III Semester

AIRCRAFT MATERIALS AND PROCESSES			
Course Code	**21AE32**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	3

Course objectives: This course will enable students to

- Acquire knowledge of different aerospace materials & their properties.
- Understand the Heat Treatment processes of aircraft metals and alloys
- Characteristics and Applications of Aluminium alloys, Ceramics, Composites and Material Testing.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Mechanical Behavior of Engineering Materials: Introduction to aerospace materials and their classification, Linear and non-linear elastic properties- Stress and Strain Curves-Yielding and strain Hardening, Toughness- Modules of resilience -- Bauchinger's effect- Effect of notches-Testing and flaw detection of materials and components, knowledge of various material testing machines

Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT

Module-2

Non-ferrous materials in aircraft construction: Aluminum and its Alloys: Types and identification. Properties -Castings-Heat treatment processes –Surface treatments.
Magnesium and its alloys: Cast and Wrought alloys-Aircraft application, features specification, fabrication problems, Special treatments.
Titanium and its alloys: Applications, machining, forming, welding and heat treatment, Copper Alloys.
Wood and fabric in aircraft construction and specifications- Glues Use of glass, plastics & rubber in aircraft, Introduction to glass & carbon composite.

Teaching-Learning Process	. 1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-3

Ferrous materials in aircraft construction: Steels: Plain and low carbon steels, various low alloy steels, aircraft steel specifications, corrosion and heat resistant steels, structural applications. Maraging Steels: Properties and Applications. Super Alloys: Use -Nickel base-Cobalt base- Iron base -Forging and Casting of Super alloys-Welding, Heat treatment.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem
Module-4	
Ceramics and Composites: Introduction, modern ceramic materials, cermets, glass ceramic, production of semi-fabricated forms, Carbon/Carbon composites, Fabrication processes and its aerospace applications involved in metal matrix composites, polymer composites.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem
Module-5	
Material Testing: Corrosion, its detection and prevention. Protective finishes. Testing: Destructive and non - destructive testing techniques. Crack detection, inspection of parts by hot oil and chalk, dye-penetrant, fluorescent and magnetic particles, X-ray, ultrasonic, eddy current and acoustic emission methods.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

PRACTICAL COMPONENT OF IPCC:

Sl. NO	Experiments
1	Machining by plain turning, taper turning & step turning
2	Machining by knurling operation
3	Machining by drilling and boring operation
4	Machining by internal and external thread cutting
5	Machining by eccentric turning
6	Machining by square and hexagon in shaping machine
7	Cutting of gear teeth using milling machine
8	Grinding operations using grinding machine
9	CNC Machine tool operations and processes
10	Geometric dimensioning and Tolerancing

11	Operational introduction to industrial robotics.
12	Additive Manufacturing

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Apply the knowledge about the mechanical behaviour of different aircraft & aerospace materials.
2. Explain the applications of Aluminium alloys, Ceramics and Composites Materials.
3. Evaluate the importance of high temperature materials and their characterization.
4. Understand the Machining Processes..
5. Gain knowledge about the CNC Programming.
6. Apply the GD&T for various applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.Marks scorded shall be proportionally scaled down to 50 Marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. Titterton GF, Aircraft Material and Processes, English Book Store, New Delhi, 5th edition,1998, ISBN-13: 978-8175980136
2. H Buhl, Advanced Aerospace Materials, Springer, Berlin1992, ISBN-13: 978-3540558880.

Reference Books

1. Balram Gupta, AerospacematerialVol.1,2,3,4 ARDB, S Chand &Co ,2009, ISBN-13: 978-8121922005.
2. Parker ER, Materials for Missiles and Space, McGraw-Hill Inc., US, 1963.
3. Hill ET, The Materials of Aircraft Construction, Pitman London.
4. CG Krishnadas Nair, Hand book of Aircraft materials, Interline publishers, Bangalore,1993
5. King and Butler, Principles of Engineering Inspection, Clever Humes Press.
6. SC Keshu & K K Ganapathi, Aircraft Production Technology & Management, Interline Publishing, Bangalore, 1993

Web links and Video Lectures (e-Resources):

- .https://www.soaneemrana.org/onewebmedia/AIRCRAFT%20MATERIALS%20AND%20PROCESSES%20BY%20GEORGE%20F.%20TITTERTON.pdf
- https://nptel.ac.in/courses/101104010

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

III Semester

FLUID MECHANICS			
Course Code	**21AE33 / 21AS33**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	3

Course objectives: This course will enable students to

- Understand the basic fluid properties.
- Understand the governing laws of fluid flow.
- Acquire the knowledge of types of fluid flows.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Basic Considerations:

Introduction, Dimensions- Modules and physical quantities, Continuum view of gases and liquids, Pressure and Temperature scales, Physical properties of fluids.

Fluid Statics:

Pressure distribution in a static fluid, Pressure and its measurement, hydrostatic forces on plane and curved surfaces, buoyancy, illustration by examples.

Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT

Module-2

Fluids in motion:

Methods of describing fluid motion, types of fluid flow, continuity equation in 3 dimensions, velocity potential function and stream function. Types of motion, Source sink, doublet, plotting of stream lines and potential lines Numerical problems.

Fluid Kinematics:

Kinematics of fluid motion and the constitutive equations, Integral (global) form of conservation equations (mass, momentum, energy) and applications, Differential form of conservation equations (continuity, Navier-Stokes equations, energy equation).

Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT Assignment of Home/field work on real-life problem

Module-3

Fluid Dynamics:
Equations of motion: Euler's and Bernoulli's equation of motion for ideal and real fluids. Momentum equation, Fluid flow measurements. Numerical problems.

Dimensional analysis and similarity:
Dimensional homogeneity, methods of dimensional analysis, model analysis, types of similarity and similitude. Dimensionless numbers. Model laws. Numerical problems.

Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT Assignment of Home/field work on real-life problem

Module-4

Flow past Immersed bodies:
Introduction to boundary layer, boundary layer thickness, Karman's integral momentum theory, drag on a flat plate for laminar and turbulent flow, Drag on immersed bodies. Expression for drag and lift. Kutta –Joukowsky theorem; Fundamentals of aerofoil theory, Numerical problems.

Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT Assignment of Home/field work on real-life problem

Module-5

Application of Fluid Mechanics:
Compressible flow and Boundary Layers theory:
Steady, one-dimensional gas dynamics, Propagation of pressure waves in a compressible medium, velocity of sound, Mach number, Mach cone, Stagnation properties, Bernoulli's equation for isentropic flow, Numerical Problem; Laminar and turbulent boundary layers.
Hydraulics & Pneumatics:
Introduction to hydraulics & pneumatics-Basic principles, power, classifications, controls, actuators & its types(brief)-No numericals

Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT Assignment of Home/field work on real-life problem

Course outcome:

At the end of the course the student will be able to:

1.

PRACTICAL COMPONENT OF IPCC:

Sl. NO	Experiments
1	Calibration of Venturimeter.
2	Determination of discharge of a given Pipe Flow using Venturimeter/Orifice meter.
3	Determination of Coefficient of discharge for a small orifice by a constant head method.
4	Determination of Coefficient of discharge for a small orifice by a variable head method.
5	Determination of Viscosity of a Fluid.
6	Calibration of contracted Rectangular Notch.
7	Verification of Bernoulli's equation.
8	Pipe friction apparatus with loss of head on pipe fittings.
9	Determination of Coefficient of loss of head in a sudden contraction and friction factor.
10	Estimation of Major loss/Minor losses for a given flow system.
11	Determination of state of flow in a closed conduit using Reynolds Experiment.
12	Impact of Jet over a flat surface.

Course outcomes:

At the end of the course the student will be able to:

1. Evaluate the effect of fluid properties.
2. Apply the governing laws of fluid flow.
3. Classify different types of fluid flows.
4. Operate the instrument and measure the BP, FP, IP and AF ratio.
5. Find the efficiency of the engine and Estimate the calorific value of the given fuel.
6. Verify the Bernoulli's equation.
7. Evaluate the viscosity of fluid.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

4. The question paper will have ten questions. Each question is set for 20 marks. Marks scorded shall be proportionally scaled down to 50 Marks
5. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
6. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. Bansal, R.K, "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi 2015,ISBN-13: 978-8131808153.
2. Radhakrishnan. E, "Fluid Mechanics", Prentice-Hall of India Pvt. Ltd, 2010, ISBN 13: 9788120331839.

Reference Books

1. Yunus A. Cengel& John M Cimbala, Fluid Mechanics and Applications, McGraw Hill Education; 3rd edition, 2013, ISBN-13: 978-0073380322.
2. Ramamritham. S "Hydraulic Fluid Mechanics and Fluid Machines", DhanpatRai&Sons, Delhi, 1988, ISBN 13: 9788187433804.
3. Kumar. K.L., "Engineering Fluid Mechanics" (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995, ISBN 13: 9788121901000.
4. Streeter. V. L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 1983, ISBN 13: 9780070665781

Web links and Video Lectures (e-Resources):

- .https://home.iitk.ac.in/~nikhilk/Book.pdf
- https://nptel.ac.in/courses/112104118
  https://nptel.ac.in/courses/105101082

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

III Semester

ELEMENTS OF AERONAUTICS			
Course Code	**21AE34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

- To know the history and basic principle of aviation.
- To understand the foundation of flight, aircraft structures, material aircraft propulsion.
- To develop an understanding stability of an aircraft along with its different systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Introduction to Aircrafts

History of aviation; Atmosphere and its properties; Classification of aircrafts; Basic components of an aircraft; aircraft axis system; aircraft motions; control surfaces and high lift devices; conventional design configurations; principle of operation of each major part; Helicopters, their parts and functions.

Aircraft Structures and Materials:

Introduction; structural members; general types of construction; monocoque, semi-monocoque and geodesic structures; typical wing and fuselage structure; metallic and non-metallic materials for aircraft application.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-2

Basic principles of flight – significance of speed of sound; airspeed and groundspeed; standard atmosphere; Bernoulli's theorem and its application for generation of lift and measurement of airspeed; forces over wing section, airfoil nomenclature, pressure distribution over a wing section. Lift and drag components – generation of lift and drag; lift curve, drag curve, types of drag, factors affecting lift and drag; center of pressure and its significance; aerodynamic center, aspect ratio, Mach number and supersonic flight effects; simple problems on lift and drag.

Teaching-Learning Process	. **1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-3

Aircraft Propulsion:
Aircraft power plants, classification based on power plant and location and principle of operation. Turboprop, turbojet and turbofan engines; ramjets and scramjets; performance characteristics. Aircraft power plants – basic principles of piston, turboprop and jet engines; Brayton cycle and its application to gas turbine engines; use of propellers and jets for production of thrust; comparative merits and limitations of different types of propulsion engines; principle of thrust augmentation.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-4

Aircraft Stability:
Forces on an aircraft in flight; static and dynamic stability; longitudinal, lateral and roll stability; necessary conditions for longitudinal stability; basics of aircraft control systems. Effect of flaps and slats on lift, control tabs, stalling, gliding, landing, turning, aircraft maneuvers; stalling, gliding, turning. Simple problems on these. Performance of aircraft – power curves, maximum and minimum speeds for horizontal flight at a given altitude; effect of changes in engine power and altitude on performance; correct and incorrect angles of bank; aerobatics, inverted maneuvers, maneuverability. Simple problems.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-5

Introduction to Aircraft Systems:
Aircraft systems (Mechanical) – hydraulic and pneumatic systems and their applications; environment control system; fuel system, oxygen system.

Aircraft systems (Electrical) – flight control system, cockpit instrumentation and displays; communication systems; navigation systems; power generation systems – engine driven alternators, auxiliary power Module, ram air turbine; power conversion, distribution and management.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Course outcome:

At the end of the course the student will be able to:

1. Appreciate and apply the basic principle of aviation.
2. Apply the concepts of fundaments of flight, basics of aircraft structures, aircraft propulsion and aircraft materials during the development of an aircraft.
3. Comprehend the complexities involved during development of flight vehicles.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for**20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

7. The question paper will have ten questions. Each question is set for 20 marks.
8. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. John D. Anderson, "Introduction to Flight", McGraw-Hill Education, 8th edition, 2015, ISBN: 978-0078027673.
2. Lalit Gupta and O P Sharma, Fundamentals of Flight Vol-I to Vol-IV, Himalayan Books. 2006, ISBN: 9788170020752

Reference Books

1. A.C. Kermode, "Flight without formulae", Pearson Education India, 1989. ISBN: 9788131713891.
2. Nelson R.C., "Flight stability and automatic control", McGraw-Hill International Editions, 1998. ISBN 9780071158381.
3. Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 2011, ISBN: 978111965006.

Web links and Video Lectures (e-Resources):

- https://www.digimat.in/nptel/courses/video/101104061/L01.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

III SEMESTER

COMPUTER AIDED AIRCRAFT DRAWING			
Course Code	**21AEL35 / 21ASL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	00:00:02:00	SEE Marks	50
Credits	01	Exam Hours	03

Course objectives: This course will enable students to

1. Understand and interpret drawings of machine and aircraft components
2. Prepare assembly drawings either manually or by using standard CAD packages.
3. Familiarize with standard components and their assembly of an aircraft.

Sl. NO	Experiments
1	**Sections of Solids:** Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections.
2	**Orthographic Views:** Conversion of pictorial views into orthographic projections. of**simple machine parts** with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.
3	**Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.
4	**Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.
5	**Keys &Joints:** Parallel key, Taper key, Feather key, Gib head key and Woodruff key
6	**Riveted Joints:** Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.
7	**Couplings:** Split Muff coupling, protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)
8	Design of propeller and hub assembly.
9	Design of wing.
10	Design of fuselage.
11	Design of Landing Gear Assembly.
12	Design of UAV

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Distinguish drawings of machine and aircraft components
2. Identify assembly drawings either manually or by using standard CAD packages.
3. Practise with standard components and their assembly of an aircraft.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours Rubrics suggested in Annexure-II of Regulation book
Suggested Learning Resources: • https://transport.itu.edu.tr/docs/librariesprovider99/dersnotlari/dersnotlarires112e/not/cadd-1.pdf?sfvrsn=4

Ability Enhancement Course

III Semester

Development of Soft Skills for Engineers			
Course Code	21AE381	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: This course will enable students to

1. Understand the significance of soft skills for engineers
2. Acquire verbal and non-verbal communication skills
3. Get the essence of personal and professional leadership skills

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Foundations of everyday leadership, Emotional intelligence, Leadership and collaborative abilities, Listening skills, Research and analytical skills

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Verbal and non-verbal communication, Stress Management and Tolerance, Email Writing, Public speaking and presentation

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-3

Negotiation skills, and diffusing project conflict, managing project risks and changes, scope , time and cost management, Strategic Planning

Teaching-	**1.** Teaching in classroom through Chalk, Talk and ICT

Learning Process	**2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-4	
Creativity and vision, Problem-solving, writing code and cross-functional skill, digital product management	
Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT • Practising the foundational knowledge
Module-5	
Adaptability and staying positive, Applications of everyday leadership, Teamwork and people skills	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply soft skills for engineering profession.
2. Practise both verbal and non-verbal communication skills effectively.
3. Use personal and professional leadership skills

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

7. First test at the end of 5th week of the semester
8. Second test at the end of the 10th week of the semester
9. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

10. First assignment at the end of 4th week of the semester
11. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

12. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Fast-Tracking Your Career: Soft Skills for Engineering and IT Professionals 1st Edition by Wushow Chou (Author)
2. Soft Skills 3rd Edition: Personality Development for Life Success Paperback – 30 October 2021 by Prashant Sharma (Author)

Web links and Video Lectures (e-Resources):

- https://www.ktit.pf.ukf.sk/images/clanky/Dokumenty/Desire/Softskillsforengineers.pdf.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Ethics, Technology and Engineering			
Course Code	21AE382	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: This course will enable students to

- Learn ethical values in engineering
- Understand how ethics are followed in technology and engineering
- Share the ethical practices

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1	
Moral sensibility: the ability to recognize social and ethical issues in engineering	
Teaching-Learning Process	Teaching in classroom through Chalk, Talk and ICT

Module-2	
Moral analysis skills: the ability to analyse moral problems in terms of facts, values, stakeholders and their interests;	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-3
Moral creativity: the ability to think out different options for action in the light of (conflicting) moral values and the relevant facts;

