Sanjay Ghodawat University Kolhapur

School of Engineering and Technology

Department of Aerospace Engineering

B. Tech. Aeronautical Engineering

Curriculum Structure and Syllabus (R23)

Semester: VII & VIII

Batch: 2023-27 & 2024-28

Programme Structure for B Tech.: Final Year Aeronautical Engineering (R23)

Semester VII: Teaching Scheme

Course code	Course Name	Teaching scheme (Hrs/week)			Credits assigned			
		Th	Pr	Tu	Th	Pr	Tu	Total credits
U11PC701	Aircraft Systems	3	-	-	3	-	-	3
U11PC702	Computational Fluid Dynamics	3	-	-	3	-	-	3
U11PE7XX	Program Elective IV	3	-	-	3	-	-	3
U01RM701	Research Methodology	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor V	2	-	-	2	-	-	2
U11PC703	Aircraft Systems Lab	-	4	-	-	2	-	2
U11PC704	Computational Fluid Dynamics Lab	-	4	-	-	2	-	2
U11PE7XX	Program Elective IV Lab	-	4	-	-	2	-	2
U11PR701 OR U11EP701 OR U11RE701	Project Phase I (Industry Internship with Capstone Project Track) OR Entrepreneurship Project Phase I (Entrepreneurship Venture Track) OR Research Project Phase I (Higher Opportunity Track)	-	4	-	-	2	-	2
Total		14	16		14	8		22

Th: Theory, Pr: practical, Tu: Tutorial

Semester VII: Evaluation Scheme

Course code	Course Name	Theory Marks					Practical Marks		Total
		Evaluation (Theory)				SEE	Term work	Practical Oral/POE	
		T1	T2	FET	Total				
U11PC701	Aircraft Systems	10	10	5	25	50	-	-	75
U11PC702	Computational Fluid Dynamics	10	10	5	25	50	-	-	75
U11PE7XX	Program Elective IV	10	10	5	25	50	-	-	75
U01RM701	Research Methodology	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor V	-	10	5	15	35	-	-	50
U11PC703	Aircraft Systems Lab	-	-	-	-	-	25	25	50
U11PC704	Computational Fluid Dynamics Lab	-	-	-	-	-	25	25	50
U11PE7XX	Program Elective IV Lab	-	-	-	-	-	25	25	50
U01PR701 **OR** U01EP701 **OR** U01RE701	Project Phase I (Industry Internship with Capstone Project) **OR** Entrepreneurship Project Phase I (Entrepreneurship Venture Track) **OR** Research Project Phase I (Higher Opportunity Track)	-	-	-	-	-	50	-	50
								Total	550

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory , T1, T2, Continuous Assessment Test, FEP, Faculty Evaluation for Practical, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course

Note: The Evaluation of Project Phase I is divided into two parts (Internal Assessment)

a) Preparation and presentation of the proposal of the Project (Motivation/ Relevance, Problem Statement, Literature Survey, Objectives, Methodology and design of the project) for 25marks.

b) Student shall present a seminar on the topic relevant to the Project work for 25 marks.

Program Elective IV					
Vertical I (Design)		**Vertical II (Maintenance)**		**Vertical III (Avionics and Drones)**	
Course Code	**Course Name**	**Course Code**	**Course Name**	**Code**	**Course Name**
U11PE711	Wind Tunnel Techniques	U11PE721	Aircraft Condition Monitoring	U11PE731	UAV Design
U11PE712	Hypersonic Aerodynamics	U11PE722	Helicopter Maintenance		

Program Elective IV Lab					
Vertical I (Design)		**Vertical II (Maintenance)**		**Vertical III (Maintenance)**	
Course Code	**Course Name**	**Course Code**	**Course Name**	**Code**	**Course Name**
U11PE713	Wind Tunnel Techniques Lab	U11PE723	Aircraft Condition Monitoring Lab	U11PE732	UAV Design Lab
U11PE714	Hypersonic Aerodynamics Lab	U11PE724	Helicopter Maintenance Lab		

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PC701	Aircraft Systems	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PC701	Aircraft Systems	10	10	5	25	40%	50	40%	75

Course Description

This course provides comprehensive knowledge of major aircraft systems, including hydraulic systems, landing gear systems, flight control systems, electrical power systems, engine control systems, and fuel systems. It focuses on system architecture, operating principles, redundancy, safety, certification requirements, and integration in modern civil transport aircraft. The course enables students to understand system design, control strategies, and aircraft-level implementation.

Pre-requisites:

- Fundamentals of Fluid Mechanics
- Basic Electrical and Electronic Engineering
- Aircraft Structures, Basic Thermodynamics and Propulsion

Course Objectives

- To impart knowledge of hydraulic and landing gear systems used in modern aircraft.
- To explain the working principles of flight control and actuation systems.
- To understand aircraft electrical power generation and distribution systems.
- To study engine control and fuel management systems in civil transport aircraft.
- To develop an analytical understanding of system integration, redundancy, and safety in aircraft design.

Course Outcomes: After the successful completion of the course, students will be able to:

- **CO1** **Discuss**[2] various Aircraft Systems
- **CO2** **Explain**[2] the working principle of the Flight Control System
- **CO3** **Explain**[2] the working principle of the Aircraft Electrical
- **CO4** **Explain**[3] the working principle of the Engine System, Aircraft Instruments and Health Monitoring Systems.
- **CO5** **Develop**[5] a model of an aircraft emergency system.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Aircraft Systems**	**9**
1	1.1	Introduction- Hydraulic Circuit Design - Hydraulic Actuation - Hydraulic Fluid - Fluid Pressure- Fluid Temperature- Fluid Flow Rate - Hydraulic Piping -Hydraulic Pumps.	
	1.2	Fluid Conditioning -Hydraulic Reservoir - Warnings and Status - Emergency Power Sources –proof of design-Civil Transport Comparison -Landing Gear Systems - Nose Gear- Main Gear - Braking Anti-Skid and Steering - Electronic Control -Automatic Braking - Multi-Wheel Systems- Brake Parachute.	
2.0		**Flight Control System**	**9**
2	2.1	Introduction - Principles of Flight Control- Flight Control Surfaces - Primary Flight Control - Secondary Flight Control - Commercial Aircraft - Flight Control Linkage Systems - Push-Pull Control Rod System - Cable and Pulley System -High Lift Control Systems- Trim and Feel - Flight Control Actuation- Simple Mechanical/Hydraulic Actuation.	
	2.2	Mechanical Actuation with Electrical Signalling - Multiple Redundancy Actuation - Mechanical Screw Jack Actuator- Integrated Actuator Package (IAP)- Advanced Actuation Implementations -Civil System Implementations - Fly-By-Wire Control Laws –Interrelationship of Flight Control, Guidance and Flight Management.	
3.0		**Aircraft Electrical System**	**9**
3	3.1	Introduction - Aircraft Electrical System - Power Generation- DC Power Generation - AC Power Generation- Power Generation Control- Primary Power Distribution - Power Conversion and Energy Storage -Secondary Power Distribution - Power Switching - Load Protection.	
	3.2	Typical Aircraft DC System- Typical Civil Transport Electrical System - Electrical Loads- Emergency Power Generation -Ram Air Turbine – Backup Power Converters- Permanent Magnet Generators (PMGs).	
4.0		**Engine Control Systems**	**9**
4	4.1	Introduction -Engine/Airframe Interfaces- Engine Technology and Principles of Operation - The Control Problem - Fuel Flow Control - Air Flow Control- Control Systems -Control System Parameters - Input Signals- Output Signals- Design Criteria.	
	4.2	Engine Starting- Fuel Control- Ignition Control - Engine Rotation - Throttle Levers- Starting Sequence -Engine Indications -Engine Oil Systems - Engine Offtakes -Reverse Thrust- Engine Control on Modern Civil Aircraft.	

5.0		**Fuel Systems**	9
5	5.1	Introduction -Characteristics of Fuel Systems - Description of Fuel System Components - Fuel Quantity Measurement - Fuel System Operating Modes - Integrated Civil Aircraft Systems-Bombardier Global Express- Boeing 777 - A340-500/600 Fuel System - Fuel Tank Safety.	
	5.2	Principles of Fuel Inerting - Air Separation Technology - Typical Fuel Inerting System- Polar Operations Cold Fuel Management - Minimum Equipment List (MEL) -Cold Fuel Characteristics -Fuel Temperature Indication.	

Text Books

1. E.H.J. Pallet, Aircraft Instruments, Pearson, 3rd Edition, 2017.

References

1. E.H.J. Pallet, Aircraft Electrical Systems, Pearson, 3rd Edition, 2016.
2. Mike Tooley & David Wyatt, Aircraft Electrical & Electronic System, ELSEVIER Publication, 1st Edition, 2009
3. Mike Tooley & David Wyatt, Aircraft Communication & Navigation System, ELSEVIER Publication, 1st Edition, 2007

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on the first two modules, and T2 (Test 2) should be based on the next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. The question paper will be of 50 marks and comprise 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on the entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	2	2	-	-	-	-	-	-	-	3	-
CO3	3	2	-	2	3	-	-	-	-	-	-	-	3	-
CO4	3	3	-	2	2	-	-	-	-	-	-	-	3	2
CO5	3	3	3	3	3	-	-	-	2	-	-	2	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
U11PC702	Computational Fluid Dynamics	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
U11PC702	Computational Fluid Dynamics	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description

This course provides a comprehensive introduction to Computational Fluid Dynamics (CFD) with emphasis on numerical solutions of fluid flow and heat transfer problems. The course covers governing equations, discretization techniques, grid generation, stability and convergence analysis, pressure–velocity coupling algorithms, and turbulence modelling. Students develop the ability to implement basic numerical schemes and critically interpret CFD results for aerospace and engineering applications.

Pre-requisites: Fluid Mechanics, Engineering Mathematics (Differential Equations, Linear Algebra), Numerical Methods (basic).

Course Objectives

- To develop a strong understanding of the mathematical formulation of fluid flow problems.
- To apply discretization methods for solving governing equations numerically.
- To analyze stability, convergence, and accuracy of numerical schemes.
- To understand pressure-velocity coupling and turbulence modeling approaches.
- To interpret and validate CFD solutions for engineering applications. Understand the fundamental concepts of stress, strain, and elastic behavior of materials under different loading conditions.

Course Outcomes: After the successful completion of the course, students will be able to:

- **CO1** **Derive**[3] and interpret4 governing equations of fluid flow.
- **CO2** **Discretize**[4] PDEs using FDM and FVM techniques.
- **CO3** **Analyze**[4] stability, accuracy, and convergence of numerical schemes.
- **CO4** **Implement**[4] pressure–velocity coupling algorithms for incompressible flows.
- **CO5** **Evaluate**[5] turbulence models and interpret CFD results for aerospace applications.

Course Contents

Module	Unit	Description	Hours
1.0		**Governing Equations and Mathematical Behavior**	**9**
1	1.1	Derivation of continuity equation, Navier–Stokes equations (vector and Cartesian form), Energy equation, Conservative vs non-conservative forms.	
	1.2	Classification of PDEs (elliptic, parabolic, hyperbolic), Initial and boundary conditions, Well-posed problems.	
2.0		**Discretization Methods**	**9**
2	2.1	Taylor series expansion, Finite Difference Method (FDM), Finite Volume Method (FVM).	
	2.2	Finite Element Method (overview), Truncation error, Consistency, Order of accuracy.	
3.0		**Grid Generation and Numerical Analysis**	**9**
3	3.1	Structured vs unstructured grids, Grid metrics and transformation, Stability analysis (Von Neumann method).	
	3.2	Convergence and boundedness, Upwind scheme, Central difference scheme, QUICK scheme, Numerical diffusion.	
4.0		**Solution Algorithms for Incompressible Flow**	**9**
4	4.1	Pressure–velocity coupling problem, SIMPLE algorithm (derivation steps), SIMPLER and SIMPLEC (concept), PISO algorithm.	
	4.2	Explicit vs implicit schemes, Iterative solvers (Gauss–Seidel, TDMA).	
5.0		**Turbulence Modeling and Applications**	**9**
5	5.1	Reynolds Averaged Navier–Stokes (RANS), Boussinesq hypothesis, k–ε model, k–ω model.	
	5.2	Introduction to LES and DNS, Grid independence study, Validation and verification, Aerospace applications: Airfoil analysis, External aerodynamic drag prediction, Nozzle flow simulation.	

