configurations – propeller, rotor, ducted fan and jet lift – Tilt wing and vectored thrust – Performance of VTOL and STOL aircraft in hover, transition and forward motion. Types – Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machines – Drag of hovercraft on land and water – Applications of hovercraft.

TEXT BOOKS

REFERENCES

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions 8 x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 706(P) PROPULSION LABORATORY

Teaching scheme
3 hours practical per week

Credits: 2

Objective
- To understand the basic concepts and carry out 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.
9. Study of free jet.
10. Study of wall jet.

Internal Continuous Assessment (Maximum Marks - 50)
- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

Semester End Examination (Maximum Marks - 100)
- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record
AN14 707(P) CAD LABORATORY

Teaching scheme
3 hours practical per week

Credits: 2

Objective

• To train the students to learn about design and analysis of aeronautical components using software.

List of experiments

1. Three View diagram of Aircraft.
2. Estimation of forces and design of members in plane and space trusses using software package.
3. Design of Landing gear.
5. Drafting of Aircraft Wing Structural Elements.
6. Drafting of Aircraft Fuselage Structural Elements.
7. Static analysis of beams using software packages.
8. Static analysis of Plates.
10. Dynamic analysis of beams.

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<thead>
<tr>
<th>Internal Continuous Assessment (Maximum Marks-50)</th>
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<td>20% - Viva voce</td>
</tr>
<tr>
<td>10% - Fair record</td>
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</tbody>
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AN14 708(P) : PROJECT

Teaching scheme
4 hours practical per week

Objective
- To practise the steps involved for the selection, execution, and reporting of the project.
- To train the students for group activities to accomplish an engineering task.

The project work shall be a theoretical/ experimental/ design/ software project on any of the topics of Aeronautical engineering interest. The head of the department will decide the framing of the project batches. Each of the batches shall consist a minimum of five students.

The topic of the project should be different from his/her mini project. A faculty member will always be supervising each group as a internal guide. In case an industrial project is selected by a batch, in addition to the internal guide, there should be an external guide from the Industry.

During this semester, each group is required to select a topic for the project and study the feasibility. A project evaluation committee will be constituted by head of the department at the beginning of the semester. A brief report of the chosen project should be submitted before the committee within two weeks from the beginning of the VIIth semester. The committee will give permission for the project after examining the feasibility. In the event of rejection of the topic by the committee, the students should resubmit a new project topic within one week, and get it approved by the committee. After getting the permission, they have to conduct a detailed literature survey, and collect sufficient information and necessary data. Further, they have to prepare an action plan to carry out the project in the next semester. At the end of the semester, each group should prepare a preliminary report of the project, and appear before the committee for evaluation. (Literature survey and 40% of the work has to be completed in the seventh semester.)

Each student has to submit an interim report of the project at the end of the 7th semester. Members of the group will present the project details and progress of the project before the committee at the end of the 7th semester. 50% of the mark is to be awarded by the guide and 50% by the evaluation committee.

Internal Continuous Assessment
20% - Technical relevance of the project
40% - Literature survey and data collection
20% - Progress of the project and presentation
10% - Report
10% - Regularity in the class
AN14 801 ROCKETS AND MISSILES

Teaching scheme

4 hours lecture and 1 hour tutorial per week

Objective

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

Module 1 (17 hours)


Module 2. (17 hours)


Module 3 (17 hours).

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.

Module 4 (16 hours)


Text books


References


Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

NOTE: PROBLEMS SHOULD BE ASKED FOR 30 MARKS

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 802 AIRCRAFT RULES AND REGULATIONS C.A.R 1 & 2

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Objective

- To teach the civil air rules and regulations which are being followed by Directorate General of Civil Aviation.

Module 1 (14 hours)
C.A.R. SERIES 'A': PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS Vis-a-vis AIR WORTHINESS DIRECTORATE

Responsibilities of operators / owners-Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators.

C.A.R. SERIES 'B': ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL: Deficiency list (MEL & CDL); Preparation and use of cockpit checklist and emergency list.

Module 2 (14 hours)
C.A.R. SERIES 'C': DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-flight readings & recordings; Maintenance control by reliability Method.

C.A.R. SERIES 'O': AND AIRCRAFT MAINTENANCE PROGRAMMES

Reliability Programmes (Engines); Aircraft maintenance programme & their approval; On condition maintenance of reciprocating engines; TBO - Revision programme; Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs Initial & revisions.

Module 3 (14 hours)
C.A.R. SERIES 'E': APPROVAL OF ORGANISATIONS

Approval of organizations in categories A, B, C, D, E, F, & G - Requirements of infrastructure at stations other than parent base.

C.A.R. SERIES 'F': AIR WORTHINESS AND CONTINUED AIR WORTHINESS:

Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

C.A.R. SERIES 'L' & 'M':

Issue of AME License, its classification and experience requirements, Mandatory Modifications Inspections.
Module 4 (12 hours)

C.A.R. SERIES 'T'&'X'

Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of tax permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

Text books

1. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)" Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi 2000.