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem
Module-4	
Moral judgement skills: the ability to give a moral judgement on the basis of different ethical theories or frameworks including professional ethics and common sense morality;	
Teaching-Learning Process	**1.** Adoption of Project-based learning 2. Practising the foundational knowledge
Module-5	
Moral decision-making skills: the ability to reflect on different ethical theories and frameworks and to make a decision based on that reflection.	
Teaching-Learning Process	**1.** Adoption of Project-based learning 2. Practising the foundational knowledge

Course outcome (Course Skill Set): At the end of the course the student will be able to :

1. Develop Ethical values in engineering and Technology
2. Adopt ethical practices
3. Assimilate the ethics in Engineering and Technology

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Ethics, Technology and Engineering , An Introduction- Wiley-Blackwell (an imprint of John Wiley & Sons Ltd)
2. Ethics in Engineering | 4th Edition Paperback – 1 July 2017by Mike W. Martin (Author)

Web links and Video Lectures (e-Resources):

- https://cdn.prexams.com/6229/BOOK.pdf
- https://www.coursera.org/learn/ethics-technology-engineering

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Digitalization in Aeronautics			
Course Code	21AE383	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: The course will enable the students to

- To become familiar with digitalization in Aeronautics
- To understand the importance of digitalization
- To accelerate the learning of digitalization in Aeronautics

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Digitalisation and the Future of the Aerospace Industry, Digitization in Production, Human Factors 4.0: Requirements and challenges for humans, teams and organizations

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Managing Maintenance, Repair and Overhaul for Civil Aircraft, The psycho-social implications of digitalization, Collaborative Aircraft Design

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-3	
The Significance of Testing concerning Maintenance of Aircraft, Maintenance in the Age of Digitalisation	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Adoption of Project-based/Activity Based learning
Module-4	
Digital Avionics Networks, Mil-STD, Modeling and Simulation of Aerospace Systems, Digital Models	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning
Module-5	
Efficient Order Reduction of Parametric Models, Parametric Model Order Reduction for Structural Analysis	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply digitalization in Aeronautics
2. Implement digitalization in collaborative design, maintenance, repair and overhaul
3. Enhance the productivity thru digitalization in Aeronautics

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

7. First test at the end of 5th week of the semester
8. Second test at the end of the 10th week of the semester
9. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

10. First assignment at the end of 4th week of the semester
11. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

12. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Aerospace and Digitalization: A Transformation Through Key Industry 4.0 Technologies (Springer Briefs in Applied Sciences and Technology) 1st ed. 2021 Edition by Diego Carou (Author)
2. Digitalisation in Aeronautics and Space by coursera
3. Mastering The Digital World : A Guide To Understanding, Using And Exploiting Digital Media by Peter Cope

Web links and Video Lectures (e-Resources):

1. https://www.lll.tum.de/certificate/digitalisation-in-aeronautics-and-space/
2. https://www.repository.cam.ac.uk/bitstream/handle/1810/278896/CDBB_REP_002_Lamb_Final.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Coding Literacy			
Course Code	21AE384	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: The course will enable the students to

- Become literate on foundation of codes
- Be familiar to the concepts of code development and operation
- Understand any code's structural components

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1	
Introduction , How Computer Programming Is Changing Writing, Why is coding literacy important? devices and software , digital environments, rules of code	
Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT
Module-2	

Core coding concepts including statement, variable, flow control, and functions through digital media, such as graphics, animation, and sound, and interaction.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-3	
Coding versus programming, develop a code, read a code, run a code, find high-level logic, use/know tools, know the language/conventions, Read best practices/design patterns	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-4	
Code Review, **Simple Codes using Javascript, MATLAB, R and Python**	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning
Module-5	
Critical thinking and evaluation, functional skills, Advanced communication, collaboration, cultural and social understanding, **Capstone project using codes**	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Develop literacy so as to understand any code
2. Start using the concepts of code and develop it
3. Share the literacy with others

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

13. First test at the end of 5th week of the semester
14. Second test at the end of the 10th week of the semester
15. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

16. First assignment at the end of 4th week of the semester
17. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

18. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Coding Literacy: How Computer Programming Is Changing Writing (Software Studies) by Annette Vee (Author)
2. The Pragmatic Programmer: From Journeyman to Master (2nd Edition) by Andrew Hunt and David Thomas
3. Computer Programming JavaScript, Python, HTML, SQL, CSS: The step by step guide for beginners to intermediate by Willam Alvin Newton (Author), Steven Webber (Author)

Web links and Video Lectures (e-Resources):

- https://static.realpython.com/python-basics-sample-chapters.pdf
- http://www.uop.edu.pk/ocontents/A%20Guide%20to%20MATALB.pdf
- https://matfuvit.github.io/UVIT/predavanja/literatura/TutorialsPoint%20JavaScript.pdf
- https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

IV Semester

AERODYNAMICS			
Course Code	**21AE42 / 21AS42**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	3

Course objectives: This course will enable students to

- Understand the basics of fluid mechanics as a prerequisite to Aerodynamics
- Acquire knowledge on typical airfoil characteristics and two-dimensional flows over airfoil and study the incompressible over finite wings
- Understand the concept of compressible flow and acquire the knowledge of shocks & wave formation

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Two Dimensional Flows & Incompressible Flow Over Airfoil

Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink. Doublet flow. Non-lifting flow over a circular cylinder. Vortex flow. Lifting flow over a circular cylinder. Kutta-Joukowski theorem and generation of Lift, D-Alembert's paradox, Numericals.

Incompressible flow over airfoils: Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Classical thin airfoil theory for symmetric and cambered airfoils. Numericals.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge

Module-2

Incompressible Flow Over Finite Wings

Biot-Savart law and Helmholtz's theorems, Vortex filament: Infinite and semi-infinite vortex filament, Induced velocity. Prandtl's classical lifting line theory: Downwash and induced drag. Elliptical and modified elliptical lift distribution. Lift distribution on wings. Limitations of Prandtl's lifting line theory. Extended lifting line theory- lifting surface theory, vortex lattice method for wings. Lift, drag and moment characteristics of complete airplane.

Teaching-Learning Process	**1.** . Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge

Module-3

Applications of Finite Wing Theory & High Lift Systems

Simplified horse-shoe vortex model, formation flight, influence of downwash on tail plane, ground effects. Swept wings: Introduction to sweep effects, swept wings, pressure coefficient, typical aerodynamic characteristics, Subsonic and Supersonic leading edges. Introduction to high-lift systems, flaps, leading-edge slats and typical high – lift characteristics. Critical Mach numbers, Lift and drag divergence, shock induced separation, Effects of thickness, camber and aspect ratio of wings, Transonic area rule, Tip effects. Introduction to Source panel & vortex lattice method.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-4

Basics of Compressible Flow

Basics of thermodynamics-definition and basic relation, Energy Equation- For flow and non-flow process, adiabatic energy equation, stagnation pressure, temperature, density, reference velocities, Bernoulli's equation, Effect of Mach number on Compressibility, Isentropic flow with variable area-Area ratio as a function of Mach number, Impulse function, Mass flow rate, Flow through nozzles and diffusers

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-5

Normal, Oblique Shocks and Expansion Waves

Governing Equations of Normal Shock Wave. Prandtl relation and Rankine - Hugoniot equation. Oblique shocks and corresponding relations. Shock polar & Hodograph plane. Supersonic flow over a wedge. Supersonic compression and supersonic expansion. Detached shocks. Mach reflection. Intersection of waves of same and opposite families.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Evaluate typical airfoil characteristics and two-dimensional flows over airfoil
2. Compute and analyse the incompressible flow over finite wings
3. Apply finite wing theory and design high lift systems from the aerodynamics view point

PRACTICAL COMPONENT OF IPCC:

Course objectives: This course will enable students to

1. Be acquainted with basic principles of aerodynamics using wind tunnel.
2. Acquire the knowledge on flow visualization techniques.
3. Understand the procedures used for calculating the lift and drag.

Experiments
Calibration of a subsonic wind tunnel: test section static pressure and total head distributions.
Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.
Smoke flow visualization studies on a two dimensional airfoil at different angles of incidence at low speeds.
Smoke flow visualization studies on a two dimensional multi element airfoil with flaps and slats at different angles of incidence at low speeds.
Tuft flow visualization on a wing model at different angles of incidence at low speeds: identify zones of attached and separated flows.
Surface pressure distributions on a two-dimensional smooth and rough circular cylinder at low speeds and calculation of pressure drag.
Surface pressure distributions on a two-dimensional symmetric airfoil.
Surface pressure distributions on a two-dimensional cambered airfoil at different angles of incidence and calculation of lift and pressure drag.
Calculation of total drag of a two-dimensional circular cylinder and cambered airfoil at low speeds using pitot-static probe wake survey.
Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and momentum thickness.
Calculation of aerodynamic coefficients and forces acting on a model aircraft at various AOA and speeds using wind tunnel balance (With and Without Yaw).
Pressure measurements on airfoil for a case of reverse flow.

Course outcomes:

At the end of the course the student will be able to:

1. Apply the flow visualization techniques.
2. Estimate the pressure distribution over the bodies.
3. Calculate the lift and drag.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- ❖ The question paper will have ten questions. Each question is set for 20 marks. Marks scorded shall be proportionally scaled down to 50 Marks
- ❖ There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- ❖ The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. Anderson J.D, "Fundamental of Aerodynamics", 5th edition, McGraw-Hill International Edition, New York **(**2011), ISBN-13: 978-0073398105.

2. Yahya, S.M., "Fundamentals of Compressible flow", Wiley Eastern, 2003

Reference Books

1. Clancy L. J. "Aerodynamics", Sterling book house, New Delhi. (2006), ISBN 13: 9780582988804

2. Louis M. Milne-Thomson, "Theoretical Aerodynamics", Imported Edition, Dover Publications, USA (2011), ISBN 9780486619804.

3. Radhakrishnan, E., "Gas Dynamics", Prentice Hall of India.1995 edition.

4. E. L. Houghton, P.W. Carpenter, "Aerodynamics for Engineering Students", 5th edition, Elsevier, New York. (2010), ISBN-13: 978-0080966328

Web links and Video Lectures (e-Resources):

- .https://nptel.ac.in/courses/101105059

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

IV Semester

AERO ENGINEERING THERMODYNAMICS			
Course Code	**21AE43 / 21AS43**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	3

Course objectives: This course will enable students to

- Understand various concepts and definitions of thermodynamics.
- Comprehend the I-law and II-law of thermodynamics.
- Acquire the knowledge of various types of gas cycles.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Fundamental Concepts & Definitions:

Thermodynamics definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and Modules, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium. Zeroth law of thermodynamics, Temperature; concepts, scales, fixed points and measurements.

Work and Heat:

Mechanics-definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge

Module-2

First Law of Thermodynamics:
Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat at constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as film and evacuation of vessels with and without heat transfer.

Teaching-Learning Process	**1.** . Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-3

Second Law of Thermodynamics:
Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Reversible and Irreversible processes; factors that make a process irreversible, reversible heat engine, Carnot cycle, Carnot principles.

Entropy: Clasius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, change of entropy, principle of increase in entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-4

Pure Substances & Ideal Gases: Mixture of ideal gases and real gases, ideal gas equation, compressibility factor use of charts. P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, Saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams.

Thermodynamic relations
Maxwell's equations, Tds relations, ratio of heat capacities, evaluation of thermodynamic properties from an equation of state.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-5

Gas Power Cycles: Efficiency of air standard cycles, Carnot, Otto, Diesel cycles, P-V & T-S diagram, calculation of efficiency. **Vapour power cycle:**SimpleRankine cycle, Analysis and performance of Rankine Cycle, Ideal and practical regenerative Rankine cycles – Reheat and Regenerative Cycles, Binary vapour cycle.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Apply the concepts and definitions of thermodynamics.
2. Differentiate thermodynamic work and heat and apply I law and II law of thermodynamics to different process.
3. Apply the principles of various gas cycles.

PRACTICAL COMPONENT OF IPCC:

Course objectives: This course will enable students to

1. Familiarize with the flash point, fire point and viscosity of lubricating oils.
2. Study IC engine parts, opening and closing of valves to draw the valve-timing diagram.
3. Gain the knowledge of various flow meters and the concept of fluid mechanics.
4. Understand the Bernoulli's Theorem.

Sl. NO	Experiments
1	Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Pensky Martins Apparatus.
2	Determination of Calorific value of solid, liquid and gaseous fuels.
3	Determination of Viscosity of lubricating oil using Torsion viscometers.
4	Valve Timing diagram of 4-stroke IC Engine.
5	Calculation of work done and heat transfer from PV and TS diagram using Planimeter.
6	Performance Test on **Four stroke Petrol Engine/Multi Cylinder** and calculations of IP, BP, Thermal efficiencies, SFC, FP and to draw heat balance sheet.
7	Heat transfer through natural and forced convection.
8	Heat transfer from PIN-FIN apparatus.
9	Determination of thermal conductivity of insulating material.
10	Determination of overall heat transfer coefficient of a composite wall.
11	Determination of Stefan Boltzmann constant.
12	Determination of Critical heat flux and emissivity of a surface.

Course outcomes:

At the end of the course the student will be able to:

1. Calculate the flashpoint, calorific and viscosity values.
2. Analyse the performance of Four stroke and Multi cylinder engines
3. Determine the heat transfer properties.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- ❖ The question paper will have ten questions. Each question is set for 20 marks. Marks scorded shall be proportionally scaled down to 50 Marks
- ❖ There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- ❖ The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in

the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. A Venkatesh, "Basic Engineering Thermodynamics", Universities Press, India, 2007, ISBN 13: 9788173715877
2. P K Nag, "Basic and Applied Thermodynamics", 2nd Ed., Tata McGraw Hill Pub. 2002, ISBN 13: 9780070151314

Reference Books

1. YunusA.Cenegal and Michael A.Boles, "Thermodynamics: An Engineering Approach", TataMcGraw Hill publications, 2002, ISBN 13: 9780071072540
2. J.B.Jones and G.A.Hawkins, John Wiley and Sons, "Engineering Thermodynamics", Wiley 1986, ISBN 13: 9780471812029
3. G.J.VanWylen and R.E.Sonntag, "Fundamentals of Classical Thermodynamics", Wiley Eastern, Wiley, 1985, ISBN 13: 9780471800149
4. Y.V.C.Rao, "An Introduction to Thermodynamics", Wiley Eastern, 1993, ISBN 13: 9788173714610.
5. B.K Venkanna, Swati B. Wadavadagi "Basic Thermodynamics", PHI, New Delhi, 2010, ISBN 13: 978-8120341128.

Web links and Video Lectures (e-Resources):

- .https://nptel.ac.in/courses/101104067

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

IV Semester

MECHANICS OF MATERIALS			
Course Code	**21AE44 / 21AS44**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:1:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: This course will enable students to

- Comprehend the basic concepts of strength of materials.
- Acquire the knowledge of stress, strain under different loadings.
- Understand the different failure theory.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Basics of linear elasticity: The concept of stress& strain, state of stress & Strain at a point, Equilibrium equations, The state of plane stress and plane strain. Compatibility equations, Constitutive Laws (Hooke's Law), Stress-strain curves for brittle and ductile materials, Allowable stress, Material selection for structural performance.

Simple & Compound Stresses: Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections. Elongation due to self-weight. Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses, Introduction to Plane stress, stresses on inclined sections, principal stresses & strains, Analytical & graphical method (Mohr's Circle) to find principal stresses & strains.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-2

Bending Moment and Shear Force in Beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

Euler-Bernoulli beam theory: The Euler-Bernoulli assumptions, Implications of the Euler-Bernoulli assumptions, the Euler-Bernoulli Beam theory derivation, Bending stress equation, Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections (Only Numerical).

Teaching-Learning Process	**1.** . Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-3

Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method.

Torsion of Circular Shafts and Elastic Stability of Columns: Introduction. Pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts.

Teaching-Learning Process	**3.** Teaching in classroom through Chalk, Talk and ICT **4.** Assignment of Home/field work on real-life problem

Module-4

Virtual work principles: Introduction, Equilibrium and work fundamentals, Principle of virtual work, Principle of virtual work applied to mechanical systems, Principle of virtual work applied to truss structures, Principle of virtual work applied to beams. Principle of complementary virtual work, internal virtual work in beams and solids.

Energy methods: Conservative forces, Principle of minimum total potential energy, Strain energy in springs, Strain energy in beams, Strain energy in solids, Applications to trusses, Development of a finite element formulation for trusses, Principle of minimum complementary, Energy theorems, Reciprocity theorems, Saint-Venant's principle.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-5

Mechanical Properties of materials:
Fracture: Type I, Type II and Type III.

Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation.

Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Apply the basic concepts of strength of materials.
2. Compute stress, strain under different loadings.
3. Distinguish the different failure theories.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for**20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. S.S. Bhavaikatii, "*Strength of Materials*", Vikas Publications House, New Delhi, 2012, ISBN-13: 978-8125927914.
2. S. Ramamrutham, R Narayanan, "*Strength of Materials"*, DhanapathRai Publishing Company, New Delhi, 2012, ISBN 13: 9789384378264

Reference Books

1. T.H.G Megson "*Introduction to Aircraft Structural Analysis*", Butterworth-Heinemann Publications, 2007, ISBN 13: 9781856179324
2. Beer.F.P. and Johnston.R, "*Mechanics of Materials*", McGraw Hill Publishers, 2006, ISBN-13:978-0073380285.
3. Timoshenko and Young "*Elements of Strength of Materials*', East-West Press, 1976, ISBN 10: 8176710199.
4. O.A.Bauchau and J.I.Craig "*Structural Analysis"* Springer Dordrecht Heidelberg London New York,ISBN 978-90-481-2515-9, e-ISBN 978-90-481-2516-6

Web links and Video Lectures (e-Resources):

- .https://nptel.ac.in/courses/105106172

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

HYDRAULICS AND PNEUMATICS SYSTEM LAB			
Course Code	**21AEL46**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	3

Course objectives: This course will enable students to

1. Study about the Hydraulic and Pneumatic systems.
2. Understand about the functions of different types of valves.
3. Gain knowledge about the several types of acting cylinders.

Sl. NO	Experiments
1	Operate hydraulic components within manufacturer's specified limits.
2	Control of a single acting cylinder using Hydraulic Circuits.
3	Control of a double acting cylinder using Hydraulic Circuits.
4	Control of a single acting cylinder using Pneumatic Circuits.
5	Control of a double acting cylinder using Pneumatic Circuits.
6	Control of double acting cylinder with limit switches using pilot operated valve.
7	Use Accumulators in hydraulic circuits.
8	Compare circuit operation when hydraulic motors are connected for Meter-Out vs. Meter-In configurations.
9	Use Safety Relief Valves in pneumatic circuits.
10	Use Rotary Actuators in pneumatic circuits.
11	Measure Flow and Pressure Drop.
12	Operate Pressure Regulators in pneumatic circuits.

Course outcomes:

At the end of the course the student will be able to:

1. Operate the hydraulic and pneumatic components.
2. Apply the suitable cylinders according to the applications.
3. Appreciate the purpose of valves.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of the semester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics

shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- https://www.aast.edu/en/complexes/is-complex/contenttemp.php?page_id=40700089

IV Semester

Ability Enhancement Course - IV

The Science of Well-being			
Course Code	21AE481	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: The course will enable students to

- Understand what is well-being
- Learn the elements of science of well-being
- Acquire indices of the happiness quotients

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Introduction, Misconceptions About Happiness, What do we think will make us happy?

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Why Our Expectations are so Bad, Why do we mispredict what makes us happy?

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-3

How Can We Overcome Our Biases, How we counteract our annoying features of the mind?

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem 3. Adoption of Project-based/Activity Based learning

Module-4

Stuff that Really Makes Us Happy, What can we do to improve our happiness?	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Putting Strategies into Practice, How can we intentionally put these strategies into practice and build healthier habits?	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Practice to develop self well-being
2. Implement the elements of science of well-being
3. Improve the happiness quotients

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. The Science of Being Well (Hardcover Library Edition) by Wallace D. Wattles (Author), General Press (Editor)
2. The Science of Well-Being Paperback by Felicia A. Huppert (Editor), Nick Baylis (Editor), Barry Keverne (Editor)

Web links and Video Lectures (e-Resources):

- https://www.researchgate.net/publication/274359025_The_science_of_well-being
- https://www.researchgate.net/publication/6616232_The_science_of_well-being_An_integrated_approach_to_mental_health_and_its_disorders
- https://ppc.sas.upenn.edu/sites/default/files/wellbeingsyllabuscurhanmarkus.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Design Thinking for Innovation			
Course Code	21AE482	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: The course will enable the students to

1. Understand what design thinking is and when to use it
2. Use design thinking to generate innovative ideas
3. Take the many ideas you generate and determine which ones are likely to produce specific, desired outcomes

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

What Is Design Thinking? Business Model Innovation, Challenges Best-Suited for Design Thinking, Visualization Tool

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Preparing Your Mind for Innovation, The Physics of Innovation, How Prepared Is Your Mind?	
Teaching-Learning Process	**3.** Teaching in classroom through Chalk, Talk and ICT **4.** Assignment of Home/field work on real-life problem
Module-3	
Idea Generation, Process, Mind Mapping Tool, Experimentation	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-4	
Human-centered Design, Developing and Testing Prototypes	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Interviewing & Empathy-building Techniques, Developing and Testing Prototypes, Making Sense of Observations & Insights	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Use design thinking for innovation
2. Generate innovative ideas based upon design thinking
3. Determine which ones are likely to produce specific, desired outcomes

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Design Thinking: Integrating Innovation, Customer Experience, and Brand Value Paperback by Thomas Lockwood (Editor)
2. Design Thinking for Innovation: Research and Practice by Walter Brenner (Editor), Falk Uebernickel (Editor)

Web links and Video Lectures (e-Resources):

- https://i.experiencepoint.com/ebooks
- https://www.researchgate.net/publication/329310644_Handbook_of_Design_Thinking

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Flight Mechanics- The basis			
Course Code	21AE483	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: The course will enable students to

1. Understand the foundation of flight mechanics
2. Have a precise thought to describe an airplane and its motion in the air.
3. Understand Newton's law to compute the evolution of the trajectory of an airplane, based on the aerodynamic forces acting on it.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Anatomy of the plane, Airplane components, Flight controls, Airplane geometry, Quiz on Airplane components

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Vocabulary and Tools- Attitude and speed, Newton's second law/Newton's law, Concept of Energy and Total path flight angle	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem
Module-3	
Basis of flight mechanics, Forces applying on an airplane, Load factor, Load factor experimentation flight, Lift and propulsion equation, Climb and descent	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-4	
Flight mechanics basis - Review of concepts, Positioning the lift vector on a drawing, Positioning the lift vector on a drawing, Expressing speed and load factor, Computing a realistic case	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Flapping and Rotary Wing Flight, Space Flight, Rocket Flight	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Get the basic knowledge of flight mechanics
- Use precise and appropriate words to describe an airplane and its motion in the air.
- Apply Newton's law to compute the evolution of the trajectory of an airplane, based on the aerodynamic forces acting on it.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Mechanics Of Flight, 11Th Edition (Paperback) by Kermode
2. Basic Flight Mechanics – A simple Approach without Equations by Ashish Tewari, Publisher: Springer International Publishing AG

Web links and Video Lectures (e-Resources):

- https://ftp.idu.ac.id/wp-content/uploads/ebook/tdg/DESIGN%20SISTEM%20DAYA%20GERAK/Introduction%20to%20aircraft%20flight%20mechanics.pdf
- https://www.coursera.org/learn/basis-flight-mechanics

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

Introduction to programming with MATLAB and Python			
Course Code	21AE484	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	02/week	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1.5

Course objectives: The course will enable the students to

1. Learn how to programme with MATLAB and Python
2. Be familiar with programming environments of MATLAB and Python
3. Carry outlab sessions using MATLAB and Python

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

The basics of MATLAB and Python, MATLAB Environment, Python Environment

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-2

Programming in MATLAB and Python for Aeronautical Engineering Problems, Running MATLAB, Syntax and Semantics of both MATLAB and Python, Data Visualisation in both the programming languages- MATLAB and Python, Programmer' Tool Box	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem
Module-3	
Lab practice of programming and submission of outputs of codes in MATLAB and Python, Matrices, Operators, Functions, debugging, File Input/Output	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-4	
Course Introduction, Intro to Programming and The Python Language, Variables, Conditionals, Jupyter Notebook, and IDLE , Introduction to Lists, Loops, and Functions, More with Lists, Strings, Tuples, Sets, and PyCharm	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Coding Demonstration, Home Work in Python and MATLAB, Practice Quiz	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Program with MATLAB and Python
2. Develop basic to complex code in the programming environments of MATLAB and Python
3. Modify and Maintain codes written using MATLAB and Python

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Programming in MATLAB ®: A problem-solving approach, 1e Paperback by Patel / Mittal (Author)
2. Python Programming: Using Problem Solving Approach by ReemaThareja (Author)

Web links and Video Lectures (e-Resources):

- https://cfm.ehu.es/ricardo/docs/python/Learning_Python.pdf
- https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experimentation – gathering knowledge through experience through lab.
- Exploration – gathering knowledge and attaining skills through active investigation.
- Expression – encouraging students to express their views through visual presentations.

V Semester

MECHANISM AND MACHINE THEORY			
Course Code	**21AE51**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the theory of mechanisms including velocity, acceleration and static force analysis.
2. Acquire knowledge of spur gears, gear train, balancing of rotating and reciprocating masses.
3. Understand the concept of governors and gyroscope.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Introduction to Mechanisms:

Types of constrained motion, Link and its types, joints and its types, kinematic pair and its types, degrees of freedom, Grubler's criterion, Types of kinematic chains and inversions:

Inversions of Four bar chain: Beam engine, coupling: rod of a locomotive, Watt's indicator mechanism. Inversions of Single Slider Crank Chain: Pendulum pump or Bull engine, Oscillating cylinder engine, Rotary internal combustion engine, Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism. Inversions of Double Slider Crank Chain: Elliptical trammels, Scotch yoke mechanism, Oldham's coupling. Straight line motion mechanisms: Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism and Ratchet and Pawl mechanism, Ackerman steering gear mechanism.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

<table>
<tr><th colspan="2">Module-2</th></tr>
<tr><td colspan="2">Velocity, Acceleration and static force analysis of Mechanisms (Graphical Methods):
Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons.

Static force analysis: Introduction: Static equilibrium, Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams, principle of virtual work. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Practising the foundational knowledge.</td></tr>
<tr><th colspan="2">Module-3</th></tr>
<tr><td colspan="2">Spur Gears and Gear Trains
Spur Gears: Gear terminology, law of gearing, Path of contact, Arc of contact, contact ratio of spur gear, Interference in involute gears, Methods of avoiding interference.

Gear Trains: Simple gear trains, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Analysis of epicyclic gear train (Algebraic and tabular methods), torques in epicyclic trains.</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.</td></tr>
<tr><th colspan="2">Module-4</th></tr>
<tr><td colspan="2">Balancing of Rotating and Reciprocating Masses
Balancing of Rotating Masses: Balancing of Several Masses Rotating in the Same Plane, Balancing of Several Masses Rotating in Different Planes (only Graphical Methods).

Balancing of Reciprocating Masses: Primary and Secondary Unbalanced Forces of Reciprocating Masses, Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine, Balancing of Primary and secondary Forces of Multi-cylinder In-line Engines, Balancing of Radial Engines (only Graphical Methods)</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.</td></tr>
<tr><th colspan="2">Module-5</th></tr>
<tr><td colspan="2">Governors and Gyroscope

Governors: Types of governors; force analysis of Porter and Hartnell governors, Controlling force, stability, sensitiveness, isochronism, effort and power of Porter and Hartnell governors.
Gyroscopes: Vectorial representation of angular motion, gyroscopic couple, effect of gyroscopic couple on plane disc and aeroplane</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.</td></tr>
</table>

Course outcome:

After studying this course, students will be able to:

1. Apply the theory of velocity, acceleration and static force analysis to design of mechanisms.
2. Design spur gears, gear train, balancing of rotating and reciprocating masses.
3. Apply governors and gyroscope.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. **Rattan S.S**, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009, ISBN: 007014477X, 9780070144774.

2. **J.J. Uicker, G.R. Pennock, J.E. Shigley.** "Theory of Machines & Mechanisms", OXFORD 3rd Ed. 2009, ISBN-13: 978-0195371239

Reference Books

1. **R. S. Khurmi, J.K. Gupta,** "Theory of Machines", Eurasia Publishing House, 2008, ISBN 13: 9788121925242.

2. **Robert L Norton,** "Design of Machinery" by McGraw Hill, 2001, **ISBN-13:** 978-0077421717.

3. **Ambekar,** "Mechanism and Machine theory", PHI Learning Pvt. Ltd., 2007, ISBN 13: 9788120331341.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/112105268

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

V Semester

AIRCRAFT PROPULSION			
Course Code	**21AE52**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the basic principle and theory of aircraft propulsion.
2. Understand the purpose of a centrifugal, axial compressors, axial and radial turbines.
3. Acquire knowledge of importance of nozzles & inlets and combustion chamber.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Introduction: Review of thermodynamic principles, Principles of aircraft propulsion, Types of power plants, Working principles of internal combustion engine, Two – stroke and four – stroke piston engines, Gas- turbine engines, Cycle analysis of reciprocating engines and jet engines, advantages and disadvantages.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Propeller Theories & Jet propulsion Types of propeller, Propeller thrust: momentum theory, Blade element theories, propeller blade design, propeller selection.

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

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Inlets & Nozzles

Internal flow and Stall in Subsonic inlets, Boundary layer separation. Major features of external flow near a subsonic inlet. Relation between minimum area ratio and eternal deceleration ratio. Diffuser performance.

Supersonic inlets: Supersonic inlets, starting problem in supersonic inlets, Shock swallowing by area variation, External deceleration. Modes of inlet operation.

Nozzles: Theory of flow in isentropic nozzles, Convergent nozzles and nozzle choking, Nozzle throat conditions. Nozzle efficiency, Losses in nozzles. Over-expanded and under-expanded nozzles, Ejector and variable area nozzles, Thrust reversal.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Gas Turbine Engine Compressors

Centrifugal compressors: Principle of operation of centrifugal compressors. Work done and pressure rise -Velocity diagrams, Diffuser vane design considerations. performance characteristics. Concept of Pre-whirl, Rotating stall.

Axial flow compressors: Elementary theory of axial flow compressor, Velocity triangles, Degree of reaction, three-dimensional flow. Air angle distribution for free vortex and constant reaction designs, Compressor blade design. Axial compressor performance characteristics.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Combustion chambers and Turbines

Classification of combustion chambers, important factors affecting combustion chamber design, Combustion process, Combustion chamber performance Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders

Axial Flow Turbines: Introduction, Turbine stage, Multi-staging of turbine, Exit flow conditions, Turbine cooling, Heat transfer in turbine cooling.

Radial turbine: Introduction, Thermodynamics of radial turbines, Losses and efficiency.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

PRACTICAL COMPONENT OF IPCC:

Sl. NO	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 free and forced convective heat transfer over a flat plate.
4	Cascade testing of a model of axial compressor and turbine blade row.
5	Study of performance of a propeller.
6	Determination of heat of combustion of aviation fuel.
7	Study of free and wall jet.
8	Measurement of burning velocity of a premixed flame
9	Study of the flame lift up and fall back phenomenon for varied Air/Fuel ratio.
10	Measurement of nozzle flow.
11	Performance studies on a scaled jet engine.
12	Study of Fuel injection characteristics.

Course outcome:

After studying this course, students will be able to:

1. Apply the basic principle and theory of aircraft propulsion.
2. Explain the functions of centrifugal, axial compressors, axial and radial turbines
3. Analyse the performance of nozzles & inlets and combustion chamber.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scorded shall be proportionally scaled down to 50 Marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. Bhaskar Roy, "Aircraft propulsion", Elsevier (2011), ISBN-13: 9788131214213.
2. V. Ganesan, "Gas Turbines", Tata McGraw-Hill, 2010, New Delhi, India, ISBN: 0070681929.

Reference Books

1. Hill, P.G. & Peterson, C.R., "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999, ISBN-13: 978-0201146592.
2. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H., "Gas Turbine Theory", Longman, 1989, ISBN 13: 9780582236325.
3. Irwin E. Treager, "Gas Turbine Engine Technology" GLENCOE Aviation Technology Series, 7th Edition, Tata McGraw Hill Publishing Co. Ltd. Print 2003, ISBN-13: 978-0028018287.
4. S. M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", 4th Edition, New Age International Publications, New Delhi 2014, ISBN 13: 9788122426687.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/112103281

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.