Text Books

1. J. D. Anderson, Computational Fluid Dynamics: The Basics with Applications. New York, NY, USA: McGraw-Hill, 1995.
2. P. K. Das and G. Biswas, Textbook of Computational Fluid Dynamics, New Delhi, India: Cengage Learning India, 2012.
3. T. J. Chung, Computational Fluid Dynamics, 2nd ed. Cambridge, U.K.: Cambridge University Press, 2010.

References

1. C. Hirsch, Numerical Computation of Internal and External Flows: The Fundamentals of Computational Fluid Dynamics, Vol. 1. New York, NY, USA: Wiley, 2007.
2. P. Wesseling, Principles of Computational Fluid Dynamics, New York, NY, USA: Springer, 2001.
3. M. K. Venkateswarlu, Computational Fluid Dynamics, Hyderabad, India: Universities Press, 2011.

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on the first two modules, and T2 (Test 2) should be based on the next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. The question paper will be of 50 marks and comprise 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on the entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	2	3	3	-	-	-	-	-	-	2	3	3
CO3	3	3	-	3	-	-	-	-	-	-	-	2	3	3
CO4	3	3	2	3	3	-	-	-	2	-	-	2	3	3
CO5	3	3	2	3	3	-	-	-	2	-	-	3	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE711	Wind Tunnel Techniques	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE711	Wind Tunnel Techniques	10	10	5	25	40%	50	40%	75

Course Description

This course covers the principles and applications of wind tunnel testing in aerodynamics. Topics include wind tunnel design, flow visualization, force and moment measurements, and data analysis. Students will gain hands-on experience in experimental aerodynamics, enhancing their understanding of aircraft performance, stability, and control through real-world testing techniques.

Pre-requisites: Fluid Mechanics and Aerodynamics

Course Objectives

- To acquire the knowledge on various types of tunnels and its losses.
- To learn the calibration of different types of high-speed tunnels
- To know the various special tunnels and its applications.
- To learn the basics of various measurement techniques of instruments of wind tunnel**.**
- To learn the various Aerodynamic techniques for data generation and testing.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the uses of various types of tunnels and its losses.
- **CO2** **Illustrate**[3] with calibration of different types of high-speed tunnels.
- **CO3** **Define**[1] use of various special tunnels and its applications.
- **CO4** **Define**[1] various measurement techniques of instruments of wind tunnel**.**
- **CO5** **Apply**[4] various techniques for aer**o**dynamic data generation.

Course Contents

Module	Unit	Description	Hours
1.0		**Wind Tunnels and Special Purpose wind tunnels**	**9**
1	1.1	Wind Tunnel, layouts and nomenclature, Types of Wind Tunnels – continuous and intermittent -closed circuit and open circuit - closed jet and open jet test section – application.	
	1.2	Special purpose tunnels - Smoke Tunnels -Spin tunnel, automobile wind tunnel Important parameters of flow similarity. types of flow similarities for compressible and incompressible flows Model power consideration.	
2.0		**Flow visualization techniques**	**9**
2	2.1	Path – Streak – Stream and Timelines; Techniques: Smoke, Tuft, Streaks, Surface oil flow.	
	2.2	Pressure measurements: Manometers – U-Tube, Inclined and Precession. Bourdon Gauge	
	2.3	Pressure Transducer – Strain Gauge, Semiconductor – Absolute and Differential. Velocity	
	2.4	Measurements: Pivot Tube – Static and Total.	
	2.5	Calibration of test section: Test section flow calibration and Boundary Layers	
3.0		**Measurements of Forces and Moments**	**9**
3	3.1	Forces, moments and Reference Frames – Balances – Internal and External - Requirements and Specifications – Fundamentals of Model Installations. Boundary correction, types of blockages:2-D..	
4.0		**High Speed Wind Tunnels**	**10**
4	4.1	Supersonic Wind Tunnels and - Classification - Runtime - Compressors - Charging Times – nozzle Mass Flows - Starting Loads - Model Size – Calibration.	
	4.2	Hypersonic Wind Tunnels: Classification– Runtime – Vacuum Tanks – Vacuum pumps – Evacuation Times.	
	4.3	Shock Tube: Driver – driven –Vacuum Pumps – Diaphragm	
5.0		**High Speed Flow Visualizations and Measurements**	8
5	5.1	Schlieren and Shadow Graph – Pressure sensitive Paints – Temperature sensitive Paints – Force Measurements – Strain Gauge Balances – Pressure Measurements Case study – Experimental analysis of flow over a bullet.	

Text Books

1. Rae, W.H. and Pope, A. ―Low Speed Wind Tunnel Testing‖, John Wiley Publication,1999
2. Pope, A., and Goin, L., ―High Speed wind Tunnel Testing‖, John Wiley Publication ,1999.
3. Pope, J B Barlow ―low speed wind tunnel testing ― 3 edition j.w publication

References

1. John D. Anderson, Jr., "Fundamentals of Aerodynamics", Third edition, McGraw- Hill publications, 2001
2. E L Houghton and PW Carpenter, "Aerodynamics for Engineering students", Fourth edition, Edward Arnold publications, 1993.

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	-	2	2	-	-	-	-	-	-	-	3	2
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	2	3	-	-	-	-	-	-	-	3	-
CO5	3	3	2	3	3	-	-	2	-	-	-	2	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE712	Hypersonic Aerodynamics	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE712	Hypersonic Aerodynamics	10	10	5	25	40%	50	40%	75

Course Description

This course deals with the aerodynamics of high-speed flows at hypersonic Mach numbers (typically M > 5). It focuses on the unique physical phenomena that occur in hypersonic regimes, including strong shock waves, thin shock layers, high-temperature gas effects, viscous–inviscid interactions, aerodynamic heating, and real gas behaviour

Pre-requisites: Fluid Mechanics and Aerodynamics

Course Objectives

- To understand the fundamental principles governing hypersonic flow regimes (M > 5).
- To analyze shock waves, expansion phenomena, and high-temperature gas effects in hypersonic flows.
- To study viscous interactions, boundary layer behavior, and aerodynamic heating.
- To evaluate aerodynamic forces, stability, and performance of hypersonic vehicles.
- To apply theoretical and analytical methods to practical hypersonic aerospace applications such as re-entry vehicles and missiles.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain[2]** the formation of shock waves due to the high-speed flow over bodies
- **CO2** **Apply[3]** the concept of hypersonic aerodynamic
- **CO3** **Apply[3]** the hypersonic in viscid flow problems
- **CO4** **Analyze[4]** the viscous boundary layers and its interactions in the hypersonic flows
- **CO5** **Analyze[4]** the effect of high temperature on hypersonic flow

Course Contents

Module	Unit	Description	Hours
1.0		**Review of High Speed Aerodynamics**	**9**
1	1.1	Normal shock relations, Prandtl's relation, Hugoniot equation, Rayleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, Reflection ofoblique shocks, left running and right running waves,	
	1.2	Interaction of oblique shock waves, slip line,shock-boundary layer interaction – transonic lambda shock – compression corner effect – incident shock interaction - Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions	
2.0		**Fundamentals of Hypersonic Aerodynamics**	**9**
2	2.1	Introduction to hypersonic aerodynamics, differences between hypersonic aerodynamics and supersonic aerodynamics,	
	2.2	Concept of thin shock layers and entropy layers, hypersonic flight paths, hypersonic similarity parameters, shock wave and expansion wave relations of inviscid hypersonic flows	
3.0		**Simple Solution Methods for Hypersonic Inviscid Flows**	**9**
3	3.1	Local surface inclination methods, Newtonian theory, modified Newtonian law, tangent wedge and tangent cone and shock expansion methods, approximate methods, hypersonic small disturbance theory, thin shock layer theory.	
4.0		**Viscous Hypersonic Flow Theory**	**10**
4	4.1	Boundary layer equations for hypersonic flow, hypersonic boundary layers, self similar and non self similar boundary layers, solution methods for non self similar boundary layers, aerodynamic heating and its adverse effects on airframe.	
5.0		**Viscous Interactions and High Temperature Effects in Hypersonic Flows**	8
5	5.1	Introduction to the concept of viscous interaction in hypersonic flows, Strong and weak viscous interactions, hypersonic viscous interaction similarity parameter, introduction to shock wave boundary layer interactions	
	5.2	Nature of high temperature flows, chemical effects in air – real and perfect gases, Gibb's free energy and entropy, chemically reacting boundary layers, recombination and dissociation	

Text Books

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

References

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

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO4	3	3	-	3	-	-	-	-	-	-	-	-	3	2
CO5	3	3	-	3	-	-	-	-	-	-	-	-	3	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
U11PE721	Aircraft Condition Monitoring	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
U11PE721	Aircraft Condition Monitoring	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description

Aircraft Condition Monitoring (ACM) refers to the systematic process of monitoring the health and performance of aircraft systems and components using inspection techniques, sensors, data acquisition, and diagnostic tools to ensure safety, reliability, and airworthiness.

Pre-requisites: Aircraft Systems, Aircraft Maintenance Practices, Aircraft Engines, Engineering Mechanics

Course Objectives

- To understand the principles and importance of aircraft condition monitoring systems.
- To study various monitoring techniques such as vibration, oil analysis, and engine health monitoring.
- To develop skills in fault detection, diagnostics, and predictive maintenance.
- To analyze aircraft system performance using monitoring data.
- To enhance reliability, safety, and maintenance planning through condition-based monitoring.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the principles and practices of the aircraft Condition Monitoring
- **CO2** **Apply**[3] different maintenance strategies to inspect various aircraft systems
- **CO3** **Explain**[2] the condition Monitoring of the Rotary parts of the Aircraft
- **CO4** **Explain**[2] the Temperature and Chemical Monitoring
- **CO5** **Apply**[3] the Vibration Monitoring concept to monitor health of various aircraft systems

Course Contents

Module	Unit	Description	Hours
1.0		**Principles and Practices of Maintenance Planning**	**9**
1	1.1	Basic Principles of maintenance planning, Objectives and principles of planned maintenance activity, Importance and benefits of sound Maintenance systems, Reliability and machine availability, MTBF, MTTR and MWT	
	1.2	Factors of availability, Maintenance organization, Maintenance economics. Maintenance categories	
	1.3	Comparative merits of each category, Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication, TPM	
2.0		**Maintenance and Condition Monitoring**	**9**
2	2.1	Importance and necessity of maintenance, different maintenance strategies like Breakdown maintenance, planned maintenance and condition based maintenance. Planned and preventive maintenance of transformer, induction motor and alternators. Insulation stressing factors, insulation deterioration, polarization index, dielectric absorption ratio.	
	2.2	Insulation ageing mechanisms, Insulation failure modes, Definition of terms, Concept of condition monitoring of electrical equipments.	
	2.3	Overview of Advanced tools and techniques of condition monitoring, Condition monitoring by thermography.	
3.0		**Condition Monitoring Analysis**	**9**
3	3.1	Condition Monitoring, Cost comparison with and without CM, On-load testing and offload testing,	
	3.2	Methods and instruments for CM, Temperature sensitive tapes, Pistol thermometers, wear-debris analysis	
4.0		**Condition Monitoring of Rotating Elements**	**8**
4	4.1	Introduction to motor condition monitoring, The need for monitoring, What and when to monitor, Construction, operation and failure modes of electrical machines, Structure of electrical machines and their types,	
	4.2	Machine specification and failure modes, Failure sequence and effect on monitoring, Typical root causes and failure modes, General, Root causes, Failure modes.	
5.0		**Temperature monitoring and Chemical monitoring:**	10

5	5.1	**Temperature monitoring:** Instrumentation requirement for Temperature measurement, Local temperature measurement, Hot-spot measurement and thermal images, Bulk measurement.	
	5.2	**Chemical monitoring:** Insulation degradation, Factors that affect detection, Insulation degradation detection,	
	5.3	Particulate detection: core monitors, Particulate detection: chemical analysis, Gas analysis off-line, Gas analysis on-line, Lubrication oil and bearing degradation	

Text Books

1. Hamid A Toliyat, Subhasis Nandi, Seungdeog Choi, HomayounMeshgin-Kelk, " Electric Machines: Modeling, Condition Monitoring and Fault Diagnostics, CRC Press

References

1. Aircraft Engine Controls: Design, System Analysis, and Health Monitoring – Link C. Jaw & Jack D. Mattingly, AIAA Education Series (2009)
2. Aircraft Maintenance Management – Harry A. Kinnison & Tariq T. Siddiqui, McGraw-Hill Education (2004)

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	2
CO3	3	2	-	2	2	-	-	-	-	-	-	-	3	-
CO4	3	2	-	2	2	-	-	-	-	-	-	-	3	-
CO5	3	3	2	3	3	-	-	-	2	-	-	2	3	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE722	Helicopter Maintenance	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE722	Helicopter Maintenance	10	10	5	25	40%	50	40%	75

Course Description

This course provides comprehensive knowledge of helicopter maintenance with emphasis on rotor systems, transmissions, power plants, tail rotors, airframes, and related systems. It covers fundamental concepts of helicopter construction, ground handling, rotor head maintenance, blade tracking and balancing, vibration analysis, and control rigging. Students will study engine–transmission coupling, freewheeling units, torque measurement, and brake systems. The course also includes power plant installation, inspection procedures, fuselage maintenance, and special equipment.