2. Aeronautical Information Circulars (relating to Airworthiness) from DGCA 2000.

References


Internal Continuous Assessment (Maximum Marks 50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 803: QUALITY ENGINEERING AND MANAGEMENT

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective
- To analyse key definitions of quality, focusing on a customer-centric approach.
- To provide knowledge on the managerial tools and techniques on quality
- To analyze the relationship of statistics to a process and to use the statistical tools
- To analyze and generate acceptance sampling plans
- To provide knowledge on the reliability and life testing of components and systems

Module 1 (14 hours)

Module 2 (13 hours)
Management tools and techniques: Benchmarking – ISO quality management systems – Quality function deployment – Quality by design – Failure mode and effect analysis – Affinity diagram – Block diagram – Pareto chart – Fish bone diagram – Flow chart – Run chart – Scatter diagram – Tree diagram – Matrix diagram

Module 3 (14 hours)
Statistical tools 1-control charts: Basic concepts - Attributes and variables - Random and assignable causes of variations- Patterns of variation - Measures of central tendency and dispersion - Probability distributions: Binomial, Poisson and Normal Control charts for variables : ¯X , R and sigma charts – Details of construction and uses Control charts for attributes: p, np, c and u charts – Details of construction and uses (Numerical problems included)

Module 4 (13 hours)
Statistical tools 2- Acceptance sampling, Reliability and Life testing: Sampling Vs inspection - OC curve - Single and double sampling plans - ATI - AOQL - Life testing - Bathtub curve – MTBF - OC curve for Life testing - System reliability (Numerical problems included)

Reference Books
# Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Attendance and Regularity in the class

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## University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN 14 804(A) SPACE MECHANICS

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Module 1 (13 hours)


Module 2 (13 hours)


Module 3 (13 hours)


Module 4 (15 hours)

TEXT BOOKS:

REFERENCES:

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 804(B) SATELLITE TECHNOLOGY (G)

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits : 4

Module 1 (13 hours)

INTRODUCTION TO SATELLITE SYSTEMS: Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

Module 2 (13 hours)

ORBITAL MECHANICS: Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction– Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements.

Module 3 (13 hours)

SATELLITE STRUCTURES & THERMAL CONTROL: Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

Module 4 (15 hours)

SPACECRAFT CONTROL: Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torquer - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Ka etc), their characteristics and applications- Coding Systems – Onboard computer- Ground checkout Systems.

TEXT BOOKS

REFERENCES


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, lit erature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
AN14 804(C) INDUSTRIAL AERODYNAMICS

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Module 1 (13 hours)

ATMOSPHERE: Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

Module 2 (13 hours)

WIND ENERGY COLLECTORS: Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

Module 3 (13 hours)

VEHICLE AERODYNAMICS: Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

Module 4 (15 hours)

BUILDING AERODYNAMICS: Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics. Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

TEXT BOOKS


REFERENCES


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**

8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**

4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 804(D) STRUCTURAL DYNAMICS

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Module 1 (13 hours)


Module 2 (13 hours)


Module 3 (13 hours)

NATURAL MODES OF VIBRATION: Equations of motion for free vibrations solution of Eigen value problems – Normal coordinates and orthogonality relations.

Module 4 (15 hours)


TEXT BOOKS:

REFERENCES:

Internal Continuous Assessment (Maximum Marks: 50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
University Examination Pattern

**PART A: Analytical/problem solving SHORT questions  8x 5 marks=40 marks**
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions  4 x 15 marks=60 marks**
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 805: ELECTIVE V

<table>
<thead>
<tr>
<th>AN14 805(A)</th>
<th>AN14 805(B)</th>
<th>AN14 805(C)</th>
<th>AN14 805(D)</th>
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</thead>
<tbody>
<tr>
<td>Combustion Technology (G)</td>
<td>Refrigeration Engineering</td>
<td>Helicopter Maintenance</td>
<td>Aeroelasticity</td>
</tr>
</tbody>
</table>

AN 14 805(A) COMBUSTION TECHNOLOGY(G)

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Module 1 (13 hours)


Module 2 (13 hours)


Module 3 (13 hours)


Module 4 (13 hours)

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AN14 805(B) REFRIGERATION ENGINEERING

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Module 1(13hours)

Review of thermodynamics of different methods of refrigeration, advanced vapour compression systems, multi pressure systems, Flash gas removal,

Module 2(13hours)

Two evaporator and one compressor systems, one evaporator and two compressor systems, other combinations of compressors, evaporators and condensers,

Module 3(13hours)

Low temperature refrigeration, cascade systems, vapour absorption refrigeration systems, principles of operation, description of components and their constructional featuresrefrigerant, absorber combinations and criteria for selection-performance characteristics.

Module 4(13hours)

Energy sources in vapour absorption systems-hot water, solar and electric. Vapour jet refrigeration systems, Thermoelectric refrigeration systems-Peltier effect combination of thermoelectric elements, Vortex and pulse tube refrigeration systems, air cycle refrigeration systems. Global warming effect, Greenhouse effect, Alternate refrigerants.