V Semester

AERO STRUCTURES			
Course Code	**21AE53**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:1:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Comprehend the basic concepts of stress and strain.
2. Acquire the knowledge of types of loads on aerospace vehicles.
3. Understand the theory of elasticity.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Design for Static Strength

Introduction: Normal, shear, biaxial and tri-axial stresses, Stress tensor, Principal Stresses, Stress Analysis, Design considerations, Codes and Standards. Static Strength: Static loads and factor of safety, Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Maximum strain theory, Strain energy theory, and Distortion energy theory, failure of brittle and ductile materials, Stress concentration, and Determination of Stress concentration factor.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Design for Impact and Fatigue Strength

Impact Strength: Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia. Fatigue Strength: Introduction, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, modifying factors: size effect, surface effect, Stress concentration effects, Fluctuating stresses, Goodman and Soderberg relationship, stresses due to combined loading, cumulative fatigue damage.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

<table>
<tr><th colspan="2">Module-3</th></tr>
<tr><td colspan="2">Loads on Aircraft and Aircraft Materials
Loads on Aircraft: Structural nomenclature, Types of loads, load factor, Aerodynamics loads, Symmetric manoeuvre loads, Velocity diagram, Function of structural components.

Aircraft Materials: Metallic and non-metallic materials, Use of Aluminium alloy, titanium, stainless steel and composite materials. Desirable properties for aircraft application.</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.</td></tr>
<tr><th colspan="2">Module-4</th></tr>
<tr><td colspan="2">Theory of Elasticity and Structures:
Theory of Elasticity: and Theory of Elasticity: Concept of stress and strain, derivation of Equilibrium equations, strain displacement relation, compatibility conditions and boundary conditions. Plane stress and Plane strain problems in 2D elasticity. Principle Stresses and Orientation of Principle Directions.

Structures: Statically Determinate and Indeterminate structures, Analysis of plane truss, Method of joints, 3D Truss, Plane frames, Composite beam, Clapeyron’s Three Moment Equation.</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.</td></tr>
<tr><th colspan="2">Module-5</th></tr>
<tr><td colspan="2">Energy Methods and Columns:
Energy Methods: Strain Energy due to axial, bending and Torsional loads. Castigliano’s theorem, Maxwell’s Reciprocal theorem.

Columns: Columns with various end conditions, Euler’s Column curve, Rankine’s formula, Column with initial curvature, Eccentric loading, south-well plot.</td></tr>
<tr><td>Teaching-Learning Process</td><td>1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.</td></tr>
<tr><td colspan="2">Course outcome:
After studying this course, students will be able to:
1. Apply the basic concepts of stress and strain analysis.
2. Compute the impact stress.
3. Identify appropriate materials for suitable application based on properties.</td></tr>
</table>

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
1. Second test at the end of the 10th week of the semester
2. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

5. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. **V.B. Bhandari,** 'Design of Machine Elements', Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.
2. **Megson, T.M.G** 'Aircraft Structures for Engineering Students', Edward Arnold, 1995.
3. **Timoshenko and Goodier,"** 'Theory of Elasticity', McGraw Hill Co.

Reference Books

1. **Robert L. Norton,** Machine Design, Pearson Education Asia, 2001.
2. **Donaldson, B.K.,** "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993.
3. **Timoshenko, S.,** "Strength of Materials", Vol. I and II, Princeton D Von Nostrand Co, 1990.
4. **Joseph E Shigley and Charles R. Mischke**, Mechanical Engineering Design, McGraw Hill International edition, 6th Edition 2009.
5. **Peery, D.J., and Azar, J.J.,** "Aircraft Structures", 2nd edition, McGraw, Hill, N.Y., 1993.
6. **Bruhn. E.H.** "Analysis and Design of Flight Vehicles Structures", Tri – state off set company, USA, 1985.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101105084

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

V Semester

AIRCRAFT PERFORMANCE AND STABILITY			
Course Code	**21AE54**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:1:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the aircraft performance in steady unaccelerated and accelerated flight.
2. Understand the airplane performance parameters and Acquire the knowledge on aircraft maneuver performance.
3. Understand the basics of aircraft stability and control
4. Understand the static longitudinal and static directional stability.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

The Equations of Motion Steady Unaccelerated Flight

Introduction, four forces of flight, General equation of motion, Power available and power required curves. Thrust available and thrust required curves. Conditions for power required and thrust required minimum. Thrust available and maximum velocity, Power available and maximum velocity, Altitude effects on power available and power required; thrust available and thrust required.

Steady Performance – Level Flight, Climb & Glide

Performance: Equation of motion for Rate of climb- graphical and analytical approach -Absolute ceiling, Service ceiling, Time to climb – graphical and analytical approach, climb performance graph (hodograph diagram); maximum climb angle and rate of climb Gliding flight, Range during glide, minimum rate of sink and shallowest angle of glide.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Fundamental Airplane Performance Parameters
The fundamental Parameters: Thrust – to – weight ratio, Wing loading, Drag polar, and lift-to – drag ratio. Minimum velocity. Aerodynamic relations associated with lift-to-drag ratio.

Range and Endurance:
Propeller driven Airplane: Physical consideration, Quantitative formulation, Breguet equation for Range and Endurance, Conditions for maximum range and endurance.
Jet Airplane: Physical consideration, Quantitative formulation, Equation for Range and Endurance, Conditions for maximum range and endurance, Effect of head wind tail wind.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Aircraft Performance in Accelerated Flight
Take-off Performance: Calculation of Ground roll, Calculation of distance while airborne to clear obstacle, Balanced field length

Landing Performance and Accelerated Climb: Calculation of approach distance, Calculation of flare distance, Calculation of ground roll, ground effects. Acceleration in climb.

Maneuver Performance
Turning performance: Level turn, load factor, Constraints on load factor, Minimum turn radius, Maximum turn rate. Pull-up and Pull-down maneuvers: (Turning rate, turn radius). Limiting case for large load factor. The V-n diagram. Limitations of pull up and push over.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem

Module-4

Static Longitudinal Stability and Control-Stick Fixed
Historical perspective, Aerodynamic Nomenclature, Equilibrium conditions, Definition of static stability, Definition of longitudinal static stability, stability criteria, Contribution of airframe components: Wing contribution, Tail contribution, Fuselage contribution, Power effects- Propeller airplane and Jet airplane Introduction, Trim condition. Static margin. stick fixed neutral points. Longitudinal control, Elevator power, Elevator angle versus equilibrium lift coefficient, Elevator required for landing, Restriction on forward C.G. range.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Static Longitudinal Stability& Static Directional Stability and Control-Stick free
Introduction, Hinge moment parameters, Control surface floating characteristics and aerodynamic balance, Estimation of hinge moment parameters, The trim tabs, Stick-free Neutral point, Stick force gradient in unaccelerated flight, Restriction on aft C.G. Introduction, Definition of directional stability, Static directional stability rudder fixed, Contribution of airframe components, Directional

control. Rudder power, Stick-free directional stability, Requirements for directional control, Rudder lock, Dorsal fin. One engine inoperative condition. Weather cocking effect.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basic airplane performance parameters.
2. Differentiate the aircraft performance in steady unaccelerated and accelerated flight.
3. Apply the basic concepts of aircraft stability and control.
4. Differentiate the static longitudinal and static directional stability.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

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5. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

6. First assignment at the end of 4th week of the semester
7. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

8. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. **John D. Anderson, Jr.** "Aircraft Performance and Design", McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 1999.

2. **John D. Anderson, Jr.**, "Introduction to flight" McGraw-Hill International Editions, Aerospace Science/ Technology Editions, 2000.

3. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988.
4. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2007.

Reference Books

5. **Perkins, C.D., and Hage, R.E.**, "Airplane Performance stability and Control", John Wiley Son Inc, New York, 1988.

6. **Barnes W. McCormick,** ` Aerodynamics, Aeronautics, and Flight Mechanics`, John Wiley& Sons, Inc. 1995.

7. Bandu N. Pamadi, `Performance, Stability, Dynamics and Control of Airplanes`, AIAA 2nd Edition Series, 2004.
8. John D. Anderson, Jr., "Introduction to flight" McGraw-Hill, International Editions, Aerospace Science Technology Editions, 2000.
9. W.J. Duncan, The Principles of the Control and Stability of Aircraft, Cambridge University Press, 2016.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101104062
https://nptel.ac.in/courses/101104007

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

V Semester

ADVANCED AIRCRAFT STRUCTURES LAB			
Course Code	**21AEL55**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	03

Course objectives: This course will enable students to

1. Learn about the simply supported beam, cantilever beam.
2. Understand the Maxwell's theorem and Poisson ration.
3. Acquire the knowledge about buckling load, shear failure and shear centre.

Sl. NO	Experiments
1	Deflection of a Simply Supported Beam and cantilever Beam.
2	Beam with combined loading by using superposition theorem.
3	Verification of Maxwell's Reciprocal Theorem.
4	Determination of Young's Modulus using strain gages.
5	Poisson Ratio Determination.
6	Buckling load of slender Eccentric Columns and Construction of Southwell Plot.
7	Shear Failure of Bolted and Riveted Joints.
8	Bending Modulus of sandwich Beam.
9	Fault detection and de-lamination studies in composite plate.
10	Determination of fundamental frequency and spectrum analysis of a cantilever beam and harmonics.
11	Vibration induced structural damage studies.
12	Determining of Shear centre location for open and closed sections-unsymmetrical bending.

Course outcomes:

After studying this course, students will be able to:

1. Compute the deflection of simply supported beam and cantilever beam.
2. Verify the Maxwell's theorem.
3. Determine the buckling load, shear failure and shear centre.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics

shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours
Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS			
Course Code	**21AE56**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	02	Exam Hours	3

Course objectives: This course will enable students to

1. Understand research methodology and IPR
2. Identify the types of intellectual property
3. Evaluate options for protecting your creative innovations with copyright law
4. Analyze and interpret a patent document for a competing product

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling:Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act,	

2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply research methodology and IPR
2. Distinguish the types of intellectual property
3. Analyse options for protecting your creative innovations with copyright law

Analyze and interpret a patent document for a competing product

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and a quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 2 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Text Books

1. C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018
2. Ranjit Kumar, Research Methodology a step-by step guide for beginners, SAGE Publications Ltd, 3rd Edition, 2011.

Reference Books

1. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing, 2005
2. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/110105139

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

V Semester

Ability Enhancement Course - V

DRONE Pilot Training			
Course Code	21AE581	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	01

Course objectives: The course will enable the students to

1. Remember the basics principles and rules of flying a drone
2. Understand the functioning of all components of drone
3. Make and Fly the drone

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1	
Regulations of DGCA , Basic Principles of Flight, ATC Procedures & Radio Telephony	
Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2	
Fixed wing Operations/Aerodynamics, Multi rotor Operations/Aerodynamics	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Module-3	
Weather & Meteorology , Drone equipment and maintenance , Emergency Identification & handling	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning

Module-4

Payload installation & utilization, Image/video interpretation, Final Test Theory	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Flight Simulator training, Practical lessons in Lab, Practical flying lessons	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply the principles of Drone flying
2. Repair and Install the components of drone
3. Judge flying conditions for Drone

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

7. First assignment at the end of 4th week of the semester
8. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

9. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. https://dgt.gov.in/sites/default/files/CTSRPA-DronePilot_CTS_NSQF-4.pdf
2. https://www.faa.gov/training_testing/testing/acs/media/uas_acs.pdf
3. https://irp.fas.org/doddir/army/34-212.pdf

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/course/uasuav-drone-remote-pilot-certification-test-part-107/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_term=_._ag_118445032537_._ad_533094112755_._kw__._de_c_._dm__._pl__._ti_dsa-1212271230479_._li_9061992_._pd__._&matchtype=&gclid=Cj0KCQjwpv2TBhDoARIsALBnVnlSE-vcBq9_eqdjjxQwqhUpnkk5V3mLMhYOcjdiEsfCc1Kd-VtLdpUaAjFTEALw_wcB
- https://www.youtube.com/watch?v=ixYnzcZZu9g

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Introduction to Swarm Drone			
Course Code	21AE582	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1

Course objectives: The course will enable students to

- Understand what is Swarm Drone
- Learn the construction of Swarm
- Acquire skill of assembly and flying swarm

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Introduction of swarm or fleet of Unmanned Aerial Vehicles (UAVs), Classification , Fully autonomous, semi-autonomous, single layered, multi-layered

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Vertically hover, take-off, and land (VTOL), remote control operations, or autonomously by using processors deployed on the drones, Military and Civil Application, Innovative Research and commercial application of Swarm

Teaching-Learning Process	**3.** Teaching in classroom through Chalk, Talk and ICT **4.** Assignment of Home/field work on real-life problem

Module-3

Application Areas, Security, Survey, Monitoring, and Surveillance, Leisure Pursuit, Disaster Management, Environmental Mapping, Search and Rescue (S&R)

Teaching-Learning	**1.** Teaching in classroom through Chalk, Talk and ICT **2.** Assignment of Home/field work on real-life problem

Process	**3.** Adoption of Project-based/Activity Based learning
Module-4	
Description of Sensors, Existing Control Approaches, Autonomous Swarms	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Battery Swapping/Recharging, Surveillance Systems, Swarm Design, Management, and Optimization	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply the concept of swarm drone design
2. Develop swarm of drone
3. Test fly the drone

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

- At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. UAV Swarm Networks: Models, Protocols, and Systems, Edited By Fei Hu, DongXiu Ou, Xin-lin Huang, ISBN 9780367519988
2. Swarm Engineering, https://spie.org/news/swarm-engineering?SSO=1

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/learn/robotics-flight
- https://www.geopoliticalmonitor.com/warfare-evolved-drone-swarms/
- https://www.forbes.com/sites/davidhambling/2021/03/01/what-are-drone-swarms-and-why-does-everyone-suddenly-want-one/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Virtual Aircraft Simulation			
Course Code	21AE583	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1

Course objectives: The course will enable students to

1. Remember the terminologies of virtual aircraft simulation
2. Understand the virtual aircraft simulation environment and settings
3. Implement the skills of virtual flying

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Introduction to virtual Aviation , Aviation rules and Organisation

Teaching-Learning Process	• Teaching in classroom through Chalk, Talk and ICT

Module-2

Air Traffic Control, Radio Communication from Pilot

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-3

Flight Mode Annunciator mode English, Flight Instruments and their working principles

Teaching-	1. Teaching in classroom through Chalk, Talk and ICT

Learning Process	**2.** Assignment of Home/field work on real-life problem **3.** Adoption of Project-based/Activity Based learning
Module-4	
Flight Instrument Essentials, Aviation Meteorology	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Practice of Flight Simulator X installation and Settings	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Use the settings and controls of virtual aircraft simulation
- Plan the new flying path for a specific situation
- Fly an aircraft virtually

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Flight Simulation Virtual Environments in Aviation By Alfred T. Lee, ISBN 9781138246195 Published September 9, 2016 by Routledge
2. Principles of Flight Simulation, David Allerton, ISBN: 978-0-470-75436-8

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=EOeDTr1x3XI

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Multi-disciplinary Research in Aeronautical Engineering			
Course Code	21AE584	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	01	Exam Hours	1

Course objectives: The course will enable the students to

1. Understand the multi-disciplinary research
2. Gather knowledge on multi-disciplinary research
3. Articulate on the data collection, analysis and interpretation

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Introduction to multi-disciplinary research

What to research and how to find out more, What is a research objective and a research question, How to formulate a research objective and a research question?