Pre-requisites: Aircraft General Engineering Maintenance, Airframe Maintenance and Repair

Course Objectives

- To understand helicopter fundamentals and basic maintenance practices.
- To explain construction and maintenance of main rotor systems, including tracking and balancing.
- To analyze rotor vibrations and perform corrective maintenance procedures.
- To study transmission systems, drive shafts, clutches, and freewheeling units.
- To understand power plant installation and maintenance procedures.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] helicopter fundamentals and ground handling procedures.
- **CO2** **Apply**[3] maintenance practices to main rotor systems.
- **CO3** **Analyze**[4] main rotor transmission systems.
- **CO4** **Explain**[2] power plant and tail rotor systems.
- **CO5** **Perform**[3] inspection and maintenance of airframe systems.

Course Contents

Module	Unit	Description	Hours
1.0		**Helicopter Fundamentals**	**9**
1	1.1	Basic directions, basic ground handling procedures	
	1.2	Bearings, gears and introductory maintenance practices.	
2.0		**Main Rotor System**	**9**
2	2.1	Rotor head maintenance, blade alignment, tracking, static and dynamic balancing,	
	2.2	Vibration analysis, dampers, swash plate system, control rigging and adjustments.	
3.0		**Main Rotor Transmissions**	**9**
3	3.1	Engine–transmission coupling, drive shafts, maintenance clutch, freewheeling units (sprag/roller), torque meter, braking systems, vibration and mounting systems.	
4.0		**Power Plants & Tail Rotors**	**8**
4	4.1	Power plant installation, modifications,	
	4.2	Different types of power plant maintenance, and tail rotor system overview.	
5.0		**High Speed Flow Visualizations and Measurements**	10
5	5.1	Fuselage maintenance, airframe systems, inspection procedures, and special purpose equipment maintenance.	

Text Books

1. Jeppesen, Helicopter Maintenance, Jeppesen and Sons Inc., 2000

References

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

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	2
CO3	3	3	2	3	2	-	-	-	-	-	-	-	3	2
CO4	3	2	-	2	2	-	-	-	-	-	-	-	3	-
CO5	3	3	2	3	3	-	-	-	2	-	-	2	3	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE731	UAV Design	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (SEE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE731	UAV Design	10	10	5	25	40%	50	40%	75

Course Description

The UAV Design course provides comprehensive knowledge of the design, analysis, and development of Unmanned Aerial Vehicles (UAVs). The course covers fundamental aerodynamic principles, airframe configuration, propulsion systems, flight stability and control, avionics integration, and mission planning specific to UAV platforms.

Pre-requisites: Engineering Mathematics, Engineering Mechanics, Fluid Mechanics, Aircraft Performance, Basic Electrical & Electronics Engineering, Engineering Drawing / CAD

Course Objectives

- To introduce students to the fundamentals of Unmanned Aerial Vehicle (UAV) systems and their classifications.
- To develop the ability to translate mission requirements into preliminary UAV design parameters.
- To impart knowledge of aerodynamic principles and their application in UAV airframe design.
- To enable students to perform weight estimation, propulsion selection, and performance analysis for UAV systems.
- To provide understanding of stability, control mechanisms, and avionics integration in UAVs.
- To familiarize students with power systems, battery management, and lightweight material selection for UAV applications.

Course Outcomes: After the successful completion of the course students will able to:2

- **CO1** **Explain**[2] UAVs and their classification
- **CO2** **Apply**[3] design parameters for UAVs design
- **CO3** **Apply**[3] design algorithm for configuring UAV layout
- **CO4** **Analyze**[4] weight estimation and wing sizing for different UAV
- **CO5** **Analyze**[4] performance and stability of UAVs

Course Contents

Module	Unit	Description	Hours
1.0		**Basics of fixed-wing UAVs**	**9**
1	1.1	Introduction to fixed-wing UAVs and their classification,	
	1.2	Measurement of flight velocity and standard atmosphere, anatomy of airplane and air foil nomenclature	
2.0		**Design Parameters of UAVs**	**9**
2	2.1	Basic design parameters, generation of lift and drag, lifting line theory,	
	2.2	Design algorithm: case study design algorithm: mission requirements	
3.0		**Design Algorithm of UAVs**	**9**
3	3.1	Feasible design parameters configuration layout: interpreting airfoil data, Cl vs AOA and drag polar,	
	3.2	Airfoil selection, configuration layout: planform geometry selection	
4.0		**Weight Estimation and Wing Sizing**	**9**
4	4.1	Weight and CG Estimation, wing sizing, Analytical parameter estimation battery charging, electrical propulsion, common propulsion systems	
5.0		**Performance and Stability Analysis**	9
5	5.1	Introduction to airfoil performance, equation of motion, thrust required and power required,	
	5.2	Calculation of performance parameters and selection of power plant, climb performance, engine sizing, power plant selection,	
	5.3	Effect of variation of CG location and static stability (Longitudinal static stability),	
	5.4	Contribution of tail in static stability and neutral point, Simulation and Detailed Sizing	

Text Books

1. Daniel P. Raymer. Aircraft Design: A Conceptual Approach
2. Reg Austin. Unmanned Aircraft Systems: UAVs Design Development and Deployment
3. Andrew J. Keane and James P. Scanlan. Small Unmanned Fixed-wing Aircraft Design: A Practical Approach

References

1. John D. Anderson Jr., Introduction to Flight, McGraw-Hill Education.
2. Gudmundsson, S., General Aviation Aircraft Design: Applied Methods and Procedures, Butterworth-Heinemann.
3. Anderson, J. D. (2016). Fundamentals of Aerodynamics (6th ed.). McGraw-Hill.

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

Semester End Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of Semester End Examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	2	3	2	-	-	-	-	-	-	-	3	3
CO5	3	3	2	3	2	-	-	-	-	-	-	-	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U01RM701	Research Methodology	3	-	-	3	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U01RM701	Research Methodology	10	10	5	25	40%	50	40%	75

Course Description

This course equips students with essential research skills including problem identification, research design, sampling, data collection, statistical analysis, hypothesis testing, and research report writing. The course emphasizes practical application and preparation for project work and higher studies.

Course Objectives

The course aims:

- To develop understanding of research fundamentals.
- To enable students to design research studies independently.
- To apply statistical tools for data analysis.
- To interpret results and draw meaningful conclusions.
- To prepare structured project reports ethically.

Course Outcomes: After the successful completion of the course students will able to:

CO1 **Explain**[2] research concepts and processes.

CO2 **Formulate**[3]research problems and hypotheses.

CO3 **Design**[4] sampling and data collection strategies.

CO4 **Apply**[3]statistical techniques for analysis and hypothesis testing.

CO5 **Prepare**[5] research reports following academic standards.

Course Contents (Common to all Branches)

Module	Unit	Description	Hours
1.0		**Introduction to Research Methodology**	
1	1.1	Meaning, objectives, and characteristics of research, Types of research (basic, applied, exploratory, descriptive, analytical), Research process, Criteria of good research.	9
	1.2	Research problem formulation, Literature review, Research gap identification, Research objectives and hypotheses formulation.	
2.0		**Research Design and Sampling**	
2	2.1	Research design: Meaning and types (exploratory, descriptive, causal, experimental), Variables and measurement scales (nominal, ordinal, interval, ratio).	9
	2.2	Sampling design: Census vs sampling, Probability and non-probability sampling methods, Sample size determination, Sampling errors.	
3.0		**Data Collection and Processing**	
3	3.1	Primary and secondary data, Methods of data collection: observation, interview, questionnaire, schedule, case study method.	9
	3.2	Data preparation: Editing, coding, classification, tabulation, Data presentation techniques (tables, charts, diagrams).	
4.0		**Statistical Analysis and Hypothesis Testing**	
4	4.1	Measures of central tendency, Measures of Variation, Measures of skewness, Correlation and regression analysis.	9
	4.2	Hypothesis testing: Null and alternative hypotheses, Type I & Type II errors, t-test, z-test, chi-square test, ANOVA (conceptual understanding).	
5.0		**Research Report Writing and Ethics**	
5	5.1	Structure of research report: Title page, abstract, introduction, literature review, methodology, analysis, findings, conclusion and references.	9
	5.2	Citation styles (APA/IEEE), Plagiarism and research ethics, Intellectual property rights, Use of software tools (SPSS/Excel/LaTeX basics for report preparation).	

Text Books

1. R. Panneerselvam, **Research Methodology**, PHI Learning Pvt. Ltd
2. C.R. Kothari & Gaurav Garg, Research Methodology: Methods and Techniques, New Age International Publishers..
3. John W. Creswell & J. David Creswell, Research Design: Qualitative, Quantitative and Mixed Methods Approaches, Sage Publications

References

1. Donald R. Cooper & Pamela S. Schindler, *Business Research Methods*, McGraw-Hill Education.
2. Uma Sekaran & Roger Bougie, *Research Methods for Business: A Skill Building Approach*, Wiley India.

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

Semester End Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of Semester End Examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	-	-	1	-	1	-	2	2	1
CO2	2	3	2	3	1	-	-	1	-	1	-	2	3	2
CO3	2	3	3	3	2	-	-	1	1	1	-	2	3	2
CO4	3	3	2	3	3	-	-	1	-	1	-	2	3	3
CO5	2	2	1	2	1	-	-	2	2	3	-	2	2	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PC703	Aircraft Systems Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PC703	Aircraft Systems Lab	25	40%	-	-	25

Course Outcomes: After the successful completion of the course, students will be able to:

- **CO1** **Explain**[2] the functioning of the various critical aircraft systems
- **CO2** **Demonstrate**[3] the working of the aircraft systems.
- **CO3** **Design**[5] an lighting system for aircraft

List of Experiments

All the experiments will be based on the course content of **U11PC701 Aircraft Systems**

Ex. No.	Experiment Name
1.	Demonstration of Hydraulic Systems.
2.	Measure the deflection and movement of the Flight Control System.
3.	Perform a test on the Engine Control System.
4.	Perform a test on Flight Deck Instruments.
5.	Experiment on Aircraft Fuel System.
6.	Study an Aircraft Electrical System.
7.	Perform a test on the Landing Gear System.
8.	Design an Aircraft Lighting System.