Reference:


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
**University Examination Pattern**

**PART A: Analytical/problem solving SHORT questions**  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 805(C) HELICOPTER MAINTENANCE

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objective
- To study the procedure adapted to the maintenance of helicopter.

Module 1 (13 hours)
Helicopter fundamentals: Basic directions - Ground handling, bearing - Gears.

Module 2 (13 hours)

Module 3 (13 hours)
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.

Module 4 (13 hours)
Power Pants & Tail Rotors: Fixed wing power plant modifications - Installation - Different type of power plant maintenance. Tail rotor system - Servicing tail rotor track - System rigging.

Airframes and related systems: Fuselage maintenance - Airframe Systems - Special purpose equipment.

Textbook

References

Internal Continuous Assessment (Maximum Marks 50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
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<tr>
<td><em>Maximum Total Marks: 100</em></td>
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</tbody>
</table>
AN14 805(D) AEROELASTICITY

Teaching scheme

3 hours lecture and 1 hour tutorial per week

MODULE 1 (13 hours)

AEROELASTICITY PHENOMENA: Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vertex induced vibration.

MODULE 2 (13 hours)


MODULE 3 (13 hours)

STEADY STATE AEROELASTIC PROBLEMS: Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semirigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

MODULE 4 (15 hours)


TEXT BOOKS :


REFERENCES


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
### University Examination Pattern

**PART A: Analytical/problem solving SHORT questions**  \[ 8 \times 5 \text{ marks} = 40 \text{ marks} \]

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B: Analytical/Problem solving DESCRIPTIVE questions**  \[ 4 \times 15 \text{ marks} = 60 \text{ marks} \]

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
AN14 806 (P): SEMINAR

Teaching scheme
3 hours practical per week

Credits: 2

Objectives

- To assess the ability of the student to study and present a seminar on a topic of current relevance in the relevant field of Aeronautical engineering or allied areas

It enables the students to gain knowledge in any of the technically relevant current topics and acquire the confidence in presenting the topic. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member, by referring papers published in reputed journals and conferences. Each student has to submit a seminar report, based on these papers; the report must not be reproduction of any original paper. A committee consisting of three/four faculty members will evaluate the seminar.

<table>
<thead>
<tr>
<th>Internal Continuous Assessment (Max. Marks : 100)</th>
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</thead>
<tbody>
<tr>
<td>20% - Relevance of the topic and literature survey</td>
</tr>
<tr>
<td>50% - Presentation and discussion</td>
</tr>
<tr>
<td>20% - Report</td>
</tr>
<tr>
<td>10% - Regularity in the class and Participation in the seminar</td>
</tr>
</tbody>
</table>
AN14 807 (P): PROJECT

Teaching scheme
7 hours practical per week

Credits: 5

Objectives

1. To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model or a system.

This project work is the continuation of the project initiated in seventh semester. The performance of the students in the project work shall be assessed on a continuous basis by the project evaluation committee through progress seminars and demonstrations conducted during the semester. Each project group should maintain a log book of activities of the project. It should have entries related to the work done, problems faced, solution evolved etc.

There shall be at least an Interim Evaluation and a final evaluation of the project in the 8th semester. Each project group has to submit an interim report in the prescribed format for the interim evaluation.

Each project group should complete the project work in the 8th semester. Each student is expected to prepare a report in the prescribed format, based on the project work. Members of the group will present the relevance, design, implementation, and results of the project before the project evaluation committee comprising of the guide, and three/four faculty members specialised in relevant field of Aeronautical engineering.

50% of the mark is to be awarded by the guide and 50% by the evaluation committee.

**Internal Continuous Assessment** *(Maximum Marks - 100)*

- 40% - Design and development/Simulation and analysis
- 30% - Presentation & demonstration of results
- 20% - Report
- 10% - Regularity in the class
AN14 808 (P): VIVA VOCE

Credits: 3

Objectives

- To examine the knowledge acquired by the student during the B.Tech. course, through an oral examination

The students shall prepare for the oral examination based on the theory and laboratory subjects studied in the B.Tech. course, mini project, seminar, and project. There is only university examination for viva-voce. University will appoint two external examiners and an internal examiner for viva-voce. These examiners shall be senior faculty members having minimum five years teaching experience at engineering degree level.

For final viva-voce, candidates should produce certified reports of mini project, seminar, and project. If he/she has undergone industrial training/industrial visit/educational tour or presented a paper in any conference, the certified report/technical paper shall also be brought for the viva-voce.

Allotment of marks for viva-voce shall be as given below.

<table>
<thead>
<tr>
<th>Assessment in Viva-voce (Maximum marks – 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% - Subjects</td>
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<tr>
<td>30% - Project and Mini Project</td>
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<tr>
<td>20% - Seminar</td>
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<tr>
<td>10% - Industrial training/industrial visit/educational tour or Paper presented at National-level</td>
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