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-2

Phases and methods of scientific research, Experimental/Study design, Data collection, Evaluation, validation and verification, Research ethics and human resource research ethics

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Module-3

Research method selection and study design: Qualitative methods**,** Quantitative methods**,** Mixed method approaches

Teaching-Learning	1. Teaching in classroom through Chalk, Talk and ICT 2. Assignment of Home/field work on real-life problem

Process	**3.** Adoption of Project-based/Activity Based learning
Module-4	
Data collection and analysis: Data collection and data management, Data analysis (qualitative and quantitative), Data interpretation, How to validate and verify data	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT 2. Practising the foundational knowledge
Module-5	
Research management, documentation and publishing, Research plan writing	
Teaching-Learning Process	• Adoption of Project-based/Activity Based learning

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply the concepts of the multi-disciplinary research
2. Examine the data collected
3. Implement the multi-disciplinary research

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. MULTI-DISCIPLINARY RESEARCH & INNOVATION by Dr Gajanan S. Futane (Author)
2. Contemporary Multi-Disciplinary Research Dimension by Wakil Kumar Yadav (Author)

Web links and Video Lectures (e-Resources):

- https://www.lawctopus.com/academike/multidisciplinary-research/
- https://research.ncsu.edu/rdo/the-difference-between-multidisciplinary-interdisciplinary-and-convergence-research/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VI Semester

AVIATION MANAGEMENT			
Course Code	**HSMC21AE61**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the airline and airport operation, scheduling and management
2. Acquire the general aviation management practices
3. Grasp the broad disciplines of management at different levels of aviation industry

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Airline and Airport Management, Airline Operation and Scheduling, Data Analysis for Business Decisions,Economic Analysis for Business Decisions,Aircraft Rules and Regulation,Airline Business in the 21st Century

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Human Resources Management, Organizational Behaviour, Accounting for Management, Airline Economics, Customer Relationship Management

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Airline Marketing Management, Total Quality Management, Strategic Management, Supply Chain management, Aircraft Maintenance Management,

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Business Application Software, Communication Skills and Business Correspondence, Research Methods in Business, International Business Management, Aviation Systems: Management of the Integrated Aviation Value Chain	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	
Aviation Law , Aviation Safety Management and Accident Investigations, Emerging Trends in Management - Case Study Analysis, Entrepreneurship Development, Airline Advertising and Sales Promotion	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the foundational knowledge of airline and airport operation, scheduling and management
2. Implement the general aviation management practices
3. Prepare for the management at different levels of aviation industry

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Introduction to Aviation Management, Andreas Wald, Christoph Fay, Ronald Gleich, LIT Verlag Münster,

2. Aviation Management (Ground Service & In-flight Service) Paperback – 1 January 2021 by Arijit Das (Author)

Reference Books

1. Aviation Management : Global And National Perspectives Hardcover – 1 January 2008 by Ratandeep Singh (Author)
2. Aviation Leadership: The Accountable Manager by By **Mark J. Pierotti**

Airline Management Finance -The Essentials By Victor Hughes

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=6Uk8F3_9ywY

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VI Semester

AIRCRAFT SYSTEMS AND AVIONICS			
Course Code	**21AE62**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the aircraft control systems.
2. Understand the aircraft systems.
3. Acquire the knowledge of avionics systems.
4. Learn about the simply supported beam, cantilever beam.
5. Understand the Maxwell's theorem and Poisson ration.
6. Acquire the knowledge about buckling load, shear failure and shear centre.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT
2. Assignment of Home/field work on real-life problem
3. Adoption of Project-based/Activity Based learning
4. Practising the foundational knowledge

Module-1

Airplane Control Systems: Conventional Systems, power assisted and fully powered systems, Power actuated systems, Modern control systems, Digital fly by wire systems, Auto pilot system.

Aircraft Systems: Hydraulic systems, components, Pneumatic systems and components, Brake system, Landing Gear systems, Classification.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Engine Systems: Fuel systems for Piston and jet engines, Components of multi engines. lubricating systems - Starting and Ignition systems.

Auxiliary System: Basic Air cycle systems, Vapour Cycle systems, oxygen & pressurization systems, Fire protection systems, De-icing and anti-icing systems.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
Aircraft Instruments: Flight Instruments, Gyroscope, Accelerometers, Air speed Indicators, TAS, EAS, Mach Meters, Altimeters, Principles and operation, Study of various types of engine instruments, Tachometers, Temperature gauges, Pressure gauges, Operation and Principles.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Power Distribution System: Bus Bar, splitbus bar system, special purpose cables. Electrical diagram and identification scheme. Circuit controlling devices. Power utilization- typical application to avionics. Need for Avionics in civil and military aircraft.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	
Flight Deck and Cockpits: Control and display technologies CRT, LED, LCD, EL and plasma panel, Touch screen, Direct voice input (DVI), MFDS, HUD,MFK,HOTAS. **Avionics Systems Integration:** Avionics equipment fit. Electrical data bus system. Communication Systems, Navigation systems, Electronic Warfare and fire control system, Data buses, MIL–STD1553B.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

PRACTICAL COMPONENT OF IPCC:

Sl. NO	Experiments
1	16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave by Digital to Analog Converter.
2	Study of Pulse Amplitude Modulation (PAM) and Demodulation.
3	Addition and Subtraction of 8-bit and 16-bit numbers using microprocessor
4	Interface programming with 4 digit 7 segment display and switches and LEDs
5	Encoder/Decoder Circuits.
6	Multiplexer/Demultiplexer Circuits
7	Addition/Subtraction of binary numbers.
8	Timer Circuits, Shift Registers, Binary Comparator Circuits.

9	Study of MIL-STD-1553 B Data Bus
10	Setting up an analog link using plastic fiber cable
11	Setting up fiber optic digital link
12	HAM Radio

Course outcome:

After studying this course, students will be able to:

1. Distinguish the conventional and modern control systems.
2. Categorize different types of aircraft systems and instruments.
3. Identify the use of avionics systems.
4. Perform measurements on different instruments used for flight operations
5. Perform analog /digital conversions and use microprocessors.
6. Handle functioning of MIL-STD-1553B Data Bus

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

3. The question paper will have ten questions. Each question is set for 20 marks.Marks scorded shall be proportionally scaled down to 50 Marks
4. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
5. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. Ian Moirand Allan Seabridge, 'Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration', Wiley India Pvt Ltd, 3rd edition, 2012, ISBN-13: 978-8126535217.
2. Pallet, E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific and Technical, 1996.
3. R.P.G. Collinson.,"Introduction to Avionics Systems", Springer,3rd edition, 2011, ISBN-13: 978-9400707078

Reference Books

1. Lalit Gupta and OP. Sharma, 'Aircraft Systems (Fundamentals of Flight Vol. IV)', HimalayanBooks;2006.
2. Treager. S, "Gas Turbine Technology", McGraw-Hill, 3rd edition,2013, ISBN-13: 978-1259064876.
3. R.W. Sloley and W.H. Coulthard, 'The aircraft Engineers Handbook, No 4, Instruments', 6th Edition, 2005, ISBN-13: 978-8175980518.

4. SR. Majumdar,'Pneumatic Systems', Tata McGraw Hill Publishing Co,1st Edition, 2001, ISBN-13: 978-0074602317.

5. William A Neese, 'Aircraft Hydraulic Systems', Himalayan Books, 2007.

6. Middleton,D.H.,Ed.,"AvionicsSystems,LongmanScientificandTechnical",LongmanGroup UKLtd.,England,1989, ISBN-13: 978-0582018815.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101104071
https://www.iist.ac.in/departments/avionics-lab

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VI Semester

GAS TURBINE TECHNOLOGY			
Course Code	**21AE63**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Comprehend the types of engines and its applications.
2. Understand the materials required for engine manufacturing.
3. Acquire the knowledge of engine performance and testing.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Types, Variation & Applications: Types of engines showing arrangement of parts. Operating parameters. Energy distribution of turbojet, turboprop and turbofan engines. Comparison of thrust and specific fuel consumption. Thrust, pressure and velocity diagrams.

Engine Parts: Compressor assembly, types of burners: advantages and disadvantages. Influence of design factors on burner performance. Effect of operating variables on burner performance. Performance requirements of combustion chambers. Construction of nozzles. Impulse turbine and reaction turbine. Exhaust system, sound suppression. Thrust reversal: types, design &systems. Methods of thrust augmentation, after burner system.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Materials and Manufacturing: Criteria for selection of materials. Heat ranges of metals, high temperature strength. Surface finishing. Powder metallurgy. Use of composites and Ceramics. Super alloys for Turbines.

Systems: Fuel systems and components. Sensors and Controls. FADEC interface with engine. Typical fuel system. Oil system components. Typical oil system. Starting systems. Typical starting characteristics. Various gas turbine starters.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Engine Performance: Design &off - design Performance. Surge margin requirements, surge margin stack up. Transient performance. Qualitative characteristics quantities. Transient working lines. Starting process &Wind milling of Engines. Thrust engine start envelope. Starting torque and speed requirements Calculations for design and off-design performance from given test data– (case study for a single shaft Jet Engine). Engine performance monitoring.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Compressor: Compressor MAP.Surge margin, Inletdistortions. Testing and Performance Evaluation. **Combustor:** Combustor MAP, Pressure loss, combustion light up test. Testing and Performance Evaluation.
Turbines: Turbine MAP. Turbine Testing and Performance Evaluation.
Inlet duct &nozzles: Ram pressure recovery of inlet duct. Propelling nozzles, after burner, maximum mass flow conditions. Testing and Performance Evaluation.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Engine Testing: Proof of Concepts: Design Evaluation tests. Structural Integrity. Environmental Ingestion Capability. Preliminary Flight Rating Test, Qualification Test, Acceptance Test. Reliability figure of merit. Durability and Life Assessment Tests, Reliability Tests. Engine testing with simulated inlet distortions and, surge test. Estimating engine-operating limits. Methods of displacing equilibrium lines.

Types of engine testing's: Normally Aspirated Testing, Open Air Test Bed, Ram Air Testing, Altitude Testing, Altitude test facility, Flying Test Bed, Ground Testing of Engine Installed in Aircraft, Flight testing. Jet thrust measurements in flight. Measurements and Instrumentation.Data Acquisition system, Measurement of Shaft speed, Torque, Thrust, Pressure, Temperature, Vibration, Stress, Temperature of turbine blading etc. Engine performance trends: Mass and CUSUM plots. Accuracy and Uncertainty in Measurements. Uncertainty analysis. Performance Reduction Methodology.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:
After studying this course, students will be able to:
1. Select the suitable materials for engine manufacturing.
2. Evaluate the performance of the engine.
3. Test the engine using several types of engine testing methods.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Irwin E. Treager, **'**Gas Turbine Engine Technology ', Mc Graw Hill Education,3rd edition, 2013, ISBN-13: 978-1259064876.

2. P.P Walsh and P. Peletcher, 'Gas Turbine Performance' Blackwell Science, 1998, ISBN0632047843.

Reference Books

1. Advanced Aero-Engine Testing, AGARD-59, Publication.

2. 2.MIL–5007E, 'Military Specifications: Engine, Aircraft, Turbo Jet &Turbofan; General Specification for Advance Aero Engine testing',1973.

3. J P Holman, 'Experimental methods for Engineers ', Tata Mc Graw Hill,7th edition,2007, ISBN-13: 978-0070647763.

4. A S Rangawala, Turbomachinery Dynamics-Design and operations, McGraw–Hill, 2005, ISBN-13: 978-0071453691.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=3Y-U7FT7AU4

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Professional Elective- I

VI Semester

FLIGHT VEHICLE DESIGN			
Course Code	**21AE641**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Comprehend the flight vehicle design process.
2. Acquire the knowledge of vehicle configuration and structural components.
3. Understand the stability & control and subsystems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Overview of Design Process: Introduction, Requirements, Phases of design, Conceptual Design Process, Initial Sizing, Take-off weight build up, Empty weight estimation, Fuel fraction estimation, Take- off weight calculation.

Thrust to Weight Ratio & Wing Loading: Thrust to Weight Definitions, Statistical Estimate of T/W. Thrust matching, Spread sheet in design, Wing Loading and its effect on Stall speed, Take-off Distance, Catapult take-off, and Landing Distance. Wing Loading for Cruise, Loiter, Endurance, Instantaneous Turn rate, Sustained Turn rate, Climb, & Glide, Maximum ceiling.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Configuration Layout & loft: Conic Lofting, Conic Fuselage Development, Conic Shape Parameter, Wing-Tail Layout & Loft. Aerofoil Linear Interpolation. Aerofoil Flat-wrap Interpolation. Wing aerofoil layout-flap wrap. Wetted area determination. Special considerations in Configuration Layout: Aerodynamic, Structural, Detectability. Crew station, Passenger, and Payload arrangements.

Design of Structural Components: Fuselage, Wing, Horizontal & Vertical Tail. Spreadsheet for fuselage design. Tail arrangements, Horizontal & Vertical Tail Sizing. Tail Placement. Loads on Structure. V-n Diagram, Gust Envelope. Loads distribution, Shear and Bending Moment analysis.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Engine Selection & Flight Vehicle Performance

Turbojet Engine Sizing, Installed Thrust Correction, Spread Sheet for Turbojet Engine Sizing. Propeller Propulsive System. Propeller design for cruise. Take-off, Landing & Enhanced Lift Devices: - Ground Roll, Rotation, Transition, Climb, Balanced Field Length, Landing Approach, Braking, Spread Sheet for Take-off and Landing. Enhanced lift design -Passive & Active. Spread Sheet.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Static Stability & Control

Longitudinal Static Stability, Pitch Trim Equation. Effect of Airframe components on Static Stability. Lateral stability. Contribution of Airframe components. Directional Static stability. Contribution of Airframe components. Aileron Sizing, Rudder Sizing. Spread Sheets. Flying qualities. Cooper Harper Scale. Environmental constraints, Aerodynamic requirements.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Design Aspects of Subsystems

Flight Control system, Landing Gear and subsystem, Propulsion and Fuel System Integration, Air Pressurization and Air Conditioning System, Electrical & Avionic Systems, Structural loads, Safety constraints, Material selection criteria.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Calculate the thrust to weight ratio and wing loading.
2. Compute the flight vehicle performance.
3. Select the subsystems as per vehicle design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
3. Second test at the end of the 10th week of the semester
4. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Daniel P. Raymer, Aircraft Design - A Conceptual Approach- AIAA Education Series, IV Edition, 2006.
2. Thomas C Corke, Design of Aircraft- Pearson Edition. Inc. © 2003.

Reference Books

1. J Roskam, Aeroplane Design –Vol: 1 to 9.
2. John Fielding, Introduction to Aircraft Design - Cambridge University Press, 2009.
3. Standard Handbook for Aeronautical & Astronautical Engineers, Editor Mark Davies, Tata McGraw Hill, 2010.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101104069

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

COMPOSITE MATERIALS AND STRUCTURES			
Course Code	**21AE642**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the basic structures of composite materials and structure
2. Acquire the knowledge of composites for various applications
3. Understand the characteristics of composite structures

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
IntroductionNatural And Man-Made Composites, Aerospace Applications, Other Structural Applications, Civil Engineering, Automotive Engineering, Other Applications	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
Composite Materials, reinforcements, Fibres, Typical thermal properties of selected fibres, Particulates, polymers and polymer composites,metals and metal matrix composites,laminate designation, Exercises	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Composite manufacturing, moulding process for polymer matrix composites,fabrication processes for metal matrix composites,fabrication process for ceramic matrix composites,machining,joining, Exercises	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Composite materials – Micromechanics, Strength Properties of Unidirectional Composites, Hygrothermal Properties,particulate and short fibre composites, characterisation of properties, NDT methods, material symmetry, two-dimensional case: plane stress, unidirectional lamina, Tsai-Wu Quadratic Interaction Criterion, Exercises	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
Thin laminated plate theory, bending of laminated plates, free vibration and buckling, shear buckling of composite plate, galerkin method, sandwich laminated plate theory, two-dimensional heat conduction in composite laminates, environmental effects, Exercises	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the principle of composite materials and structure for various applications
2. Distinguish different types of composites
3. Implement basic knowledge in in the manufacture of composites

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. **COMPOSITE MATERIALS AND STRUCTURES by PK Sinha**
2. **Mechanics of Composite Materials and Structures by Madhujit Mukhopadhyay ,** University Press

Reference Books

1. K.H.G. Ashbee, Fundamental Principle of Fiber Reinforced Composites (2nd Edition), Technomic Publishing AG, Switzerland, 1993.
2. N.K. Naik, Woven Fabric Composites, Technomic Publishing AG, Switzerland, 1993.
3. G.S. Springer and S.R. Finn, Composite Plates Impact Damage: An Atlas, Technomic Publishing Co., Lancaster, 1991.
4. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
5. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.