References

1. Dingle, Lloyd, and Tooley, Michael H. Aircraft engineering principles. Netherlands, Elsevier Butterworth-Heinemann, 2004.
2. Seabridge, Allan G., and Moir, Ian. Design and Development of Aircraft Systems: An Introduction. United Kingdom, American Institute of Aeronautics and Astronautics, 2004.

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student, with every assignment graded from time to time.
2. The grades will be converted to marks as per the 'credit and grading system' manual and should be added and averaged.
3. Based on the above scheme, grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PC704	Computational Fluid Dynamics Lab	-	04	-	-	02	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PC704	Computational Fluid Dynamics Lab	25	40%	25	40%	50

Course Outcomes: After the successful completion of the course, students will be able to:

- **CO1** Perform CFD simulations using appropriate discretization and grid strategies.
- **CO2** Interpret simulation results for aerospace engineering applications.

List of Experiments

All the experiments will be based on the course content of **U11PC702 Computational Fluid Dynamics**

Ex. No.	Experiment Name
1.	Simulation of flow through an elbow pipe
2.	Simulation of flow (hot and cold) mixing in a t-pipe
3.	Simulation of flow through a convergent-divergent (cd) nozzle
4.	Simulation of supersonic flow over a wedge airfoil
5.	Simulation of subsonic flow over an asymmetrical airfoil
6.	Simulation of flow through compressor blades of a jet engine
7.	Simulation of flow through an axial flow turbine blade passage
8.	Simulation of combustion process in a combustor
9.	Simulation of flow through subsonic diffusers
10.	Simulation of flow through supersonic diffusers

References

1. J. D. Anderson, Computational Fluid Dynamics: The Basics with Applications. New York, NY, USA: McGraw-Hill, 1995.
2. J. Blazek, Computational Fluid Dynamics: Principles and Applications, 3rd ed. Oxford, U.K.: Butterworth-Heinemann, 2015.
3. ANSYS Fluent Theory Guide — ANSYS Inc.

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student, with every assignment graded from time to time.
2. The grades will be converted to marks as per the 'credit and grading system' manual and should be added and averaged.
3. Based on the above scheme, grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	2	-	-	2	3	3
CO2	3	3	2	3	3	-	-	-	2	-	-	2	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE713	Wind Tunnel Techniques Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PE713	Wind Tunnel Techniques Lab	25	40%	-	-	25

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the various types of wind tunnels and their uses and losses
- **CO2** **Discuss**[3] the design considerations and performance implications of various types of wind tunnels and supersonic and hypersonic wind tunnels.

List of Experiments

All the experiments will be based on the course content of **U11PE711 Wind Tunnel Techniques**

Ex.No	Experiment Name
1	Calibration of wind tunnel using Pitot-static tube.
2	Measurement of pressure distribution over an aerofoil.
3	Determination of lift and drag characteristics of an aerofoil.
4	Flow visualization using smoke/tuft/oil flow methods.
5	Boundary layer velocity profile measurement.
6	Drag measurement on bluff bodies (cylinder/sphere).
7	Force measurement using three-component balance.
8	Study of flow separation and stall characteristics.

References

1. Rae, W.H. and Pope, A. ―Low Speed Wind Tunnel Testing‖, John Wiley Publication,1999
2. Pope, A., and Goin, L., ―High Speed wind Tunnel Testing‖, John Wiley Publication ,1999.
3. Pope, J B Barlow ―low speed wind tunnel testing ― 3 edition j.w publication

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
3. Based on above scheme grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE714	Hypersonic Aerodynamics Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PE714	Hypersonic Aerodynamics Lab	25	40%	-	-	25

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the high temperature effects in the hypersonic flows
- **CO2** **Visualize**[3] the Hypersonic flow over bodies
- **CO3** **Analyze**[4] the shock wave and boundary layer interaction

List of Experiments

All the experiments will be based on the course content of **U11PE712 Hypersonic Aerodynamics**

Ex.No	Experiment Name
1	Measure Flow visualization techniques in high-speed flows
2	Conduct Schlieren flow visualization over conical body at Hypersonic flow
3	Investigate the change in flow field over a conical body on introduction of spike
4	Perform Flow investigation of the surface of a conical body using oil flow visualization at Hypersonic speed.
5	Obtain Flow field over a cavity at hypersonic flow using schlieren flow visualization
6	Perform Flow field on a protrusion using oil flow visualization
7	Obtain Shock wave and boundary layer interaction point
8	Perform over expanded flow studies on a jet
9	Measure Shock reflections inside an air intake at hypersonic speed

References

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

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
3. Based on above scheme grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	-	3	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE723	Aircraft Condition Monitoring Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PE723	Aircraft Condition Monitoring Lab	25	40%	-	-	25

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the condition Monitoring if the Rotary parts of the Aircraft
- **CO2** **Analyze**[3] the temperature and chemical performance at various conditions
- **CO3** **Assess**[4] the vibration performance at various conditions

List of Experiments

All the experiments will be based on the course content of **U11PE721 Aircraft Condition Monitoring**

Ex.No	Experiment Name
1	Perform frequency response analysis
2	Perform Vibration Analysis of Aircraft
3	Perform Spectrum/FET Analysis of Aircraft
4	Demonstration of Signature Analysis
5	Identification of methods of Mechanical Faults
6	Perform the thermography diagnosis
7	Demonstration of Engine Health Monitoring
8	Perform Ultrasonic Health Monitoring of shafts

References

1. Aircraft Engine Controls: Design, System Analysis, and Health Monitoring – Link C. Jaw & Jack D. Mattingly, AIAA Education Series (2009)
2. Aircraft Maintenance Management – Harry A. Kinnison & Tariq T. Siddiqui, McGraw-Hill Education (2004)

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
3. Based on above scheme grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	2	-	-	-	-	-	-	2	3	3
CO2	3	3	2	3	2	-	-	-	-	-	-	2	3	3
CO3	3	3	2	3	2	-	-	-	-	-	-	2	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE724	Helicopter Maintenance Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PE724	Helicopter Maintenance Lab	25	40%	-	-	25

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the components of Helicopter
- **CO2** **Select**[3] the type of ground support equipment to be used for various ground handling operations
- **CO3** **Analyze**[4] the function of components in helicopter Rotor System

List of Experiments

All the experiments will be based on the course content of **U11PE722 Helicopter Maintenance**

Ex.No	Experiment Name
1	Study on Helicopter Control System
2	Demonstration of Helicopter Flight Deck
3	Perform test using different Helicopter Blade Tracking Methods
4	Carry out Balancing of Helicopter Blade
5	Perform Vibration Check of Helicopter Gear Box
6	Inspection of Main Rotor Blade
7	Inspection of Tail Rotor Blade
8	Inspection of Landing Skid and Airframe
9	Perform Helicopter Pre-flight Inspection

References

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

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
3. Based on above scheme grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	2	2	2	3	-	-	2	-	2	2	3	3
CO3	3	3	2	3	-	-	-	-	-	-	-	2	3	3

*****

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE732	UAV Design Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PE732	UAV Design Lab	25	40%	-	-	25

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Design**^{3} of a quadcopter with conventional data.
- **CO2** **Selection**^{5} of a motor and electronics equipment.
- **CO3** **Perform**^{3} autopilot integration and calibration of UAV

List of Experiments

All the experiments will be based on the course content of **U11PE731 UAV Design**

Ex.No	Experiment Name
1.	Design method of Quad copter
2.	Selection of motors and other electronics.
3.	Assemble of parts of UAV
4.	Demonstration of Autopilot integration, calibration and testing.
5.	GPS based Waypoint Navigation
6.	Navigation in a GPS Denied Environment.
7.	Path Planning and Obstacle Avoidance
8.	Hands on practice on flight simulator
9.	Hands on practice on Flying of quad copter
10.	Practice on Simulator and flying

References

1. Daniel P. Raymer, Aircraft Design: A Conceptual Approach, 6th Edition, AIAA Education Series.
2. Andrew J. Keane and James P. Scanlan, Small Unmanned Fixed-Wing Aircraft Design: A Practical Approach, Wiley Publications.
3. Reg Austin, Unmanned Aircraft Systems: UAVs Design, Development and Deployment, Wiley Publications.

Evaluation Scheme

1. TERM WORK assessment shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
3. Based on above scheme grading and TERM WORK assessment should be done.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	2	-	-	2	3	3
CO2	3	3	3	2	3	-	-	-	2	-	2	2	3	3
CO3	3	3	2	3	3	-	-	-	2	-	-	2	3	3

B Tech (Common to all Programs) Semester - VII

Track I: Industry Internship with Capstone Project Track

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Project/ Internship	Tutorial
U11PR701	Project Phase I (Industry Internship with Capstone Project)	-	4	-	-	2	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PR701	Project Phase I (Industry Internship with Capstone Project)	50	40%	-	-	50

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** Identify and analyse a real-world engineering problem through literature survey and problem definition.
- **CO2** Design and develop an innovative engineering solution using appropriate tools and techniques.
- **CO3** Apply modern engineering tools, software, and experimental methods for implementation and testing of the proposed system.
- **CO4** Analyse experimental results/data and optimize system performance to achieve desired objectives.
- **CO5** Demonstrate teamwork, project management skills, professional ethics, and effective communication through project documentation and presentation.

As a part of the B. Tech curriculum, each student is required to undertake a project in a group during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VII Semester towards earning prescribed credit are as follows:

1. Formation of a project team not exceeding Four Students.
2. Allotment of a Faculty Supervisor to each group.
3. Student group can choose the Projects offered by the faculty guides or can come out with project ideas to be finalized in consultation with project guide / supervisor or can carry out the industry sponsored projects in groups.
4. Student Group is required to prepare the project proposal in a standard format for approval.
5. Student group will present the project proposal to an evaluation committee appointed by the Head of the Department.
6. On approval of the Project Proposal, students can start the project. If there are any suggestions by committee, the students are required to rework on the project proposal and submit incorporating all

suggestions.

7. Students have a choice to make their own groups.

General guidelines for selection of a Project:

1. Design, testing and fabrication and of a product / machine.
2. Improvement in the existing system. Augment of performance of the existing system.
3. Solution to the existing problem using innovative problem-solving techniques.
4. Optimization techniques using heuristics.
5. Developing application software ‘s.
6. Application of Industrial Engineering / Optimization tools to solve industry problems.
7. Modeling and analysis and Optimization Projects.
8. Projects with technical solutions to the Social Problems.
9. Solving Industry related problems.
10. Extensive data collection, data analysis using computers and optimal solution. The list is not exhaustive. Students can identify feasible of this project beyond the list.

Evaluation Scheme

- **Term Work Assessment:** Based on overall performance of the student/group through continuous evaluation (proposal, literature review, progress, presentations, and documentation).
- **Grading:** Each activity shall be graded periodically. Grades will be converted into marks as per the **Credit and Grading System Manual** and averaged for final assessment.
- **Final Result:** Based on the above evaluation, a final grade (Pass/Fail or applicable grade) will be awarded. Successful completion of Phase I is mandatory to continue to Phase II.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	-	-	-	2	3	2
CO2	2	3	3	2	2	1	1	-	-	-	2	2	2	3
CO3	2	2	2	3	3	-	-	-	-	-	1	2	3	2
CO4	2	3	2	3	2	-	-	-	-	-	2	2	3	2
CO5	-	-	-	-	-	1	1	3	3	3	3	2	1	2

B Tech (Common to all Programs) Semester – VII

Track II: Entrepreneurship Venture Track

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Project/ Internship	Tutorial
U11EP701	Entrepreneurship Project Phase I (Entrepreneurship Venture Track)	-	4	-	-	2	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11EP701	Entrepreneurship Project Phase I (Entrepreneurship Venture Track)	50	40%	-	-	50

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Analyze**[3] personal strengths, weaknesses, opportunities, and threats (SWOT) to assess entrepreneurial potential and prepare a self-development action plan
- **CO2** **Examine**[3] the traits, leadership styles, risk-taking ability, and resource mobilization strategies of successful entrepreneurs through structured interactions.
- **CO3** **Analyze**[3] the business model, financial health, competitive strategy, and technology adoption of a startup or entrepreneurial venture.
- **CO4** **Develop**[2] a preliminary entrepreneurial plan based on market need, customer analysis, funding sources, and innovation strategy
- **CO5** **Demonstrate**[2] entrepreneurial mindset, professional communication, networking ability, and ethical responsibility in pursuing a startup venture.

