## SCHEME -2013

### IV SEMESTER

**AERONAUTICAL ENGINEERING (S)**

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Credits</th>
<th>Weekly load, hours</th>
<th>CA Marks</th>
<th>Exam Duration Hrs</th>
<th>U E Max Mark s</th>
<th>Total Marks</th>
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</thead>
<tbody>
<tr>
<td>13.401</td>
<td>Engineering Mathematics -III (BCHMNPSU)</td>
<td>4</td>
<td>3 1</td>
<td>50</td>
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<tr>
<td>13.402</td>
<td>Aerocraft Structures-I (S)</td>
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<tr>
<td>13.403</td>
<td>Fundamentals of Aerodynamics (S)</td>
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<tr>
<td>13.404</td>
<td>Aero Acoustics (S)</td>
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<tr>
<td>13.405</td>
<td>Theory of Machines (S)</td>
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<td>13.406</td>
<td>Turbo Machinery (S)</td>
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<td>13.407</td>
<td>Modelling and Simulation Lab (S)</td>
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<td>- -</td>
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<tr>
<td>13.408</td>
<td>Production Engg Lab (S)</td>
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<td><strong>15 5 9</strong></td>
<td><strong>400</strong></td>
<td><strong>800</strong></td>
<td><strong>1200</strong></td>
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Course Objective:

- To introduce the basic notion in complex analysis such as Analytic Functions, Harmonic functions and their applications in fluid mechanics and differentiations and integration of complex functions, transformations and their applications in engineering fields.
- Numerical techniques for solving differential equations are also introduced as a part of this course.

Module – I


Conformal mapping: Conformality and properties of the transformations \( w = \frac{1}{z} \), \( w = z^2 \), \( w = \frac{1}{z} \), \( w = \sin z \), \( w = e^z \) - Bilinear transformations.

Module – II

Complex Integration: Line integral – Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s and Laurent’s series – zeros and singularities – residues and residue theorem. Evaluation of real definite integrals – \( \int_0^{2\pi} f(\sin x, \cos x) \, dx \), \( \int_{-\infty}^{\infty} f(x) \, dx \) (with no poles on the real axis). (Proof of theorems not required).

Module – III


Module – IV

Numerical integration-Trapezoidal Rule- Simpson’s one third rule.


Numerical Solution of two-dimensional partial differential equation (Laplace equation)- using finite difference method (five point formula)
References:


Internal Continuous Assessment (*Maximum Marks-50*)

- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
- 20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours  
Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able to use numerical methods to solve problems related to engineering fields. This course helps students to master the basic concepts of complex analysis which they can use later in their career.
13.402 AIRCRAFT STRUCTURES – I (S)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

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 – I

Classification of structures: Static equilibrium, Determinate Structures and Indeterminate Structures, static stability concept


Module – II

Energy methods: Work and energy principles, Strain Energy and complementary strain energy, potential and complementary potential theorems, Maxwell's Reciprocal theorem, dummy load & unit load methods, applications of energy principles for analysis of statically determinate and indeterminate structures.

Module – III

Beams: Beams bending and extension, stress resultants, modulus weighted section properties, bending shear stresses- solid and open section.

Shells: Idealization of stiffened shells, shear center, shear flow in thin walled multicell box beams, effect of taper.

Module – IV


References:


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

50% - Tests (minimum 2)

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

20% - Regularity in the class

**University Examination Pattern:**

Examination duration: 3 hours

Maximum Total Marks: 100

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

Students successfully completing this course will be able:

- To perform linear static analysis of determinate and indeterminate aircraft structural components
- To design the structural component using different theories of failure
13.403 FUNDAMENTALS OF AERODYNAMICS (S)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

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

Module – I

Review of basic fluid mechanics, Continuity, momentum and energy equations. Viscous flow: Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum thickness, Flow over a flat plate, Blasius solution. Two dimensional 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. Kutta-Joukowski's theorem.

Module – II


Module – III


Module – IV

Differential equations of motion for steady compressible flow: 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 centre of pressure of supersonic profiles.

Airfoil in high speed flows: 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.
References:


Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Students successfully completing this course are expected to have:

- An ability to apply airfoil theory to predict airfoil performance
- Knowledge of incompressible flow
- An exposure to Boundary layer theory
- Understanding on fluid flow characteristics over wings, airfoils and airplanes
- Knowledge gained in shock phenomenon and fluid waves.
Course Objectives:

To expose the students to the acoustic principle, transmission, measurement, various types of noise control and various methods of acoustic insulation.

Module – I


Module – II


Module – III

Noise measurement: Decibel scale - relationship between pressure, intensity and power - sound level meter, noise analyzer and graphic level recorder-measurement in anechoic and reverberation chambers, machinery noise control.

Environmental noise control: Human reaction to sound-definitions of speech interference level, perceived noise level, phon and sone etc, hearing loss-principles of noise control- control at source, during transmission and at receiver-protection of receiver.