Web links and Video Lectures (e-Resources):

http://www.ae.iitkgp.ac.in/ebooks/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Computational Fluid Flow and Heat Transfer			
Course Code	**21AE643**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Learn about discretization methodologies
2. Understand complex large scale fluid flow simulations.
3. Gain knowledge of important concepts such as consistency and convergence.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Introduction , Comparison of experimental, theoretical and computational approaches, Historical perspectives, Mathematical description of fluid flow and heat transfer

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Conservation equations for mass, momentum, energy and chemical species, classification of partial differential equations, coordinate systems; discretization techniques using finite difference methods: Taylor-Series and control volume formulations;

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Applications of numerical methods, Implicit and Explicit methods,
wave equation, heat equation, Laplace equation, Burgers equation- Lax method, MacCormack Method, FTCS method, ADI method, Predictor-Corrector Method

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

modelling of heat conduction, convection-diffusion, and flow field using finite volume method (FVM), Grid Generation, introduction to FVM with unstructured grids; modelling of phase change problems;

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

introduction to turbulence modelling; application to practical problems
Numerical methods for Boundary Layer Type Problem, Numerical methods for the Navier-Stokes Equations,

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply discretization methodologies to PDEs
2. Analyse complex large scale fluid flow through simulations.
3. Implement important concepts such as consistency

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. **Computational Fluid Mechanics and Heat Transfer by JC Tannehill, DA Anderson, RH Pletcher**
2. **Numerical Heat Transfer and Fluid Flow by Suhas V. Patankar**

Reference Books

3. **Computational Fluid Dynamics and Heat Transfer by Author(s): P.S. Ghoshdastidar**
4. **Computational Fluid Dynamics, An Introduction by JF Wendt**

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/112104030

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Principles of flight simulation			
Course Code	**21AE644**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the basic principles of flight simulation
2. Gain knowledge on the flight modelling and flight control systems
3. Understand the navigation and display principles.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Historical Perspective, The Case for Simulation, The Changing Role of Simulation., The Organization of a Flight Simulator, The Concept of Real-time Simulation, Pilot Cues, Training versus Simulation, Examples of Simulation	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
Principles of Modelling. Modelling Concepts, Newtonian Mechanics, Axes Systems, Differential Equations, Numerical Integration, Real-time Computing. Data Acquisition. Flight Data. Interpolation, Distributed Systems, A Real-time Protocol, Problems in Modelling.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Principles of Flight Modelling, The Atmosphere, Forces, Moments. Axes Systems, Quaternions. Equations of Motion, Propulsion, The Landing Gear The Equations Collected.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Simulation of Flight Control Systems: The Laplace Transform. Simulation of Transfer Functions. PID Control Systems, Aircraft Flight Control Systems, The Turn Coordinator and the Yaw Damper, Vertical Speed Management, Altitude Hold. Auto-land Systems, Flight Management Systems **Aircraft Displays** Principles of Display Systems, Character Generation, Simulation of Aircraft Instruments, Simulation of EFIS Displays, Head-up Displays.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	

Simulation of Aircraft Navigation Systems.

Principles of Navigation, Navigation Computations. Map Projections. Primary Flight Information, Automatic Direction Finding (ADF), Instrument Landing Systems (ILS).The Flight Director, Inertial Navigation Systems, Global Positioning Systems

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basic principles of flight simulation
2. Implement the rules in flight modelling and flight control systems
3. Use the principles of the navigation and display.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Principles of Flight Simulation by David Allerton ISBN: 978-0-470-75436-
2. Flight Dynamics Principles by Michael V. Cook

Reference Books

1. Aircraft Control and Simulation: Dynamics, Controls Design by Brian L. Stevens, Frank L. Lewis, Eric N. Johnson

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=nb74_jkr8u0

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Open Electives – I

Introduction to Aerospace History			
Course Code	**21AE651**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Learn the history and chronology of aviation and its development
2. Understand the basic flight mechanics
3. Compare the historical developments in aviation

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Aerospace History, The first decade, World War I, Between the Wars, the advent of jets and missiles, the space age, growth of the aircraft industry, cooperation and consolidation in a global economy, The First Aeronautical Engineers, Internationalization, Mergers and divestitures	
Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Practising the foundational knowledge.

Module-2	
The Aeronautical Triangle, The problem of Propulsion, Fundamental Physical Quantities of Flowing Gas, The source of all aerodynamics forces, Anatomy of Airplane, The NACA and NASA, The Standard Atmosphere, Basic Aerodynamics, Continuity, Momentum and Energy Equations	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
Elementary Thermodynamics, Introduction to viscous flow, Historical Notes- Reynolds and His Number, Airfoils, Wings and Other Aerodynamic shapes	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Elements of Airplane Performance, Rate of Climb, Range and Endurance- Propeller-driven Airplane and Jet Airplane	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	
Principles of Stability and Control, History Note: The development of Flight Controls, Jet Propulsion	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Appreciate the history and chronology of aviation and its development
2. Apply the basic flight mechanics
3. Prepare for the new developments in aviation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Flight: The Complete History of Aviation by R.G. Grant (Author), Smithsonian Institution (Contributor)
2. Introduction to Flight: Its Engineering and History by JD Anderson

Reference Books

1. Aviation History by Anne Marie Millbrooke
2. A Chronology of Aviation: A Day-by-day History of a Century by Jim Winchester

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=JVJrWgU2Xfs

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Introduction to Helicoptors			
Course Code	**21AE652**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the basic elements , kinematics of helicopter
2. Remember the equations of motions for helicopter
3. Gain knowledge on aerodynamics of propeller

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Introduction, Elements of a helicopter, Performance, Components, Vectors and Vector Resolutions	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
Axis Systems, Kinematics and Flight Dynamics, Quaternions, Mass Properties, Equations of Motion	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Applied forces and moments, Longitudinal Equations of Motion, Atmosphere, Bernoulli's Equation, **Compressibility and Wing lift, Wing Drag**	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Aerodynamic Velocity, Inertial Velocity, Wash Velocity, and Gusts, Aerodynamics of Airfoils, Wings, and Fins	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	

Aerodynamics of Propellers, Propeller Analysis, Introduction to Aeroelastic Rotor Models, Rotor Downwash Modeling, Aerodynamic Interference, Engines Drive Trains, Controls, Landing Gear, Trimming	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basic elements , kinematics of helicopter
2. Analyse the equations of motions for helicopter
3. Implement aerodynamics of propeller

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Introduction to Helicopter Aerodynamics by Wieslaw Zenon Stepniewski
2. Fundamentals of Helicopter Dynamics by C. Venkatesan

Reference Books

1. **Basic Helicopter Aerodynamics by J Seddon**

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/101/104/101104017/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Indian Aviation			
Course Code	**21AE653**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	03	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the Indian Aviation Sector
2. Enumerate the Aviation policies and procedure
3. Identify the areas of Aviation for improvement

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
History of Indian Aviation Sector, Regulatory and Legislative Framework, Ministry of Civil Aviation, National Civil Aviation Policy, Airports Authority of India Act	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
Opportunity for Foreign Investment in the Indian Aviation Sector, Investment in Airline Operators, Investment in Airports, The Airport Act, International Conventions, Bilateral Agreements	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Growth of Indian Aviation Sector, Recent trends and Strategies, Growth Drivers, Growth Drivers	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Liberalization, Liberalization, Foreign Direct Investment- Low Cost Carriers, Greenfield airports, post 1991 growth in the aviation sector	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	

The failing state of the aviation sector, Taxation, Infrastructure, The Dollar to Rupee situation, Discussion on case studies	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Relate the Indian Aviation Sector with its counterparts
2. Implement the Aviation policies and procedure
3. Improve the areas of Aviation in India

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. **Indian Aviation Industry - Opportunities And Challenges Paperback – 1 January 2006by Ravi Kumar V V (Author)**
2. **Indian Airline: A study of its Airlines by Desari Panduranga Rao**

Reference Books

1. **Journey of Civil Aviation in IndiaBy Rajesh Jethwani**
2. **Indian Airlines (Ministry of Tourism and Civil Aviation).**

Web links and Video Lectures (e-Resources):

https://www.iata.org/en/pressroom/pr/2018-09-04-01/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Airline and Airport Management			
Course Code	**21AE654**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the basic airline and airport management principles
2. Develop the broad skills of management in aviation industry
3. Understand the statistics of management in aviation sector

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Contemporary issues facing the aviation and aerospace industries ,airline management principles and processes, airline, economics, organization, forecasting, marketing, alliances, pricing, technology management.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
Scheduling, finance, fleet planning, labor relations and air freight, Business ethics pertaining to airlines, marketing, route analysis, aircraft selection, financial analysis, federal regulations, Aviation Law, Aircraft Rules & Security	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
Leadership and Communication Skills, Personality Development, Grooming, Airport Ground Handling, Ticketing (Computerized Reservation Systems), Interview Skills and Group Discussion, Airport Strategic Planning	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4	
Airline and Airport Organization, Management Accounting, Airline Customer Service, Business Computing, Environmental Engineering	
Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Assignment of Home/field work on real-life problem.

Module-5	
E-Business Information Systems, Logistics and Air cargo Management, Statistics for Aviation, Disaster Management, Human Resource Management, Management Information System	
Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Assignment of Home/field work on real-life problem.
Course outcome: After studying this course, students will be able to: 1. Apply the basic principles of airline and airport management 2. Utilise the broad skills of management in aviation industry 3. Analyse the statistics of management in aviation sector	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks** (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Airline Operations and Management by Gerald N Cook, Bruce Billig
2. Airport Management by C. Daniel Prather

Reference Books

3. Business and Corporate Aviation Management, Second Edition, John J. Sheehan Published: April 23rd 2013 and ISBN: 9780071801904
4. Aviation Maintenance Management, Second Edition by Harry A. Kinnison, Tariq Siddiqui Published: November 13th 2012 , ISBN: 9780071805025

Web links and Video Lectures (e-Resources):

https://www.uwl.ac.uk/courses/aviation-airline-and-airport-management

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VI Semester

FLIGHT MODELLING, ANALYSIS AND SIMULATION LAB			
Course Code	**21AEL66**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	3

Course objectives: This course will enable students to

1. Understand the procedure to draw the geometric models of symmetric, cambered aerofoil, nozzle, wing and other structures.
2. Acquire the knowledge of types of meshing.
3. Understand the basics of flow and stress analysis.

Sl. NO	Experiments
1	Modeling of 2-D Incompressible and Inviscid Flow over Symmetrical/Cambered Airfoil, and Plotting of Pressure distribution and Velocity vectors for Subsonic/Supersonic Mach numbers.
2	Modeling of 2-D Compressible and Viscid Flow over Symmetrical/Cambered Airfoil, and Plotting of Pressure distribution and Velocity vectors for Subsonic Mach numbers.
3	Isentropic Flow Analysis in a 2-D Subsonic Diffuser and a Subsonic Nozzle.
4	Isentropic Flow Analysis in a 2-D Supersonic Diffuser and a Supersonic Nozzle.
5	Geometric Modeling and Mesh Generation of a 2-D Pipe and Modeling of Steady and Unsteady Heat Convection and Conduction (Rayleigh Flow).
6	Structural Modeling of Sandwich Beam of Rectangular Cross-section and Analyses for Stress for Unsymmetrical bending case.
7	Structural Modeling and Stress Analysis of a Fuselage Frame.
8	A Plate fixed at one end has a hole in centre and has varying thickness, determine stresses developed due to applied static loads in vertical direction.
9	Simulate a spring- mass- damper system with and without a forcing function though SIMULINK
10	Simulate a bomb drop from an aircraft on a moving tank in pure pursuit motion
11	Develop a straight and level flight simulation program using MATLAB
12	Simulate aircraft Take-off and Landing with trajectory tracing

Course outcomes:

After studying the course, the students will be able to

1. Draw the geometric models of symmetric, cambered aerofoil, nozzle, wing and other structures.
2. Apply different types of meshing.
3. Perform the flow and stress analysis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours Rubrics suggested in Annexure-II of Regulation book
Suggested Learning Resources: https://www.youtube.com/watch?v=LzQPJRt00Ng

VII Semester

CONJUGATE HEAT TRANSFER			
Course Code	**21AE71**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:1:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand what is conjugate heat transfer and its significance
2. Remember the basics principles of conjugate heat transfer phenomenon
3. Acquire the knowledge of solving the conjugate heat transfer problem

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

History, Conjugate problem, Body domain, fluid domain, initial , boundary and conjugate conditions, Heat Transfer by Solids and Fluids, Conjugate Heat Transfer Applications

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Fourier's law, Conduction processes, Thermal resistance, Fins, Heat equation and lumped capacitance, Effective Heat Transfer

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Incompressible fluid flow, subsonic analysis, multiphase fluid flow analysis, static and dynamic heat transfer, Fluid and Solid Interactions, Natural Convection, Forced Convection	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Radiative Heat Transfer, Elementary convection, including laminar and turbulent boundary layers, Thermal radiation, including Stefan-Boltzmann law, Basic concepts of heat exchanger	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-5	
Construction of a general solution of Heat Conduction Equation, Factors of conjugation, Solution of characteristic Problem – Harmonic Law of Oscillation, Universal Algorithm of computation of the factor of conjugation, Nucleate boiling, Drop wise condensation, Turbulent Heat Transfer	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basics principles of conjugate heat transfer phenomenon
2. Analyse conjugate heat transfer problems
3. Implement the knowledge of solving the conjugate heat transfer problem

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1 Numerical Heat Transfer and Fluid Flow by Suhas V Patankar , CRC Press
2 Computational Fluid Mechanics and Heat Transfer by Dale Anderson, Richard H. Pletcher, John C. Tannehill, Ramakanth Munipalli, Vijaya Shankar

Reference Books

1. Fundamentals of Engineering Numerical Analysis by Parviz Moin
2. Computational Heat Transfer by Yogesh Jaluria and Kenneth E Torrance

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/112103297

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

CONTROL ENGINEERING			
Course Code	**21AE72**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	02	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basic concepts of control systems and mathematical models.
2. Acquire the knowledge on block diagrams and signal flow graphs.
3. Understand the frequency response analysis and various types of plots.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Introduction to Control Systems and Mathematical Models
Introduction: Concept of controls, Open loop and closed loop systems with examples, Concepts of feedback and basic structure of feedback control system, requirements of an ideal control system.

Mathematical Models: Transfer function models of mechanical systems, electrical circuits, DC and AC motors in control systems, Analogous systems: Force voltage and Force current analogy.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Block Diagrams and Signal Flow Graphs
Transfer functions definition and its properties, block representation of control systems and terminologies, block diagram algebra and reduction of block diagrams, Signal flow graph method, Mason's gain formula and its applications.

Transient and Steady State Response Analysis
Introduction, type and order of systems, time response specifications, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response.
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Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

System stability analysis using Routh's – Hurwitz Criterion.

Root Locus Plots
Definition of root loci, General rules for constructing root loci, Analysis using root locus plots, Determination of desired gain, limit gain, gain margin and conditional stability.

Frequency Response Analysis Using Bode Plots:
Bode attenuation diagrams for first and second order systems, Simplified Bode diagrams, Stability analysis using Bode plots and determination of phase margin and gain margin and gain.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Frequency Response Specification and Analysis using Polar plots:
Specification: Frequency response definition, frequency response specifications and its relationship with time response specifications.

Analysis: Polar plots, Nyquist stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin, M&N circles.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Feedback control systems:
Types of controllers – Proportional, Integral, Derivative controllers, Proportional – Integral, Proportional – Integral – Derivative controllers; Compensation methods – Series and feedback compensation, Lead, Lag and Lead-Lag Compensators.

State Variable Characteristics of Linear Systems:
Introduction to concepts of states and state variable representation of linear systems, Advantages and Disadvantages over conventional transfer function representation, state equations of linear continuous data system. Matrix representation of state equations, Solution of state equation, State transition matrix and its properties, controllability and observability, Kalman and Gilberts test.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:
After studying this course, students will be able to:

1. Apply the concepts of control systems.
2. Reduce the block diagrams and signal flow graphs.
3. Determine the frequency response analysis by using various types of plots.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. U.A. Bakshi and V.U. Bakshi, Control Engineering, Technical Publications, ISBN: 978-93-5099-657-7.

2. A. Nagoor Kani, Control Systems Engineering, RBA Publications, 2014.

Reference Books

1. Katsuhiko Ogatta, Modern Control Engineering, Pearson Education,2004.

2. I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age Publishers, 2017.

3. Richard. C. Dorf and Robert.H. Bishop, Modern Control Systems, Addison Wesley, 1999.

4. N.S. Nise, Control Systems Engineering, 6th Edition, Wiley, 2012.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/108106098

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VII Semester

WIND TUNNEL TECHNIQUES			
Course Code	**21AE721**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basic of wind tunnel testing.
2. Understand the types and functions of wind tunnel.
3. Acquire the knowledge on conventional measurement techniques and special wind tunnel.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Principles of Model Testing: Buckingham Theorem, Non-dimensional numbers, Scale effect, Geometric Kinematic and Dynamic similarities.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Types and Functions of Wind Tunnels: Classification and types, special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions, Layouts, sizing and design parameters.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Calibration of Wind Tunnels: Test section speed, Horizontal buoyancy, Flow angularities, Flow uniformity & turbulence measurements, Associated instrumentation, Calibration of subsonic & supersonic tunnels.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Conventional Measurement Techniques: Force measurements and measuring systems, Multi component internal and external balances, Pressure measurement system, Steady and Unsteady Pressure, single and multiple measurements, Velocity measurements, Intrusive and Non-intrusive methods, Flow visualization techniques, surface flow, oil and tuft, flow field visualization, smoke and other optical and nonintrusive techniques.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Special Wind Tunnel Techniques: Intake tests, store carriage and separation tests, Unsteady force and pressure measurements, wind tunnel model design.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the principles and procedures for model testing in the wind tunnel.
2. Classify the types and functions of wind tunnel.
3. Distinguish the conventional measurement techniques and special wind tunnel techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Rae W.H. and Pope. A, "Low Speed Wind Tunnel Testing", John Wiley Publication, 3rd edition, 2010, ISBN-13: 978-8126525683.