As a part of the B. Tech curriculum, each student is required to undertake a project in a group during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VII Semester towards earning prescribed credit are as follows:

- This track is designed for students aspiring for staring their own enterprise / new start up and has a burning desire to become an entrepreneur. Though CGPA is not the only criteria for selection, a student is required to go through a well- structured process of selection and also an interaction with parents.
- During the 7th Semester, students are expected to be familiar with the traits t make a successful entrepreneur. Personal SWOT analysis and area in which he wants to think of taking up the business venture.

The activities for the Semester - VII include:

1. Self-analysis report and action plan for improvement of overall personality.
2. Interaction with minimum three entrepreneurs. Preferably one each from first generation entrepreneur, family business and women entrepreneur. Study and observe closely how they have built their units, their vision, planning, resource mobilization, style of working, risk taking ability and other personality dimensions make a brief report.
3. Study a unit started by a young entrepreneur and prepare a report with the following details:
   a. The beginning (start) Brief Profile of company, Products / Services, sources of Finance
   b. Customers
   c. What is special about the company? How they compete in the market
   d. What is the Financial Health?
   e. How they leverage technologies and all other aspects of running an enterprise

Eligibility for choice of this track

1. Student should possess the right attitude and mind set to start his venture assessed through the test and personal interview.
2. Interaction with parents is mandatory to seek the support and co-operation to their wards for starting a new venture.
3. Students are required to work hard to interact and connect with entrepreneurs. Complete the other course requirements mentioned in the track.

Evaluation Scheme

- **Term Work Assessment:** Based on overall performance of the student/group through continuous evaluation (proposal, literature review, progress, presentations, and documentation).
- **Grading:** Each activity shall be graded periodically. Grades will be converted into marks as per the **Credit and Grading System Manual** and averaged for final assessment.
- **Final Result:** Based on the above evaluation, a final grade (Pass/Fail or applicable grade) will be awarded. Successful completion of Phase I is mandatory to continue to Phase II.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	-	-	-	-	-	2	1	2	1	3	1	1
CO2	-	2	-	-	-	1	-	2	2	2	2	2	1	1
CO3	1	3	2	2	1	1	1	1	1	1	2	2	2	2
CO4	2	3	3	2	2	1	1	1	1	1	3	2	2	3
CO5	-	-	-	-	-	1	1	3	3	3	2	2	1	2

B Tech (Common to all Programs) Semester - VII

Track III: Higher Opportunity Track

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Project/ Internship	Tutorial
U11RE701	Research Project Phase I (Higher Opportunity Track)	-	4	-	-	2	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11RE701	Research Project Phase I (Higher Opportunity Track)	50	40%	-	-	50

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Identify**[3] a suitable research domain and formulate a research problem based on current trends and societal/industrial needs.
- **CO2** **Conduct**[3] a comprehensive literature survey using research databases and critically review published work to identify research gaps.
- **CO3** **Define**[3] research objectives and develop a clear research methodology under the guidance of a supervisor.
- **CO4** **Prepare**[3] a structured research proposal in standard format incorporating problem statement, objectives, methodology, and expected outcomes.
- **CO5** **Demonstrate**[3] research aptitude, independent learning ability, ethical practices, and professional communication skills during proposal presentation and evaluation.

As a part of the B. Tech curriculum, each student is required to undertake a research project during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VII Semester towards earning prescribed credit are as follows:

- Undergraduate Higher Opportunity Track is specially designed for students who would like to make their career in research, wish to pursue graduate programs (B.Tech) in reputed institutes and want to study abroad for Master's program (MS) and get a good opportunity to work with R&D departments of company. At the beginning of the academic year, the department is going to publish the details like list of Faculty available to guide Higher Opportunity Track, the number of candidates they can guide, Research area and the brief note of research projects they can offer.

Activities students are expected to carry out for Phase I

1. Selection of research project area and the research supervisor (to be confirmed by department based of prefixed criteria)
2. Make a literature survey by collecting the relent details and making a review of the literature.
3. Identify the research topic and decide the research project title under the guidance of a supervisor.
4. Make a research proposal which is to be worked out in Semester II in a standard format.

Eligibility requirements

1. The interest and passion for research judged through prior projects done, participated in research competitions and publications in conferences.
2. A good academic performance with a CGPA greater than 8.5 at the end Semester VI with no back logs.
3. Ready to work hard on a chosen topic to get the desired outcomes.
4. Students who get opportunity to carry out this track in premier institutions are required to meet the additional expenses incurred.

- The final proposal evaluation will be evaluated by a committee appointed by the Head of the department. If the committee recommends the proposal, student can start the work in vacation and if the committee suggests modification, changes in scope, the student is required to complete and resubmit the same for final approval and on approval can start the work.
- Students can take up the research projects outside the university premises like Government R&D laboratories, DRDO, Auto Vehicle Testing Labs, etc., reputed premier Institutes like IIT's and R&D Organizations.

Evaluation Scheme

- **Term Work Assessment:** Based on overall performance of the student through continuous evaluation (proposal, literature review, progress, presentations, and documentation).
- **Grading:** Each activity shall be graded periodically. Grades will be converted into marks as per the **Credit and Grading System Manual** and averaged for final assessment.
- **Final Result:** Based on the above evaluation, a final grade (Pass/Fail or applicable grade) will be awarded. Successful completion of Phase I is mandatory to continue to Phase II.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	-	-	-	-	-	-	-	2	2	1
CO2	3	3	-	3	2	-	-	1	-	1	-	3	2	1
CO3	2	3	3	2	2	-	-	-	-	-	1	2	3	2
CO4	2	3	3	2	2	1	-	1	-	2	1	2	3	2
CO5	-	-	-	-	-	1	-	3	2	3	1	3	1	1

Programme structure for B. Tech: Final Year Aeronautical Engineering (R23)
Track I: Industry Internship with Capstone Project Track
Semester VIII: Teaching Scheme

Course code	Course Name	Teaching scheme			Credits assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total credits
U11PE8XX	Program Elective V	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor VI	2	-	-	2	-	-	2
U11PR801	Project Phase II	-	8	-	-	4	-	4
U11OT801	Internship/On job Training	-	24	-	-	12	-	12
Total		**5**	**32**	**-**	**5**	**16**	**-**	**21**

Semester VIII: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical Marks		Total
		Evaluation (Theory)				SEE	Evaluation (Lab)		
		T1	T2	FET	Total		Term work	Practical Oral/POE	
U11PE8XX	Program Elective V	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor VI	-	10	5	15	35	-	-	50
U11PR801	Project Phase II	-	-	-	-	-	50	50	100
U11OT801	Internship/On job Training	-	-	-	-	-	200	100	300
								Total	**525**

Programme structure for B. Tech: Final Year Aeronautical Engineering (R23)

Track II: Entrepreneurship Venture Track

Semester VIII: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total Credits
U11PE8XX	Program Elective V	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor VI	2	-	-	2	-	-	2
U11EP801	Online Course in Advanced Technology (Domain area)	-	-	-	4	-	-	4
U11EP802	Entrepreneurship project Phase II	-	24	-	-	12	-	12
Total		**5**	**24**	**-**	**9**	**12**	**-**	**21**

Semester VIII: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical Marks		Total
		Evaluation (Theory)				ESE	Evaluation (Lab)		
		T1	T2	FET	Total		Term work	Practical Oral/PO	
U11PE8XX	Program Elective V	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor VI	-	10	5	15	35	-	-	50
U11EP801	Online Course in Advanced Technology (Domain area)	-	-	-	25	75	-	-	100
U11EP802	Entrepreneurship project Phase II	-	-	-	-	-	200	100	300
								Total	**525**

Programme structure for B. Tech: Final Year Aeronautical Engineering (R23)

Track III: Higher Opportunity Track

Semester VIII: Teaching Scheme

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total Credits
U11PE8XX	Program Elective V	3	-	-	3	-	-	3
UXXMM0XX	Multidisciplinary Minor VI	2	-	-	2	-	-	2
U11RE801	Online Course in Advanced Technology (Domain area)	-	-	-	4	-	-	4
U11RE802	Research Project Phase II	-	24	-	-	12	-	12
Total		**5**	**24**	**-**	**9**	**12**	**-**	**21**

Semester VIII: Evaluation Scheme

Course Code	Course Name	Theory Marks					Practical Marks		Total
		Evaluation (Theory)				ESE	Evaluation (Lab)		
		T1	T2	FET	Total		Term work	Practical Oral/PO	
U11PE8XX	Program Elective V	10	10	5	25	50	-	-	75
UXXMM0XX	Multidisciplinary Minor VI	-	10	5	15	35	-	-	50
U11RE801	Online Course in Advanced Technology (Domain area)	-	-	-	25	75	-	-	100
U11RE802	Research Project Phase II	-	-	-	-	-	200	100	300
								Total	**525**

Program Elective V					
Vertical I (Design)		Vertical II (Maintenance)		Vertical III (Avionics and Drones)	
Course Code	Course Name	Course Code	Course Name	Course Code	Course Name
U11PE811	Lighter Than Air Systems	U11PE821	Civil Aviation Regulations	U11PE831	Aerodynamics for Drones
U11PE812	Experimental Stress Analysis	U11PE822	Airport and Airline Management		

Note:

- Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory , T1, T2, Continuous Assessment Test, FEP, Faculty Evaluation for Practical, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course
- The Program Elective V and Multidisciplinary Minor VI shall be conducted in online mode, by faculty of SGU or other institute/ University. Students can also opt a course from MOOCs platforms such as SWAYAM, NPTEL, Coursera etc. In case there is no assessment and examination conducted by the MOOCs platforms then the assessment and examination will be conducted by SGU.
- Additional Credits for Bachelor's Degree- with Double Minor 12 Credits.
- These are additional credits to be offered from the second year to the final year and will be offered as an option to students.
- Additional Credits for Bachelor's Degree- with Honors: 16-20 Credits.
- These are additional credits from same domain to be offered from the second year to the final year and will be offered as an option to students.
- Additional Credits for Bachelor's Degree- Honors with Research: Minimum 16-20 Credits.
- These are additional credits to be offered in the final year and will be offered as an option to students.

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE811	Lighter Than Air Systems	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE811	Lighter Than Air Systems	10	10	5	25	40%	50	40%	75

Course Description

This course is a fundamental course dealing with analysis of thin-walled aircraft structures required for design of aerospace vehicles. The course primarily discusses analysis of thin-walled aircraft structures under torsion, shear and bending loads from the concepts of theory of elasticity.

Pre-requisites:

Course Objectives

- Understand the basic principles and theories related to aerospace structures.
- Identify and describe the different types of loads and stresses experienced by aerospace structures.
- Learn about the materials commonly used in aerospace structures, such as metals, composites, and alloys.
- Understand the mechanical properties of these materials and their impact on structural design.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] components of LTA system
- **CO2** **Explain**[2] principles of aerostatics.
- **CO3** **Explain**[2] Design and development of Airship Technology.
- **CO4** **Describe**[2] Development of Aerostat Technology.
- **CO5** **Describe**[2] Current and future developments.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction & Historical Perspectives**	**7**
1	1.1	Introduction to LTA Systems, Historical Developments, Key Subsystems and Components of LTA Systems.	
2.0		**Principles of Aerostatics**	**9**
2	2.1	Variation of Atmospheric Properties, Static Lift Prediction, Effect of ambient conditions on Static Lift, Climb, Descent and Pressure Height.	
3.0		**Airship Technology**	**10**
3	3.1	Methodology for airship conceptual design, Aerodynamicsθ & Stability analysis of Airships, Ground Handling and Mooring systems, Case Studies in Airship Operations, Design& Development of Remotely Controlled Airships.	
4.0		**Aerostat Technology**	**10**
4	4.1	Methodology for sizing of Aerostat sub-systems, Equilibrium and Stability analysis o aerostats, Design and Development of Tethered Aerostats, Remotely Controlle Airships & Tethered Aerostats.	
5.0		**Current and Future Developments**	9
5	5.1	Challenges in design of LTA System, Hybrid LTA Systems, Stratospheric Airships, Current Trends and Recent Developments	

Text Books

1. Pant, R. S., Course Material for Design and Development of LTA systems, Curriculum Development Program, IIT Bombay, 2010.