Module – IV

Acoustic insulation-acoustic materials-acoustic filter and mufflers – plenum chamber-noise criteria and standards - noise and number index guide lines for designing quieter equipments – machinery noise such as pumps, rotating machines, reciprocating machines etc. Methods of control of noise using baffles, coverings, perforations etc. Transmission through structures – control vibration by damping and other methods. Principles of noise control in an auditorium-requirements of a good auditorium.
References:

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

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

**University Examination Pattern:**

Examination duration: 3 hours  Maximum Total Marks: 100

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

- Students would be able to understand the generation and propagation of sound in fluids, and sound generated by turbulent flows.
- Students will know how scaling laws may be derived and to interpret the results.
- Students will have an exposure to the state-of-the-art research in aero acoustics and will be able to apply aero acoustics theory to new problems.
Course Objective:

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

Module – I


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

Module – II

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

Module – III


Module – IV


References:


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

50% - Tests (minimum 2)

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

20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours*  
*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

After this programme students are expected to have a thorough understanding of different mechanisms and theories which will help in optimising design of machines and its components, and also to solve practical problems in the area of machines and mechanisms.
Course Objectives:

To expose the students the different types of machineries like turbines, compressors, their operation, purpose of cascading, various stages, losses, efficiencies, performance studies.

Module – I
Definition and Classification of Turbo-machines, Principles of operation, Specific work-representations on enthalpy entropy diagram. Fundamental equation of energy transfer, flow mechanism through the impeller, vane congruent flow, velocity triangles, ideal and actual flows, slip and its estimation, losses and efficiencies, degree of reaction, shape number and specific speed.

Module – II
Two dimensional cascades: cascade nomenclature, lift and drag, circulation and lift, losses and efficiency, compressor and turbine cascade performance, cascade test results, cascade correlations, fluid deviation, off–design performance, optimum space-chord ratio of turbine blades.

Module – III
Axial flow compressors: Two dimensional analysis Velocity diagram, Thermodynamics, Stage losses and efficiency, reaction ratio stage loading, stage pressure rise, stability of compressors. Centrifugal compressors: Theoretical analysis of centrifugal compressor, inlet casing, impeller, diffuser, inlet velocity limitations, optimum design of compressor inlet, pre-whirl, slip factor, pressure ratio, choking in a compressor stage, Mach number at exit.

Module – IV
Axial flow turbines: Two dimensional theory Velocity diagram, Thermodynamics, stage losses and efficiency, Soderberg’s correlation, stage reaction, diffusion within blade rows, efficiencies and characteristics.

Radial Flow Turbines. Types of inlet flow radial turbines (IFR), thermodynamics of 90 IFR turbine. Efficiency, Mach number relations, loss coefficient, off-design operating conditions, losses, pressure ratio limits.

References:


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

- 50% - **Tests** *(minimum 2)*
- 30% - **Assignments** *(minimum 2)* such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
- 20% - **Regularity in the class**

**University Examination Pattern:**

*Examination duration: 3 hours*  
*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

At the end of the course, the students will have an overview of

- Different types of fluid machinery used for energy transformation, such as pumps, fans, compressors, as well as wind-, hydraulic, steam- and gas-turbines.

- Applications for transfer the power, as well as energy use in refrigeration and the built environment.
**13.407 MODELLING AND SIMULATION LAB (S)**

**Teaching Scheme:** 0(L) - 0(T) - 3(P)  
**Credits:** 3

**Course Objective:**

To introduce the design and drafting of aero components and to give practical training using modelling and simulation.

**List of Experiments:**

1) Design and drafting of riveted joints  
2) Design and drafting of welded joints.  
3) Layout of typical wing structure.  
4) Stress analysis of a rectangular plate with a hole.  
5) Static analysis on cantilever beam  
6) Static analysis of forces in a simply supported beam  
7) Static analysis- Plane truss  
8) 2-D static stress analysis  
9) 3-D static stress analysis  
10) Three view diagram of a typical aircraft  
11) Analysis of a model airplane wing  
12) Simulation of flow through a Converging-diverging nozzle.  
13) Structural analysis of a tapered wing  
14) Stress and modal analysis of a cylinder under pressure  
15) Stress distribution in indeterminate structure

**References :**


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

40% - Test  
40% - Class work and Record  
20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100

Questions based on the list of experiments prescribed.

80% - Procedure, conducting experiment, results, tabulation and inference

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

Students will get an insight into the use of different simulation and analysis software (viz. PRO/E, CATIA, ANSYS, MSC / Nastran) to simulate flow behaviour and perform Structural analysis.
13.408 PRODUCTION ENGINEERING LAB (S)

Teaching Scheme: 0(L) - 0(T) - 3(P)  
Credits: 3

Course Objective:

- To acquaint the basics of lathe and accessories, shaping and slotting machine, planning machines
- To learn the different tools used for various operations of machines.
- To impart training on plane turning, groove cutting, form turning, taper turning, facing and thread cutting.

List of Experiments:

1. General study of Lathe and Accessories, Tools used for different operations.
2. Exercises involving plane turning, Groove cutting, form turning, taper turning, facing and thread cutting.
3. Study of shaping and slotting machines, and planning machines, exercises involving production of flat surfaces, grooves and key ways.

Note: Students should complete at least 8 models using the above operations

Internal Continuous Assessment (Maximum Marks-50)

40% - Test  
40% - Class work and Record  
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours  
Maximum Total Marks: 100

Questions based on the list of experiments prescribed.

80% - Procedure, conducting experiment, results, tabulation and inference  
20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, the students will be familiar with the various operations using lathe, shaping, slotting and planning machines.