2. Pope. A and Goin. L, "High Speed Wind Tunnel Testing", John Wiley, 1985.

Reference Books

1. E. Radhakrishnan, Instrumentation, Measurements, and Experiments in Fluids, CRC Press, 2007.

2. Bradsaw "Experimental Fluid Mechanics",Pergamon Press,2nd Revised edition,1970, ISBN-13: 978-0080069814.

3. Short term course on Flow visualization techniques, NAL, 2009.

4. Lecture course on Advanced Flow diagnostic techniques, NAL.

5. NAL-UNI Lecture Series 12:" Experimental Aerodynamics", NAL SP 98 01 April 1998.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101106040

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VII Semester

HELICOPTER DYNAMICS			
Course Code	**21AE722**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:
This course will enable students to

1. Comprehend the basic concepts of helicopter dynamics.
2. Acquire the knowledge of critical speed and rotor bearing system.
3. Understand the turbo rotor system and blade vibration.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Introduction: History of helicopter flight. Fundamentals of Rotor Aerodynamics; Momentum theory analysis in hovering flight. Disk loading, power loading, thrust and power coefficients. Figure of merit, rotor solidity and blade loading coefficient. Power required in flight. Axial climb, descent, and autorotation.

Blade Element Analysis: Blade element analysis in hovering and forward flight. Rotating blade motion. Types of rotors. Concept of blade flapping, lagging and coning angle. Equilibrium about the flapping hinge, lead/lag hinge, and drag hinge.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Basic Helicopter Performance: Forces acting on helicopters in forward flight. Methods of achieving translatory flight. Controlling cyclic pitch: Swash-plate system. Lateral tilt with and without conning. Lateral and longitudinal asymmetry of lift in forward flight. Forward flight performance- total power required, effects of gross weight, effect of density altitude. Speed for minimum power, and speed for maximum range. Factors affecting forward speed, and ground effects.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Rotor Airfoil Aerodynamics: Rotor airfoil requirements, effects of Reynolds number and Mach number. Airfoil shape definition, Airfoil pressure distribution. Pitching moment. Maximum lift and stall characteristics, high angle of attack range.

Rotor Wakes and Blade Tip Vortices: Flow visualization techniques, Characteristics of rotor wake in hover, and forward flight. Other characteristics of rotor wake.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Helicopter Stability and Control. Introductory concepts of stability.Forward speed disturbance, vertical speed disturbance, pitching angular velocity disturbance, side-slip disturbance, yawing disturbance. Static stability of helicopters: longitudinal, lateral-directional and directional. Dynamic stability aspects. Main rotor and tail rotor control. Flight and Ground Handling Qualities-General requirements and definitions. Control characteristics, Levels of handling qualities.

Flight Testing- General handing flight test requirements and, basis of limitations.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Standards, and Specifications: Scope of requirements. General and operational requirements. Military derivatives of civil rotorcraft. Structural strength and design for operation on specified surfaces. Rotorcraft vibration classification.

Conceptual Design of Helicopters: Overall design requirements. Design of main rotors-rotor diameter, tip speed, rotor solidity, blade twist and aerofoil selection, Fuselage design, Empennage design, Design of tail rotors, High speed rotorcraft.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basic concepts of helicopter dynamics.
2. Compute the critical speed by using various methods.
3. Distinguish the turbo rotor system stability by using transfer matrix and finite element formulation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
3. Second test at the end of the 10th week of the semester
4. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. J. Gordon Leishman, Principles of Helicopter Aerodynamics, Cambridge University Press, 2002.

2. George H. Saunders, Dynamics of Helicopter Flight, John Wiley & Sons, Inc, NY,1975.

Reference Books

1. W Z Stepniewski and C N Keys, Rotary Wing Aerodynamics, Dover Publications, Inc, New York, 1984.

2. ARS Bramwell, George Done, and David Balmford, Helicopter Dynamics, 2nd Edition, Butterworth-Heinemann Publication, 2001.

3. John, M. Seddon and Simon Newman, Basic Helicopter Aerodynamics, Wiley, 2011.

4. Gareth D. Padfield, Helicopter Flight Dynamics, 2nd Edition, Wiley, 2011.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101104017

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VII Semester

FLIGHT TESTING			
Course Code	**21AE723**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:
This course will enable students to

1. Comprehend the basic concepts of flight test instrumentation.
2. Acquire the knowledge of performance flight testing and stability control.
3. Understand the flying qualities.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Introduction: Sequence, Planning and governing regulations of flight testing. Aircraft weight and center of gravity, flight testing tolerances. Method of reducing data uncertainty in flight test data - sources and magnitudes of error, avoiding and minimizing errors.

Flight test instrumentation: Planning flight test instrumentation, Measurement of flight parameters. Onboard and ground based data acquisition system. Radio telemetry.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Performance flight testing - range, endurance and climb: Airspeed – in flight calibration. Level flight performance for propeller driven aircraft and for Jet aircraft - Techniques and data reduction. Estimation of range, endurance and climb performance.

Performance flight testing -take-off, landing, turning flight: Manoeuvring performance estimation. Take-off and landing -methods, procedures and data reduction.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Stability and control - longitudinal and manoeuvring:
Static & dynamic longitudinal stability: - methods of flight testing and data reduction techniques. Stick free stability methods. Manoeuvring stability methods & data reduction.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Stability and control - lateral and directional:
Lateral and directional static & dynamic stability: - Coupling between rolling and yawing moments. Steady heading slide slip. Definition of Roll stability. Adverse yaw effects. Aileron reversal. Regulations, test techniques and method of data reduction.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Flying qualities: MIL and FAR regulations. Cooper-Harper scale. Pilot Rating. Flight test procedures.

Hazardous flight testing: Stall and spin- regulations, test and recovery techniques. Test techniques for flutter, vibration and buffeting.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:
After studying this course, students will be able to:

1. Measure the flight parameters.
2. Estimate the performance of flight.
3. Apply the FAR regulations.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
3. Second test at the end of the 10th week of the semester
4. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Ralph D Kimberlin, Flight Testing of Fixed Wing Aircraft, AIAA educational Series,2003.
2. Benson Hamlin, Flight Testing- Conventional and Jet-Propelled Airplanes, Mac Millan, 1946.

Reference Books

1. AGARD, Flight Test Manual Vol. I to IV.
2. A.J. Keane, A. Sobester, Small Unmanned fixed-wing Aircraft Design, Wiley, 2017.
3. A. Filippone, Flight Performance of Fixed and Rotary Wing Aircraft, AIAA Series, 2006.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc21_ae05/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

VII Semester

HEAT AND MASS TRANSFER			
Course Code	**21AE724**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hour	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the different modes of heat transfer.
2. Understand the free convection and forced convection.
3. Acquire the knowledge of heat transfer problems in combustion chambers.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Fundamentals: Different modes of heat transfer and mass and momentum transfer, elements of mass diffusion and boundary layer theory. Mass transfer definition and terms used in mass transfer analysis, Fick's First law of diffusion (no numerical).

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Conduction: Derivation of general three-dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems. Effect of variation of thermal conductivity on heat transfer in solids - Heat transfer problems in infinite and semi-infinite solids - Extended surfaces. One dimensional transient heat conduction: Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Convection: Concepts of Continuity, Momentum and Energy Equations. Dimensional analysis- Buckingham's Pi Theorem - Application for developing non-dimensional correlation for convective heat transfer.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate, Use of empirical relations for Vertical plates and pipes.

Forced Convection: External Flows, Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for Flat plates and Cylinders. Internal Flows, Concepts about Hydrodynamic and Thermal Entry Lengths, use of empirical correlations for Horizontal Pipe Flow and annulus flow.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Radiation & Heat Exchangers Design: Radiation: Introduction to physical mechanism - Radiation properties - Radiation shape factors - Heat exchange between non-black bodies - Radiation shields.

Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Heat and Mass Transfer Problems in Aerospace Engineering: Heat transfer problems in gas turbine combustion chambers - Rocket thrust chambers - Aerodynamic heating -Ablative heat transfer.

Mass Transfer: Introduction, Fick's law, Species conservation equation, Introduction to convective and diffusive mass transfer.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Describe the fundamental of heat and mass transfer.
2. Familiarize the student in the area of conduction, convection and radiation.
3. Analyze the problems due to heat transfer in several areas.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Ozisik, Heat transfer-A basic approach, Tata McGraw Hill 2002.

2. Holman, J.P., " Heat Transfer ", McGraw Hill Book Co., Inc., New York, 8th edition., 1996, ISBN-13: 978-0071143202.

Reference Books

1. Sachdeva, S.C., " Fundamentals of Engineering Heat and Mass Transfer “, Wiley Eastern Ltd., New Delhi, 1981.

2. Sutton, G.P., “Rocket Propulsion Elements ", John Wiley and Sons, 5th Edn.1986.

3. Mathur. M and Sharma, R.P., " Gas Turbine and Jet and Rocket Propulsion, “Standard Publishers, New Delhi 1988.

4. P.K. Nag, Heat transfer, Tata McGraw Hill 2002.

5. Yunus A- Cengel, Heat transfer, a practical approach, Tata McGraw Hill, 3rd edition, 2007.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/112101097

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

AI AND ML FOR AEROSPACE APPLICATIONS			
Course Code	**21AE725**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basics of Artificial Intelligence and Machine Learning
2. Acquire the knowledge of the foundations of AL and AL
3. Gather the information on its different algorithms and their applications in Aerospace Engineering

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Data Science, AI & ML, Scientific Method, Modeling Concepts, CRISP-DM methods, Programming: Commands and Syntax , Packages and Libraries, Introduction to Data Types, Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data., Control structures and Functions	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
Descriptive Statistics Data exploration, Qualitative and Quantitative Data, Measure of Central Tendency, Measure of Positions , Measure of Dispersion , Anscombe's quartet, Statistical Analysis Initial Data Analysis, Probability	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
Data Acquisition , Data Quality and Transformation, Handling Text Data, Principles of Big Data,Data Visualization, Sampling and Estimation, Inferential Statistics	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4	
Linear Regression, Multiple Linear Regression, Non-Linear Regression, Forecasting models, Foundations for ML, Clustering, Naïve Bayes Classifier, K-Nearest Neighbors, Support Vector Machines, Support Vector Machines	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5

Foundations for AI, AI: Application areas, AI Basics (Divide and Conquer, Greedy, Branch and Bound, Gradient Descent), NN basics (Perceptron and MLP, FFN, Back propagation), Convolution Neural Networks, Recurrent Neural Networks, Deep Learning	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basics of Artificial Intelligence and Machine Learning
2. Use the knowledge of the foundations of AL and AL
3. Implement the information on its different algorithms and their applications in Aerospace Engineering

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. The Hundred-Page Machine Learning Book **by** Andriy Burkov
2. Machine Learning by Tom M Mitchell
3. Artificial Intelligence: A Modern Approach, 4th US ed. by Stuart Russell and Peter Norvig

Reference Books

1. Machine Learning and Data Mining in Aerospace Engineering by Aboul Ella Hassanien
2. Applications of Machine Learning by Jitendra Kumar Verma
3. Artificial Intelligence and Machine Learning for Business for Non-Engineers by CRC Press

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/106106198

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

SPACE MECHANICS			
Course Code	**21AE731**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basic concepts of space mechanics and the general N-body.
2. Study satellite injection and satellite orbit perturbations.
3. Acquire the knowledge of interplanetary and ballistic missile trajectories.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1

Space Environment: Peculiarities of space environment and its description, effect of space environment on materials of spacecraft structure and astronauts, manned space missions, effect on satellite life time.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2

Basic Concepts and Two body Problem: The solar system, reference frames and coordinate systems, terminology related to the celestial sphere and its associated concepts, Kepler's laws of planetary motion and proof of the laws, Newton's universal law of gravitation, motion of body under central force field, two body problem, relations between position and time, orbital elements, orbit types.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3

Satellite Injection and Satellite Perturbations: General aspects of satellite injection, satellite orbit transfer, various cases, orbit deviations due to injection errors, special and general perturbations, Cowell's method and Encke's method, method of variations of orbital elements, general perturbations approach.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Interplanetary Trajectories: Two-dimensional interplanetary trajectories, fast interplanetary trajectories, three dimensional interplanetary trajectories, launch of interplanetary spacecraft, trajectory estimation about the target planet, concept of sphere of influence, Lambert's theorem.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
Ballistic Missile Trajectories: Introduction to ballistic missile trajectories, boost phase, the ballistic phase, trajectory geometry, optimal flights, time of flight, re-entry phase, the position of impact point, influence coefficients.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Apply the basic concepts of space mechanics and the general N-body.
2. Explain satellite injection and satellite orbit perturbations.
3. Distinguish between interplanetary and ballistic missile trajectories.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, W.H. Freeman&co,1984.
2. Thomson, Introduction to Space Dynamics, Dover Publications, Revised edition,2012.

Reference Books

1. VandeKamp,P.,"ElementsofAstromechanics",Pitman,1979
2. Willian E. Wiesel, Space Flight Dynamics, Create Space Independent Publishing Platform, 3rd Edition ,2010,ISBN-13: 978-1452879598
3. George P. Sutton and Oscar Biblarz, Rocket Propulsion Elements, Wiley India Pvt Ltd,7th edition, 2010,ISBN-13: 978-8126525775.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/101105083

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

AIRCRAFT MAINTENANCE, REPAIR AND OVERHAUL			
Course Code	**21AE732**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Comprehend the fundamentals of maintenance and certification.
2. Acquire the knowledge of documentation for maintenance.
3. Understand the Aircraft Maintenance, safety and trouble shooting.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Fundamentals of Maintenance & Certification Types of maintenance, Redesign, Failure rate pattern, Other maintenance considerations. Aviation industry certification requirements, Type certificate (FAA form 8110.9), Airworthiness certificate (FAA form 8100-2), Aviation maintenance certifications, General, Airframe, Power plant, Avionics courses.	
Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Practising the foundational knowledge.
Module-2	
Documentation for Maintenance Manufacturers documentation, Airplane maintenance manual, Fault insulation manual, Illustrated parts catalogue, structural repair manual, wiring diagram manual, Master minimum equipment, Federal Aviation regulation (FAR), Advisory circulars, Airworthiness direction ATA document standards, Technical policies and procedure manuals (TPPM)	
Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Practising the foundational knowledge.
Module-3	
Aircraft Management Maintenance Structure, Role of aviation management, Line supervisory management, Management areas of concern in airlines, Manager of overhaul shops, Line maintenance control centre flight line (preflight & post flight), Aircraft Logbook, Maintenance crew skill requirements	
Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Assignment of Home/field work on real-life problem.
Module-4	

Hanger Maintenance (on Aircraft) & Material Support

Introduction, organization of hanger maintenance, Non- routine item, parts availability, cannibalization, Types of shops- sheet metal shop, Aircraft interior shop, Engine shop, Avionics shop, ground support equipment, outsourcing of shop maintenance work, operation of overhaul shops, Material support, Material management inventory control, Support functions of material, Parts ordering, Storage, Issue, control and handling, Parts receiving quality control, calibration program, stock level adjustments, shelf life, exchanges, warranty & modifications of parts.

Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Assignment of Home/field work on real-life problem.

Module-5

Maintenance Safety & Trouble shooting

Safety regulations, occupational safety and health standards maintenance safety program, Airlines safety management, General safety rules, Accident & injury reporting, Hazardous materials storage and handling aircraft furnishing practices trouble shooting, Knowledge of malfunctions.

Teaching-Learning Process	3. Teaching in classroom through Chalk, Talk and ICT. 4. Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Maintain the aircraft maintenance manual and logbook.
2. Do the quality control and calibration.
3. Incorporate the safety regulations and rules.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Harry A Kinnison, Tariq Siddiqui**,** Aviation Maintenance Management, Mc Graw Hill education (India) Private Ltd 2013.
2. Kroes, Watkins, Delp, 'Aircraft maintenance and repair', Mc Graw Hill, 2013.