References

1. Taylor, J. A., Principles of Aerostatics, The Theory of Lighter-Than-Air Aircraft, ISBN13:978-1-49481-053-5, 2014.
2. Khoury, G., Ed., Airship Technology, 2nd Edition, Cambridge Aerospaceθ Series, Cambridge University Press, ISBN 978-1107019706, 2012.
3. Carichner, G. E., and Nicolai, L. M., Fundamentals of Aircraft and Airshipθ Design, Volume 2 – Airship Design and Case Studies, AIAA Education Series, ISBN: 978-1-60086-898-6, 2013, DOI: 10.2514/4.868986

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	3	-	1	-	-	-	-	-	-	-	1	3	2
CO3	2	3	3	2	2	-	1	-	-	-	1	2	3	3
CO4	2	2	2	2	1	-	1	-	-	-	1	2	2	3
CO5	1	2	1	-	-	-	2	-	-	-	1	3	2	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE811	Experimental Stress Analysis	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE811	Experimental Stress Analysis	10	10	5	25	40%	50	40%	75

Course Description

This course is aimed at the final year Aeronautical Engineering. It is an important vertical course in Aeronautics under structures and may be pre-requisites for other courses related to the structures domain in Aeronautical engineering. It covers experimental techniques involved for measuring displacements, strain gages, photo elasticity techniques and NDT techniques.

Pre-requisites: Second year Engineering.

Course Objectives

- Be able to understand the various experimental techniques involved for measuring displacements, stresses, strains in structural components.
- To familiarize with the different types of strain gages used.
- To familiarize with the instrumentation system used for strain gauges.
- Be able to use photo elasticity techniques and methods for stress analysis.
- Be able to familiarize with the different NDT techniques.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1**: **Analyse**[3] the performance of measuring instrumentation.
- **CO2**: **Impart**[2] knowledge on different methods of strain measurement.
- **CO3**: **Design**[2] different strain gauge circuits.
- **CO4**: **Use**[1] photo elasticity for stress analysis.
- **CO5**: **Exposure**[3] the different types of non-destructive testing methods.

Course Contents

Module	Unit	Description	Hours
1.0		**Basics of Mechanical Measurements**	**9**
1	1.1	Characteristics and Requirements of a Measuring System ,Principles of Measurements , Precision, Accuracy, Sensitivity and Range of Measurements .	
	1.2	Sources of Error, Statistical Analysis of Experimental Data, Contact Type Mechanical Extensometers, Advantages and Disadvantages, Examples of Non -Contact Measurement Techniques .	
2.0		**Electrical-Resistance Strain Gauges**	**9**
2	2.1	Strain Sensitivity in Metallic Alloys,Gage Construction,Gage Sensitivities and Gage Factor	
	2.2	Corrections for Transverse Strain Effects Components of an airplane and their functions	
	2.3	Performance Characteristics of Foil Strain Gages, Materials Used for Strain Gauges , Environmental Effects Conventional control, Powered control	
	2.4	The Three-Element Rectangular Rosette for Strain Measurement Basic instruments for Flying	
	2.5	Other Types of Strain Gages,Semiconductor Strain Gages Grid & Brittle Coating Methods of Strain Analysis.	
3.0		**Strain-Gauge Circuits & Instrumentation**	**9**
3	3.1	The Potentiometer Circuit and Its Application to Strain Measurement ,Variations from Basic Circuit, Circuit Output	
	3.2	Analog to Digital Conversion, Calibrating Strain-Gage Circuits, Effects of Lead Wires and Switches	
	3.3	Current and Constant Voltage Circuits, Electrical Noise, Strain Measurement in Bars, Beams and Shafts.	
	3.4	Circuit Sensitivity & Circuit Efficiency.	
	3.5	The Wheatstone Bridge Circuit and its modifications	
4.0		**Photoelastic Methods of Stress Analysis**	**9**
4	4.1	Introduction to Photo elastic Methods, Stress-Optic Law, Effects of a Stressed Model in a Plane Polariscope	
	4.2	Effects of a Stressed Model in a Circular Polariscope , Tardy Compensation	
	4.3	Two-Dimensional Photo elastic Stress Analysis, Fringe Multiplication and Fringe Sharpening, Metallic and non-metallic materials.	
	4.4	Materials for Two-Dimensional Photo elasticity, Properties and Calibration of Commonly Employed Photo elastic Materials	

	4.5	Introduction to Three-Dimensional Photo elasticity. General types of construction	
5.0		**Non-Destructive Testing**	9
5	5.1	Different types of NDT Techniques, Acoustic Emission Technique, Ultrasonic – Pulse-Echo – Through Transmission, Eddy Current Testing, Magnetic Particle Inspection , X-Ray Radiography	
	5.2	Challenges in Non-Destructive Evaluation	
	5.3	Non-Destructive Evaluation in Composites, Image Processing Basics	

Text Books

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009E
3. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi,

References

1. Albert S. Kobayashi,' Handbook on Experimental Mechanics, Prentice Hall Publishers,2008.
2. Durelli, A.J.Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970.
3. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York
4. James F. Doyle and James W. Phillips, 'Manual on Experimental Stress Analysis', 5th Edition, 1989.
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2	-	-	-	-	-	-	2	3	2
CO2	3	2	-	1	1	-	-	-	-	-	-	1	3	1
CO3	2	3	3	2	3	-	-	-	-	-	1	2	3	3
CO4	2	2	1	3	3	-	-	-	-	-	1	2	3	2
CO5	2	3	1	2	2	1	1	-	-	-	1	2	2	2

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE821	Civil Aviation Regulations	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE821	Civil Aviation Regulations	10	10	5	25	40%	50	40%	75

Course Description

This course provides comprehensive knowledge of Civil Aviation Regulations (CAR) issued by the Directorate General of Civil Aviation (DGCA) and their role in ensuring airworthiness, safety, and continued operational compliance of civil aircraft. The course emphasizes regulatory procedures related to aircraft certification, defect recording, maintenance programs, organizational approvals, and Aircraft Maintenance Engineer (AME) licensing.

Pre-requisites:

Course Objectives

- Understand the requirement of airworthiness certification in civil aircraft.
- Understand how to record various data for future investigation in civil aircraft.
- Know the basic requirements and knowledge for institution certification.
- Provide basic knowledge of eligibility and requirements for maintenance licensing.
- Explore various flight testing and basic requirements for safe flying.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain**[2] the maintenance requirement for airworthiness of aircraft and systems.
- **CO2** **Describe**[3] the procedure followed for airworthiness certificate.
- **CO3** **Describe**[3] the Airworthiness procedures based on Regulation Authorities.
- **CO4** **Explain**[2] the issuance, renewal and experience requirements of AMEs.
- **CO5** **Classify**[2] about the Flight Testing of aircraft.

Course Contents

Module	Unit	Description	Hours
1.0		**C.A.R. Series 'A' – Procedure for Civil Airworthiness Requirements and Responsibility Of Operators Vis-À-Vis Airworthiness Directorate**	**9**
1	1.1	To introduce the civil aviation regulations followed by Directorate General of Civil Aviation (DGCA);	
	1.2	C.A.R. Series 'A' – Procedure for civil airworthiness requirements and responsibility of operators vis-à-vis Airworthiness Directorate.	
2.0		**C.A.R. Series 'C' - Defect Recording, Monitoring, Investigation and Reporting**	**9**
2	2.1	Defect recording, reporting, investigation, rectification and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-fight readings & recordings; maintenance control by reliability method.	
	2.2	**C.A.R. Series 'D' - And Aircraft Maintenance Programmes:** reliability programme (engines); aircraft maintenance programme & their approval; on condition maintenance of reciprocating engines; TBO - revision programme; maintenance of fuel and oil uplift and consumption records - light aircraft engines; fixing routine maintenance and component tbos initial & revisions.	
3.0		**C.A.R. Series 'E' – Approval of Organisations**	**9**
3	3.1	Approval of organizations in categories A, B, C, D, E, F, & G; requirements of infrastructure at stations other than parent base.	
	3.2	**C.A.R. Series 'F' – Airworthiness and Continued Airworthiness:**Procedure relating to registration of aircraft; procedure for issue / revalidation of type certificate of aircraft and its engines / propeller; issue / revalidation of certificate of airworthiness; requirements for renewal of certificate of airworthiness.	
4.0		**C.A.R. Series 'L' – Aircraft Maintenance Engineer Licensing**	**9**
4	4.1	Issue of AME license, its classification and experience requirements, complete Series 'L'.	
	4.2	**C.A.R. Series 'M' – Mandatory Modifications and Inspections**: Mandatory modifications/inspections. Procedure for issue of type approval of aircraft components and equipment including instruments	
5.0		**C.A.R. Series 'T' - Flight Testing of Aircraft**	**9**
5	5.1	Flight testing of (series) aircraft for issue of C of A; fight testing of aircraft for which C or A had been previously issued.	

	5.2	C.A.R. SERIES 'X' MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; weight and balance control of an aircraft; provision of first aid kits & hysician's kit in an aircraft; use furnishing materials in an aircraft; concessions. Aircraft log books; document to be carried on board on Indian registered aircraft; procedure for issue of taxy permit	

Text Books

1. " Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 171, Connaught Circus, New Delhi.
2. Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi. "

References

1. Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. "
2. Advisory Circulars ", form DGCA. as Managers – Consulting Engineers Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership Sample Code of Conduct

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	1	-	-	2	1	3	1
CO2	3	2	1	-	1	-	-	1	-	-	2	1	3	1
CO3	3	3	1	1	1	-	-	2	-	-	2	2	3	1
CO4	3	2	1	-	2	-	-	1	-	-	2	2	3	1
CO5	3	3	1	1	2	-	-	1	-	3	-	2	3	1

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE822	Airport and Airline Management	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE822	Airport and Airline Management	10	10	5	25	40%	50	40%	75

Course Description

This course provides comprehensive knowledge of airport planning, operations, airline management, aviation regulations, safety, security, financial management, and emerging trends in the aviation industry. It equips students with managerial and operational insights required in the modern airport and airline industries.

Pre-requisites:

- Basic knowledge of Aviation Fundamentals
- Fundamentals of Management Principles
- Basic understanding of the Air Transportation System
- 12th level Mathematics and Economics (Desirable)

Course Objectives

- To introduce students to the structure and functioning of airports and airlines.
- To understand airport planning, design, and terminal operations.
- To study airline operations, scheduling, and fleet management.
- To analyze aviation safety, security, and regulatory frameworks.
- To develop managerial skills in airline finance and marketing.