Reference Books

1. Larry Reithmaier" Aircraft Repair Manual" Palmar Books, Marquette, 1992.
2. Brimm. DJ, Bogges, HE, Aircraft Maintenance, Pitman publishing corp, London, 1952.

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc20_ae03/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

THEORY OF AIRCRAFT VIBRATIONS			
Course Code	**21AE734**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basic concepts of vibrations.
2. Understand the working principle of vibration measuring instruments.
3. Acquire the knowledge of numerical methods for multi-degree freedom systems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Introduction: Types of vibrations, S.H.M, principle of super position applied to Simple Harmonic Motions. Beats, Fourier theorem and simple problems.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
Undamped Free Vibrations: Single degree of freedom systems. Undamped free vibration, natural frequency of free vibration, Spring and Mass elements, effect of mass of spring, Compound Pendulum. **Damped Free Vibrations:** Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3
Forced Vibration: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation, transmissibility ratio due to harmonic excitation and support motion. **Vibration Measuring Instruments & Whirling of Shafts:** Vibration of elastic bodies – Vibration of strings – Longitudinal, lateral and torsional Vibrations.

Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

Systems with Two Degrees of Freedom: Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Geared systems. Forced Oscillations-Harmonic excitation. Applications: Vehicle suspension, Dynamic vibration absorber and Dynamics of reciprocating Engines.
Continuous Systems: Introduction, vibration of string, longitudinal vibration of rods, Torsional vibration of rods, Euler's equation for beams.

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Module-5

Numerical Methods for Multi-Degree Freedom Systems:
Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, Method of matrix iteration-Method of determination of all the natural frequencies using sweeping matrix and Orthogonality principle. Holzer's method, Stodola method.

Teaching-Learning Process	5. Teaching in classroom through Chalk, Talk and ICT. 6. Assignment of Home/field work on real-life problem.

Course outcome:
After studying this course, students will be able to:

1. Apply the principle of super position to Simple Harmonic Motions.
2. Determine the vibrations using vibration instruments.
3. Analyze the multi-degree freedom systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. W.T. Thomson and Marie Dillon Dahleh, Theory of Vibration with Applications, Pearson Education 5th edition, 2008, ISBN-13: 978-8131704820.
2. V.P. Singh, Mechanical Vibrations, Dhanpat Rai & Company Pvt. Ltd.,2016,ISBN-13: 978-8177004014.

Reference Books

1. S.S. Rao, Mechanical Vibrations, Pearson Education Inc, 4th Edition,2003,ISBN-13: 978-8177588743
2. S. Graham Kelly, Mechanical Vibrations- Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. J.S. Rao & K. Gupta, Theory & Practice of Mechanical vibrations, New Age International Publications, New Delhi, 2001.
4. Leonanrd Meirovitch, Elements of Vibrations Analysis, Tata McGraw Hill, Special Indian edition, 2007.

Web links and Video Lectures (e-Resources):

https://www.acessystems.com/fundamentals-series-aviation-vibration/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

SYSTEM ENGINEERING			
Course Code	**21AE733**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand what is a system, engineering and System Engineering
2. Identify the system's requirement and specification
3. Predict the System Engineering problems

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. **Teaching in classroom through Chalk, Talk and ICT.**
2. **Assignment of Home/field work on real-life problem.**
3. **Adoption of Project-based/Activity Based learning.**
4. Practising the foundational knowledge.

Module-1	
Introduction: System, Engineering and System Engineering(SE), The evolving State of SE practice- Challenges and Opportunity, Definition of key terms, Defining a problem,	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
System attributes, properties and Characteristics, Analytical representation of a system, System Stake Holders, System's State of Equilibrium and Balance of Power, System/product Life Cycle concept, System Acceptability- Challenges for success	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
User Enterprise Roles, Missions and System's Applications, User Needs, Mission Analysis, Use cases and Scenarios, System Concepts Formulation and Development, System command and control, Phases, Modes and States of Operation	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4

System Levels of Abstraction, Semantics and Elements, Logical -Physical Entinty Relation (ER) concept, Modelling Mission System, Enabling System Operations, Introduction to System Development Strategies, System Verification and Validation(V&V) Strategy,System development Process Models, Configuration Items	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
Developmental Configuration Baselines,Quality System and Engineering Data, Export Control of Sensitive Data and Technology, Attributes of a well-defined Specification, Specification Requirement, Requirement Statement Development, Sensitivity Analysis, System Modelling and Simulation, System Reliability, Maintainability, Availability	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Correlate what is a system, engineering and System Engineering
2. Articulate on the system's requirement and specification
3. Present the System Engineering problems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. System Engineering Analysis, Design and Development by Charles S Wasson published by Wiley
2. Systems Engineering by Dahai Liu published by CRC Press

Reference Books

1. Architecture and Principles of Systems Engineering by Charles Dickerson, Dimitri N. Mavris

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=pSfZutP9H-U https://nptel.ac.in/courses/110104074
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. Experimentation – gathering knowledge through experience through lab. 2. Exploration – gathering knowledge and attaining skills through active investigation. 3. Expression – encouraging students to express their views through visual presentations.

COMPUTATIONAL SCIENCE AND ENGINEERING			
Course Code	**21AE735**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	04	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:
This course will enable students to

1. Understand the power of computation as an approach to major challenges at the frontiers of all engineering fields.
2. Understand mathematical techniques for modeling and simulation of complex systems
3. Acquire the foundations of computational techniques through programming

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Mathematical Model, Basic Concepts, Ordinary Differential Equations, Partial differential equations(PDE), Boundary and Initial-Boundary Value Problem, Vector Spaces, Complex Numbers,	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	

Matrix Algebra, Eigen Values, Analysis Tools, Taylor's Series, Polynomials, Fourier Transform, Least Square Problems, Finite Difference Method, Finite Element Methods, Spectral Methods,	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Numerical Solution of Non-linear Equations, Linear System of Equations, Multidisciplinary aspects of computation	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Wave Propagation- Hyperbolic PDE, Acoustics, Elasticity, The Schrodinger Equation, Heat Conduction-Parabolic PDE, Elliptic PDE,	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
Fluid Dynamics-Continuity Equation Euler Equation, Shocks, Incompressible Navier-Stokes Equation, Low Speed Flow, Aircraft Design , Weather Prediction, Basic Principles of programming , Parallel Computers, Optimization	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:
After studying this course, students will be able to:

1. Apply the power of computation as an approach to major challenges at the frontiers of all engineering fields.
2. Solve modeling and simulation of complex systems
3. Differential different computational techniques through programming

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

4. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. Fundamentals in Scientific Computing by Bertil Gustafsson
2. Computational Science and Engineering by Gilbert Strang , Wellesley-Cambridge Press ISBN: 9780961408817, 0961408812

Reference Books

1. Recent Trends in Computational Science and Engineering by M Serdar Celebi
2. Introduction to Computational Science by Angela B Shiflet, George W Shiflet

Web links and Video Lectures (e-Resources):

https://www.epfl.ch/education/master/programs/computational-science-and-engineering/
https://onlinecourses.nptel.ac.in/noc21_ae02/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

Open Electives-II

EARTH AND SPACE SCIENCE			
Course Code	**21AE741**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basics of Earth Science
2. Acquire the knowledge of Space Science
3. Connect the concepts of Earth and Space Science for aeronautical/Aerospace Engineering

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Earth System Science, Doing Science, Earth in Space, Near-Earth Objects, Plate tectonics, Continental Drift, Plate Boundaries, The Science of Earth Quakes, Seismic Waves, Earth quake hazards	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
Volcanoes and Mountains, Rocks and Minerals, weathering and Soils, Physical Weathering, weathering rates, Oceans and Coastlines, Ocean Waters, Oceanic Circulations, Shoreline feature and protection, The atmosphere, Earth's climate System.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
A brief History of discovery, Exploration of Solar System, The Sun and the Beyond, Remote Sensing of The Earth's Climate System, Remote Sensing Methodology, Measurement by remote sensing, Atmospheric factors, Instrumental factors, Using Reflected Sunlight, Using Thermal Emission, Using Radar	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4	
Planetary Science, Terrestrial Planets, Outer Planets, Comets, Asteroids, Magnetosphere, Missions, Space Plasma Physics	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5	
Space Weather, Solar Activity, The Solar Wind, Aurora, Solar flares, The Ionosphere, Coronal Mass Ejections and Geomagnetic Storms, The Physics of the Sun, X-Ray Astronomy	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Appreciate the foundations of Earth Science
2. Apply the knowledge of Space Science
3. Analyse Earth and Space Sciences for aeronautical/Aerospace Engineering

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. Exploring Earth Science - 16 editionISBN13: 978-0078096143 by Stephen Reynolds
2. Space Science by Louise K Harra and K O Mason , Imperial College Press

Reference Books

1. Principles of Environmental Science: Inquiry and Applications. **William Cunningham**, **Mary Cunningham** ISBN**13:** 9780073532516
2. Earth Science / Edition 13 by Edward J. Tarbuck
3. Concepts in Space Science by RR Daniel

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/115107121
https://nptel.ac.in/courses/105104152

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

AVIATION AND INTERNET INFRASTRUCTURE			
Course Code	**21AE742**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the need for the flight 4.0
2. Gain Knowledge on both aviation and its internet infrastructure
3. Understand the operation and working principle of internet infrastructure

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
The Aerospace Sector, Aerospace Transformation through Industry 4.0 technologies, Flight 4.0: The changing Technology Landscape, The Internet : An Introduction	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-2	
Advances in Avionics Platforms: Multicore systems, Emerging trends in Avionics Networking, Internet Infrastructure working principle	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.

Module-3	
IoT and Service Oriented Infrastructure for Flight 4.0, Big Data and Data Analytics in Aviation, Ontologies in Aeronautics, TCP/IP, In-Flight Wi-Fi	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-4	
Advances in Software Engineering and Aeronautics, Autonomy and Safety of Unmanned Aircraft Systems	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.

Module-5	
Aerospace Engineering Curricular Expansion in Information Systems, Networking, Web services, Cloud Computing	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Analys the need for the flight 4.0
2. Implement Knowledge on both aviation and its internet infrastructure
3. Modify the operation and working principle of internet infrastructure

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. **Advances in Aeronautical Informatics- Technology towards Flight 4.0 by Umut Durak, Springer**
2. **Principles of flight 4.0 by ISBN** 9788281070318, 8281070315

Reference Books

1. Aircraft Technology by Melih Cemal Kushan

Web links and Video Lectures (e-Resources):

https://www.coursera.org/lecture/cybersecurity-policy-aviation-internet/l26-internet-infrastructure-vCsja

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

AIR TRAFFIC AND WEATHER			
Course Code	**21AE743**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand the Air Traffic Control
2. Acquire Knowledge on the weather condition for flight traffic
3. Remember the symbols of ATC for different weather conditions

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
The earth's atmosphere, Temperature, Atmospheric Pressure and Altimetry, Wind, moisture, cloud formation, precipitation, Stable and Unstable Air, clouds, Airmasses and Fonts	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
Turbulence, Icing, Thunderstorm, High Altitude Weather, Arctic weather, Tropical Weather	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Problems- Traffic, Weather, Congestion, Air traffic flow management, Airport capacity, Traffic Management Overview Basic Traffic Management Techniques and Terms Ground Delay Programs (GDP) Time-based Flow Management (TBFM) Traffic Management Advisor (TMA) Airspace Flow Programs (AFP) Ground Stops (GS) Adaptive Compression (AC) Integrated Collaborative Rerouting (ICR) Delay Tier Information Operational Information System (OIS)	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
Weather Tools De-icing/Anti-icing Severe Weather Avoidance Plan (SWAP) Routes Preferred Routes Coded Departure Routes (CDR) National Playbook Flow Evaluation Area (FEA)/Flow Constrained Area (FCA), **Global air-traffic management**	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
Call signs, Technology, Air Navigation Service providers and Air traffic service providers, Privatization ATC regulations Weather Conditions Worldwide, METAR, Cloud reporting Abbreviation	

Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Course outcome:

After studying this course, students will be able to:

1. Implement the knowledge during the Air Traffic Control
2. Analyse the weather condition for flight traffic
3. Apply the symbols of ATC for different weather conditions

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. Mastering the Systems: Air Traffic Control and Weather by Richard L. Collins
2. Aviation Weather for Pilots and Flight Operation PersonnelGordon Press Publishers

Reference Books

1. New Concepts and Methods in Air Traffic Management by Amedeo R Odoni, Springer
2. Air Traffic Control by Max Mulder , published by InTech

Web links and Video Lectures (e-Resources):

https://www.ll.mit.edu/about/facilities/air-traffic-control-automation-aviation-weather-decision-support-laboratories

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

INDUSTRIAL AERODYNAMICS			
Course Code	**21AE744**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Familiarize non-aeronautical uses of aerodynamics in road vehicles, buildings and problems of flow induced vibrations.
2. Understand methods for constructing various tall structures.
3. Understand the effect of wind on different structures

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
ATMOSPHERE: Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows. Case Study – Measurement of basic wind parameters in open atmospheric condition	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
WIND ENERGY COLLECTORS Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
VEHICLE AERODYNAMICS Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
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. Case Study – Experimental analysis of high rise buildings	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
FLOW INDUCED VIBRATIONS Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.	
Teaching-	**1.** Teaching in classroom through Chalk, Talk and ICT.

Learning Process	**2.** Assignment of Home/field work on real-life problem.

Course outcome:
After studying this course, students will be able to:
1. To familiarize the learner with atmosphere and its effect on the structures.
2. To explore the aerodynamics of different structures
3. To estimate the performance of the vehicle at different speeds

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:
Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and road vehicles", Plenum press, New York, 1978.
2. N.G. Calvent, "Wind Power Principles", Charles Griffin & Co., London, 1979.

Reference Books

1. P. Sachs, "Winds forces in engineering", Pergamon Press, 1978.
2. R.D. Blevins, "Flow induced vibrations", Van Nostrand, 1990

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc22_ae09/preview
https://www.youtube.com/watch?v=z3QJT0CfJLw

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experimentation – gathering knowledge through experience through lab.
2. Exploration – gathering knowledge and attaining skills through active investigation.
3. Expression – encouraging students to express their views through visual presentations.

BASICS OF FLIGHT SIMULATION			
Course Code	**21AE745**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	3

Course Objectives:

This course will enable students to

1. Understand the basic principle of working of flight components
2. Remember the names of components and their functions
3. Think to simulate a flight

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Teaching in classroom through Chalk, Talk and ICT.
2. Assignment of Home/field work on real-life problem.
3. Adoption of Project-based/Activity Based learning.
4. Practising the foundational knowledge.

Module-1	
Historical Perspectives, The case for simulation, Engineering Flight Simulation, The changing role of simulation,	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-2	
The organisation of flight simulator, Equation of Motion, Aerodynamic model, Engine Model, Engine model, data acquisition model, Gear Model , weather model, Visual System, Sound System, Motion System, Controls, Instrument Display, Navigation Systems, Maintenance	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. 2. Practising the foundational knowledge.
Module-3	
Principles of Flight Modeling , Newtonian Mechanics, Differential Equations, Numerical Integration, Real-time computing, Flight Data	
Teaching-Learning Process	1. Teaching in classroom through Chalk, Talk and ICT. 2. Assignment of Home/field work on real-life problem.
Module-4	
The atmosphere, forces, moments, Axes System, Quaternions, Equations of Motions, propulsion-Piston Engine, Jet Engine, the landing gear	
Teaching-Learning Process	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.
Module-5	
Simulation of flight control systems, the Laplace transform, PID control systems, Trimming, Aircraft Displays, Attitude Indicator, Altimeter, Airspeed Indicator, compass card, Automatic Direction Finding(ADF), VHF omnidirectional Range(VOR), Distance Measuring Equipment(DME),Instrrument Landing Systems(ILS), GPS, Inertial Naviation System	
Teaching-Learning	**1.** Teaching in classroom through Chalk, Talk and ICT. **2.** Assignment of Home/field work on real-life problem.

Process	

Course outcome:

After studying this course, students will be able to:

1. Apply the basic principle of working of flight components
2. Practise the names of components and their functions
3. Simulate a flight

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

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The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. Principles of Flight Simulation by David Allerton, Wiley Publisher
2. Flight Dynamics, Simulation, and Control by Ranjan Vepa , CRC press

Reference Books

1. Flight Simulation by JM Rolfe and K J Staples, Cambridge University Press
2. In-flight Simulation-theory and Application by Edwin A. Kidd, Gifford Bull, Robert P. Harper

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=QL4q_Tbv0jM

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