Course Outcomes: After the successful completion of the course, students will be able to:

- **CO1** **Explain**[2] airport planning, layout, and infrastructure requirements.
- **CO2** **Discuss**[3] airline organizational structure and operational management.
- **CO3** **Analyze**[3] aviation regulatory framework and safety standards.
- **CO4** **Apply**[4] airline scheduling and fleet planning concepts.
- **CO5** **Evaluate**[3] financial and marketing strategies in the airline business.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Aviation Industry and Airport Planning**	**9**
1	1.1	Evolution of civil aviation – Types of airports – Role of ICAO, IATA, DGCA – Structure of the aviation industry	
	1.2	Airport master planning – Site selection – Runway orientation – Taxiway and apron layout.	
2.0		**Airport Operations and Management**	**9**
2	2.1	Airside operations – ATC – Aircraft parking – Ground handling – Turnaround process	
	2.2	Landside operations – Check-in systems – Security screening – Access control	
3.0		**Airline Operations and Fleet Management**	**9**
3	3.1	Types of airlines – Organizational structure – Airline alliances	
	3.2	Fleet selection – Route planning – Hub and spoke system – Scheduling	
	3.3	Crew scheduling – Load factor – Yield management – Maintenance planning	
4.0		**Aviation Safety, Security and Regulations**	**9**
4	4.1	ICAO regulations – DGCA guidelines – Airport certification	
	4.2	Safety Management System – Risk assessment – Accident investigation	
	4.3	Aviation security measures – Passenger and baggage screening – Crisis management	
5.0		**Airline Economics, Finance and Marketing**	**9**
5	5.1	Cost structure – Revenue sources – Break-even analysis	
	5.2	Aircraft leasing – Capital investment – Financial indicators	
	5.3	Airline marketing – Branding – CRM – Pricing strategies	

Text Books

1. Kazda, Antonin, and Caves, Robert E. Airport Design and Operation. Japan, Emerald Group Publishing Limited, 2015.
2. Doganis, Rigas. Flying Off Course: The Economics of International Airlines. Saint Lucia, Routledge, 2002.
3. Wells, Alexander T., and Young, Seth B. Airport Planning & Management. United Kingdom, McGraw-Hill Companies, Incorporated, 2004.

References

1. International Air Transport Association. (2022). *Airport Development Reference Manual* (12th ed.). IATA Publications.
2. ICAO Annexures (Latest Edition).
3. Ashford, Norman J., et al. Airport Engineering: Planning, Design, and Development of 21st Century Airports. Germany, Wiley, 2011.
4. Holloway, Stephen. Straight and Level: Practical Airline Economics. United Kingdom, Ashgate, 2003.

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on the first two modules, and T2 (Test 2) should be based on the next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

End Semester Examination

1. The question paper will be of 50 marks and comprise 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on the entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	2	1	-	-	-	1	2	2	1
CO2	2	3	1	1	-	2	-	1	2	2	3	2	1	1
CO3	2	3	-	2	-	3	1	3	-	1	1	2	2	1
CO4	2	3	3	2	2	2	-	1	1	1	3	2	2	2
CO5	1	3	2	1	-	2	-	1	1	2	3	2	1	2

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11PE831	Aerodynamics for Drones	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (SEE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11PE831	Aerodynamics for Drones	10	10	5	25	40%	50	40%	75

Course Description

The UAV Design course provides comprehensive knowledge of the analysis, design, and performance evaluation of Unmanned Aerial Vehicles (UAVs), including fixed-wing, rotary-wing, and emerging UAV configurations. The course covers aerodynamic principles, propulsion systems, flight mechanics, stability, and control aspects relevant to UAV platforms.

Pre-requisites: Fluid Mechanics Low speed Aerodynamics

Course Objectives

- To introduce the fundamental concepts, classifications, and applications of UAV systems.
- To develop understanding of aerodynamic principles governing fixed-wing and rotary-wing UAVs.
- To enable students to analyze performance parameters such as lift, drag, range, endurance, and rate of climb.
- To provide understanding of flight dynamics and stability of UAVs with emphasis on quadrotor systems.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Explain[2]** the fundamentals, classifications, and applications of Unmanned Aerial Vehicle (UAV) systems.
- **CO2** **Apply[3]** aerodynamic principles to analyze lift, drag, pitching moment, and wing loading for fixed-wing UAVs.
- **CO3** **Analyze[4]** the performance of fixed-wing and rotary-wing UAVs in terms of range, endurance, rate of climb, and power requirements.
- **CO4** **Apply[3]** rotor theory, blade element theory, and Blade Element Momentum (BEM) theory to evaluate rotary wing UAV performance
- **CO5** **Analyze[4]** flight dynamics and stability characteristics of UAVs with emphasis on quadrotor systems.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to UAV Systems and Fixed-Wing Fundamentals**	**9**
1	1.1	Introduction to Unmanned Aerial Vehicles (UAVs), types of UAVs and applications, UAV design process and design goals.	
	1.2	UAS as a system of systems – airframe, propulsion, avionics, communication, ground control station. Fixed-wing primary controls and introduction to aerodynamics.	
2.0		**Aerodynamic Performance and Fixed-Wing UAV Performance**	**9**
2	2.1	Aerodynamic performance – lift, drag, lift-to-drag ratio (L/D), effect of pitching moment.	
	2.2	Wing loading for UAVs, stalling speed. Concept of load factor, range, endurance, and rate of climb for fixed-wing UAVs (fuel-powered and battery-powered).	
	2.3	Low Reynolds number aerodynamics and introduction to propeller theory.	
3.0		**Rotary Wing Aerodynamics**	**9**
3	3.1	Introduction to rotary wing aerodynamics. Momentum theory in hover, climb, descent, and forward flight.	
	3.2	Nomenclature for rotary wing systems. Blade element theory, rotors in axial and edgewise flight.	
	3.3	Blade Element Momentum (BEM) Theory and Prandtl tip loss function.	
4.0		**Performance of Rotary Wing UAVs**	**9**
4	4.1	Performance analysis of rotary wing UAVs – range, endurance, rate of climb, maximum speed.	
	4.2	Power requirements and efficiency considerations.	
5.0		**Advanced UAV Concepts and Flight Dynamics**	9
5	5.1	Introduction to flapping wing UAVs and unsteady aerodynamics.	
	5.2	Flight dynamics of UAVs with focus on quadrotor flight dynamics.	
	5.3	Stability and control concepts for multirotor systems.	

Text Books

1. Randal W. Beard and Timothy W. McLain, Small Unmanned Aircraft: Theory and Practice, Princeton University Press, 2012.
2. John D. Anderson Jr., Fundamentals of Aerodynamics, 6th Edition, McGraw-Hill Education, 2016.
3. Andrew J. Keane and James P. Scanlan, Small Unmanned Fixed-Wing Aircraft Design: A Practical Approach, Wiley, 2013.

References

1. Daniel P. Raymer, Aircraft Design: A Conceptual Approach, 6th Edition, American Institute of Aeronautics and Astronautics (AIAA), 2018.
2. Reg Austin, Unmanned Aircraft Systems: UAVs Design, Development and Deployment, Wiley, 2010.

Internal Assessment (T1, T2 and FET)

1. T1 (Test 1) should be based on first two modules and T2 (Test 2) should be based on next two modules, for 10 marks each.
2. FET shall be assessed for 5 marks separately.

Semester End Examination

1. Question paper will be of 50 marks comprise of 5 questions, each carrying 10 marks.
2. The duration of Semester End Examination shall be Two hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	3	2	2	2	-	-	-	-	-	1	2	3	3
CO3	3	3	2	3	2	-	-	-	-	-	1	2	3	3
CO4	3	3	2	3	2	-	-	-	-	-	1	2	3	3
CO5	3	3	2	3	2	-	-	-	-	-	1	2	3	3

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Track I: Industry Internship with Capstone Project Track

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Tutorial	Project/ Internship
U11OT801	Internship/On job Training	-	-	-	-	-	12

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11OT801	Internship/On job Training	200	40%	100	40%	300

Course Description:

The Industrial Internship provides students with an opportunity to gain practical exposure to real-time industrial environments and organizational practices. The course enables students to understand company operations in terms of inputs, transformation processes, and outputs (products and services). Students observe and participate in professional work culture, safety norms, ethical practices, and organizational procedures.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Understand**[2] the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
- **CO2** **Develop**[2] an attitude to adjust with the company culture, work norms, code of conduct.
- **CO3** **Understand**[2] and follow the safety norms, Code of conduct.
- **CO4** **Demonstrate**[3] the ability to observe, analyze and document the details as per the industry practices.
- **CO5** **Understand**[2] the processes, systems and procedures and to relate to the theoretical concepts that is being studied.
- **CO6** **Improve**[2] the leadership abilities, communication.
- **CO7** **Demonstrate**[3] project management and finance and cost management skills.

Internship/On job Training

Sanjay Ghodawat University place high focus on the interaction with industries to give them adequate exposure to the practicing aspects of theoretical knowledge they learn in classroom. Moving a step ahead, in order to enhance the students, experience with world of work, we are introducing industry internship with project after a through consultation with industry persons, academicians as a part of the major curricular reforms in the choice-based credit system (CBCS).

Choice Based for students at Semester VIII for full semester (16 weeks minimum) and pre-work at semester VII (Preparation). This track aims at giving students hands on experience with the world of work which imbibes in them the skills and competencies required to make them competent graduates for employment as per the expectation of the industry. It is a semester long (16 Weeks 16 weeks minimum) course where the students are expected to work as interns and carry out the individual project assigned to them by the company. The student's learning progress is monitored by both industry person concerned and the institutional Faculty assigned.

This course aims at giving students hands on experience to the world of work which imbibes in them the skills and competencies required to make them competent graduates for employment as per the expectation of the industry. It is a semester long course where the students are expected to work as interns and carry out the individual project assigned to them by the company. The student's learning progress is monitored by both industry person concerned and the institutional Faculty assigned.

1. CRITERIA FOR SELECTION OF STUDENTS

The students who want to opt Track I: Industry Internship With Capstone Project Track are required to fulfill the criteria specified below:

1. CGPI of students up to semester VI should be ≥ 6.75 (with no backlogs)
2. Ready to move to the place where industry assignment is allotted.
3. The entire cost of the Internship will be borne by the students (lodging boarding and any other cost). However, any facilities extended by the company like conveyance facility, subsidized canteen facility and stipend the students can avail.
4. They have to go through the selection process of the company if required.
5. Maximum number of students will be decided based on the policy guidelines prepared by the university/Department and also availability of internships at industries from time to time.
6. Once the student is allotted the company (after final selection process) cannot be changed and it is binding on the student to complete the assignment in that company.

2. CRITERIA FOR LISTING OF COMPANIES

1. It should be a medium or large-scale industry having the functional departments and facilities to design develop and manufacture the products or offer services and potential to offer challenging projects.
2. Company should provide minimum 2-3 internship assignments along with projects and extend facilities to students the on-the-job training (OJT) as well as access to data & information and guidance to complete the assigned project.
3. Should be able to keep record of attendance and provide a mentor to monitor the project.
4. And help the students to sort out problem/ issues.
5. Students who are eligible as per criteria and get the internship with their own contacts can also be

considered subjected to approval of the company by the University for Internship.

3. PROJECT ASSIGNMENT

1. A student doing internship in the company is required to carry out an individual project in the domain specific area with help of company mentor/Guide and faculty guide assigned to qualify for the credits mentioned in structure and also required to undergo self-study or online certification course approved by Department Program Committee of the host department.
2. The project proposal is to be prepared and get approved by the DPC of the department student is required select the problem for solution which requires a problem definition, data Collection, analysis and implementation of the solution, Design ,fabrication and testing as applicable (It is not a just company Internship Report)

4. INDUSTRY INTERNSHIP AND PROJECT MONITORING

A team of faculty members from the institute assigned will monitor closely the progress of training and project and helps to sort out any issues concerned. The institute faculty accountability includes proper orientation of student in the company, helping in finalizing project assignments, mentoring the student for overall effectiveness of internship program and a liaison between companies, student and the department.

3. INTERNSHIP MONITORING

Each student is assigned a faculty mentor by the program department who monitors the progress of both the internship and project and helps the student to sort out any issues/ problems faced by the students. The faculty is scheduled to make five visits during the internship

1	At the beginning of the program for orienting students to the company.	Prior to the program or during first week of program
2	Finalization of project proposal (if Industry Project)	During 4th week
3	Mid of the program (to review program)	Between 8th and 9th Week
4	Final progress review	During 15th week
5	At the end of the internship for evaluation	During16 ^{the} week

Note: Apart from these scheduled visits, the faculty on request of students/company will visit in case of any issue related to the internship /project.

4. WORK DIARY

Each student is provided with a diary which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done and write the remarks/ instruction. At the end of the internship, the duly completed dairy to be submitted to the department.

5. EVALUATION OF INTERNSHIP

The assessment of the internship will be done jointly by the industry and the faculty ssigned to the students. The tentative scheme of assessment will be

1.	Punctuality, behavior and following code of conduct (to be assessed bythe company personal)	20%
2.	Initiative, observation and interest in learning new things (faculty in charge)	20%
3.	Familiarization with specific Department/shop/function assigned tostudent (to be assessed by the company personal)	20%
4.	Final evaluation based on presentation of work, internship report (jointly by the company personnel and examiner appointed by institute & faculty guide.	40%

Minimum 50% is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	2	2	1	2	1	1	2	3	2
CO2	1	1	1	1	1	2	2	3	2	2	1	2	2	1
CO3	3	3	2	3	2	1	1	1	2	2	1	2	3	2
CO4	1	1	1	1	1	2	1	2	3	3	2	2	1	1
CO5	2	2	2	1	1	2	1	1	3	2	3	2	2	1

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Tutorial	Project/ Internship
U11PR801	Project Phase II	-	-	-	-	-	4

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11PR801	Project Phase II	50	40%	50	40%	100

Course Description:

The Capstone Project enables students to identify real-world industry problems, apply engineering and analytical knowledge, develop feasible solutions, and present implementable outcomes through systematic project execution.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Identify**[2] the project/problem in the domain of program and relevant to the company.
- **CO2** **Collect**[3] the information to the pertaining to the problem identified.
- **CO3** **Analyse**[3] the information using the statistical tools/ techniques.
- **CO4** **Suggest**[3] the feasible alternative solution and select the best solution.
- **CO5** **Present**[3] the solution to the company and seek assistance in the implementation.

As a part of the B. Tech curriculum, each student/group is required to undertake a project Phase I in a group during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VIII Semester towards earning prescribed credit are as follows:

Problem Identification & Project Planning

- Industry interaction and problem selection
- Understanding company processes and workflow
- Problem statement formulation
- Defining objectives, scope, and deliverables
- Project planning (Work Breakdown Structure, Gantt Chart)
- Risk identification and mitigation planning

Data Collection & Requirement Analysis

- Literature review and background study
- Primary and secondary data collection methods

- Survey design, interviews, and technical observations
- Documentation and requirement specification
- Tools for data management (Excel, ERP data, technical logs)

Data Analysis & Interpretation

- Data preprocessing and validation
- Statistical analysis (Mean, Standard Deviation, Correlation)
- Hypothesis testing
- Regression and trend analysis
- Root cause analysis (Pareto, Fishbone diagram)
- Use of analytical tools/software (Excel/SPSS/MATLAB/Python basics)
- Interpretation of analytical results

Solution Design & Feasibility Study

- Generation of alternative solutions
- Technical feasibility analysis
- Economic feasibility and cost–benefit analysis
- Risk and sustainability assessment
- Optimization techniques
- Selection of best solution using decision-making tools

Implementation, Documentation & Presentation

- Prototype/model development (if applicable)
- Testing and validation
- Implementation planning and scheduling
- Performance evaluation
- Preparation of project report (IEEE/standard format)
- Presentation to industry panel
- Feedback incorporation and final submission

Evaluation Scheme

- Project Proposal & Review I – 20%
- Mid-term Progress Review – 20%
- Final Report – 25%
- Project Demonstration/Prototype – 15%
- Final Viva-Voce & Presentation – 20%

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	1	1	2	1	1	2	3	2
CO2	3	3	2	3	2	1	1	1	2	1	1	2	3	2
CO3	3	3	2	3	3	1	1	1	2	1	1	2	3	3
CO4	3	3	3	2	2	2	2	1	3	2	2	2	3	3
CO5	2	2	3	2	2	2	2	2	3	3	2	2	3	3

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Tutorial	Project/ Internship
U11EP802	Entrepreneurship Project Phase II	-	-	-	-	-	12

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11EP802	Entrepreneurship Project Phase II	200	40%	100	40%	300

Course Description:

Student will prepare technically feasible and economically viable detailed project report including market survey.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Identify**[3] and evaluate a viable business opportunity through industry interaction and market analysis.
- **CO2** **Collect**[3] and organize technical, market, regulatory, and financial data required for preparation of a business plan.
- **CO3** **Analyze**[3] the technical feasibility and economic viability of the proposed business idea.
- **CO4** Develop[3] a detailed Techno-Economic Project Report (DPR) suitable for submission to financing and approval agencies.
- **CO5** **Present**[2] the business plan effectively before an expert committee and demonstrate entrepreneurial, communication, and project management skills.

As a part of the B. Tech curriculum, each student is required to undertake a project Phase I in a group during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VIII Semester towards earning prescribed credit are as follows:

Introduction to Entrepreneurship & Business Idea Finalization

- Role of Entrepreneurship in Economic Development
- Identification and Screening of Business Ideas
- Market Need Analysis and Opportunity Assessment
- Interaction with IEDC/Mentor for Business Idea Approval
- Ethical and Regulatory Considerations

Industry Interaction & Data Collection

- Collection of Primary and Secondary Data for Business Plan
- Visits to Relevant Industries and Government Organizations
- Interaction with Regulatory Authorities
- Consultation with Raw Material Suppliers and Vendors
- Meetings with Bankers and Financial Institutions
- Documentation of Industrial and Market Observations
- Maintaining Record of Field Visits and Data Collection

Technical Feasibility Analysis

- Technical Requirements of Proposed Business
- Selection of Location and Infrastructure Planning
- Production/Service Process Design
- Machinery, Equipment and Resource Planning
- Manpower Planning
- Compliance with Safety and Regulatory Norms

Financial & Economic Feasibility

- Cost Estimation (Capital and Operating Cost)
- Working Capital Assessment
- Pricing Strategy
- Break-even Analysis
- Profitability Projections
- Sources of Finance and Loan Procedures
- Preparation of Financial Statements
- Risk Assessment and Mitigation

Techno-Economic Project Report & Presentation

- Structure of Detailed Project Report (DPR)
- Preparation of Techno-Economic Feasibility Report
- Documentation of Systematic Work Execution
- Business Plan Writing as per Financing Agency Requirements
- Presentation Skills and Report Submission
- Evaluation by Expert Committee (IEDC & COE Approved Panel)

Evaluation Scheme

- Review I – 20%
- Mid-term Progress Review – 20%
- Final Report – 25%
- Project Demonstration– 15%
- Final Viva-Voce & Presentation – 20%

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	1	1	2	1	1	2	3	2
CO2	3	3	2	3	2	1	1	1	2	1	1	2	3	2
CO3	3	3	2	3	3	1	1	1	2	1	1	2	3	3
CO4	3	3	3	2	2	2	2	1	3	2	2	2	3	3
CO5	2	2	3	2	2	2	2	2	3	3	2	2	3	3

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U11EP801	Online Course in Advanced Technology (domain area)	-	-	-	04	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U11EP801	Online Course in Advanced Technology (domain area)		-	-	25	40%	75	40%	100

Course Outcomes: after the end of this course students will able to

CO1: **Obtain**[3] certificates for courses is to make students employable in the industry

CO2: **Pursue**[2] a suitable higher education programme

CO3: **Explain**[2] continuous and open learning, roughly in that order of preference

Course Contents

1. NPTEL began the initiative of offering certification to students for courses. The process of certification is as follows. Student enroll at least one course for 12 weeks available on Swayam/ NPTEL
2. Subject Matter Experts (SME - faculty from IITs or partner institutes with input from industry) create recorded video contents for courses
3. The course is uploaded on the portal and opened for enrollments, which is free
4. Every week, about 3 hrs. of video contents is released along with an assignment, which is evaluated and provides the student with a score
5. Teaching Assistants (TAs) and the faculty members support the discussion forum – answering questions and clearing doubts
6. If someone wants to get a certificate from the IITs/IISc after doing the course, he/she should register for the in-person proctored certification exam that is conducted in about 100 cities across India in collaboration with an exam partner. The certification exam is not free but has a nominal fee of Rs 1000
7. Final score=25% assignment score + 75% exam score. To be eligible for a certificate, the learner should have scored >=40% final score. E- verifiable certificates are made available on nptel.ac.in/noc and hard copies are also dispatched to the candidates
8. These certificates are envisioned for use in credit transfer to universities or for making the student more employable or for enhancing his growth in his current place of work.

CO–PO–PSO Mapping Table

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	2	2	1	1	2	1	1	1	1	1	1	3	2	2
CO3	1	1	1	1	2	1	1	2	1	1	1	3	1	2

Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Tutorial	Project/ Internship
U11RE802	Research Project Phase II	-	-	-	-	-	12

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		End Semester Exam (OE/POE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U11RE802	Research Project Phase II	200	40%	100	40%	300

Course Description

Research Project course aims to develop research skills in UG students. The acquired skills shall be useful to pursue higher level research at M. Tech/M. S or Ph. D level. This course may also help students to get admission in reputed foreign universities for M. S. program as research project completed at UG is one of the selection criteria.

Course Outcomes: After the successful completion of the course students will able to:

- **CO1** **Identify**[2] and define[2] a research problem through comprehensive literature review and critical evaluation of existing theories and practices.
- **CO2** **Formulate**[3] an appropriate research methodology and perform[3] systematic searches to collect relevant information and data.
- **CO3** **Develop**[3] and implement[3] a viable solution to the defined research problem using discipline-relevant tools and techniques.
- **CO4** **Analyze**[3] and explain[2] the conceptual viability, major components, and potential impact of the research work on the relevant field of study.
- **CO5** **Document**[3] research activities and prepare[3] a structured research report and technical paper.

Course Objectives:

After completion of this course, the student will be able to

- Identify and define research problem.
- Understand and critically evaluate theories, practices, and / or research on a chosen topic by conducting a thorough literature review and submitting a written integrative, critical summary of the current literature.
- Approach a research problem and develop a methodology.
- Perform searches for relevant information.
- Develop and implement solution to the research problem defined.
- Develop the ability to explain the conceptual viability of the project and describe the major components involved.

- Develop the ability to explain how the project will impact the relevant body of work.
- Develop advanced discipline-relevant skills and competencies.
- Properly keep an accurate record of research performed.
- Write a research report and technical paper.

Guidelines

- Students opting URE module must finalize research advisor, area of research and research project in VII semester of UG program.
- Credit Hours: Students are expected to devote 12 hours a week in research project.
- Students should carefully discuss with their research advisor the time expectations for completion of the requirements research project.

Assessment:

Research advisor is encouraged to strongly consider the following grading rubric:

Degree to which students meet expectations. Expectations are to be established by the research advisor and student a minimum of one semester in advance of the student's enrollment in the research course. The following is a minimum set of expectations for every student enrolled in this course for credit:

i. Perform a background literature search and review,

ii. Develop a project plan,

iii. Perform experimental work or applied experimental work

iv. Write and present a research report.

All four of these minimum expectations as well as additional expectations (e.g. attendance at departmental and/or college, research seminars, participation in research group meeting, etc) are to be clearly established and articulated to the student by the research advisor prior to commencement of the research project.

Quality of the final report and oral presentation. The research advisor will provide clear expectations of the desired format, content, and deadlines of the final report. The research advisors and DPC will jointly grade the final report.

Attendance:

In order to provide the students a measure of performance, the research advisor is expected to complete a mid-term evaluation of the student, accompanied by recommendations for Improvement for the remainder of the term. The mid-term evaluation of the student should be accompanied by a one-on-one meeting between the research advisor and the student. Student is required to report his/her research advisor every week and brief about the work done for that week. Maintain separate diary for that purpose.

Absences and Make-up Work: Requirements for attendance is as per University norms.

SEE:

1. End semester evaluation on all aspects (Scheduled before the end of term dates as notified by DPC)
2. A project report on the activity in prescribed format is to be submitted for evaluation.

A technical paper based on research work must be submitted on or before SEE to suitable journal.

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CO4	2	3	2	3	2	2	2	1	1	2	1	2	3	2
CO5	1	1	2	1	1	1	1	2	2	3	1	2	1	1

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Course Code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
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Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					End Semester Exam (ESE)		
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CO3	1	1	1	1	2	1	1	2	1	1	1	3	1	2