MAHENDRA ENGINEERING COLLEGE
Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
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DEPARTMENT OF AERONAUTICAL ENGINEERING

B.E. AERONAUTICAL ENGINEERING

REGULATION 2022

CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

DEPARTMENT OF AERONAUTICAL ENGINEERING

MAHENDRA ENGINEERING COLLEGE

(AUTONOMOUS)

MALLASAMUDRAM WEST, TAMILNADU-637503

DEPARTMENT OF AERONAUTICAL ENGINEERING

Regulation-2022- Curriculum (CBCS)							
V Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22AE14501	High Speed Aerodynamics	PC	3	0	0	3
2	22AE14502	Aircraft Propulsion	PC	3	0	0	3
3	22AE14503	Advanced Aircraft Structures	PC	3	0	0	3
4	-	Professional Elective-III	PE	3	0	0	3
5	-	Professional Elective-IV	PE	2	0	1	3
6	-	Open Elective -III	OE	3	0	0	3
7	22MBAT6S06	Managerial Skills, Project and Quality Management	HS	3	0	0	3
PRACTICAL							
8	22AE26501	Modelling and simulation Laboratory	EEC	0	0	2	1
9	22AE24501	Propulsion Laboratory	PC	0	0	2	1
10	22EN60002(R)	Interview Skills & Soft Skills	HS	0	1	2	2
			TOTAL	**21**	**1**	**6**	**25**

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DEPARTMENT OF AERONAUTICAL ENGINEERING

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

Syllabus

Department	**Aeronautical Engineering**	**Programme Code**	**1101**

V Semester

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14501	**HIGH SPEED AERODYNAMICS**	**3**	**0**	**0**	**3**	**100**

Objective(s)	The course should enable the students: • To introduce the concepts of compressibility. • To make the student understand the theory behind the formation of shocks • To enhance the idea of Expansion wave in supersonic flow. • To introduce the methodology of measurements in Supersonic flows. • To understand the working concept of airfoil in high speed flow.

UNIT-I	**AIRFOIL IN HIGH SPEED FLOWS**	**9**

Lower critical Mach number, upper critical Mach number,-lift and drag divergence-Shock induced separation-Characteristic of Swept wings-Effects of thickness- camber and aspect ratios of wings-Transonic area rule-Tip effects

UNIT-II	**ONE DIMENSIONAL COMPRESSIBLE FLOW**	**10**

Energy, Momentum, continuity and state equations. Velocity of sound, Adiabatic steady state flow equations, Flow through converging, diverging passages. Performance under various backpressures.

UNIT-III	**NORMAL, OBLIQUE SHOCKS**	**11**

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

UNIT-IV	**EXPANSION WAVES AND METHOD OF CHARACTERISTICS**	**8**

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

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UNIT-V	**TURBINES FOR JET ENGINES**	**7**
Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert affine transformation relations for subsonic flows, Linearised two-dimensional supersonic flow theory, Lift, drag pitching moment and center of pressure of supersonic profiles		
	Total	**45Periods**

Outcome(s):

After completion of the course students will be able to

- Calculate the compressible flow through a duct of varying cross section.
- Analyze compressible flow problems by using quasi one-dimensional theory.
- Estimate fluid properties in Rayleigh and Fanno type flows.
- Estimate the properties across normal and oblique shock waves.
- Predict the properties of hypersonic flows.

TEXT BOOK :

1	Anderson, J. D, "Modern Compressible Flow", McGraw-Hill & Co., 2002.
2	L.J. Clancy, “Aerodynamics” Sterling Book House, 2006

REFERENCES:

1	Zucrow, M.J. and Anderson, J.D., “Elements of gas dynamics”, McGraw-Hill Book Co., New York, 1919.
2	Rathakrishnan., E,"Gas Dynamics", Prentice Hall of India, 2004.
3	Mc Cornick. W., “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, New York, 1979.
4	Shapiro, A. H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.
5	Oosthuizen,P.H., & Carscallen,W.E., "Compressible Fluid Flow", McGraw- Hill & Co.,1997

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MAHENDRA ENGINEERING COLLEGE
(Autonomous)

Syllabus

Department	Aeronautical Engineering	Programme Code	1101

V Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22AE14502	AIRCRAFT PROPULSION	3	0	0	3	100

Objective(s)

The course should enable the students:

- To know the fundamentals of gas turbines and its components
- To learn about the design and performance of inlets and nozzles.
- To familiarize with the design and performance characteristics of combustion chamber
- To understand the design and performance of different types of compressors
- To teach about the blade design and performance characteristics of aircraft turbines.

UNIT-I	PRINCIPLES OF AIR BREATHING ENGINES	9

Operating principles of piston engines – thermal efficiency calculations – classification of piston engines - illustration of working of gas turbine engines – factors affecting thrust – methods of thrust augmentation – performance parameters of jet engines.

UNIT-II	JET ENGINE INTAKES AND EXHAUST NOZZLES	9

Ram effect, Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternal deceleration ratio – diffuser performance – modes of operation - supersonic inlets – starting problem on supersonic inlets – shock swallowing by area variation – real flow through nozzles and nozzle efficiency – losses in nozzles – interaction of nozzle flow with adjacent surfaces – thrust reversal.

UNIT-III	JET ENGINE COMBUSTION CHAMBERS	9

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

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UNIT-IV	**JET ENGINE COMPRESSORS**	**9**
Principle operation of centrifugal compressor, Principle operation of axial flow compressor— velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance parameters axial flow compressors		
UNIT-V	**JET ENGINE TURBINES**	**9**
Principle of operation of axial flow turbines – Velocity diagrams – Degree of reaction- Performance characteristics of axial flow turbine– Turbine blade cooling methods – Basic blade profile design considerations – Matching of compressor and turbine.		
	Total	**45 Periods**

Outcome(s):

After completion of the course students will be able to

- Analyze thermodynamics of an aircraft jet engine and calculate the performance measures, such as thrust and specific fuel consumption in terms of design requirement.
- Apply the knowledge to design suitable inlets for aircraft at different conditions
- Choose suitable combustion chamber for various aircraft.
- Determine the performance and design parameters of various compressors
- Evaluate the operating characteristics of turbines in terms of given blade shapes, angles, and direction of rotation

TEXT BOOK :

1	Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion", Pearson Education., 2009.
2	Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman,6th edition, 2008.
3	Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, StandardPublishers & Distributors, Delhi, 1999.

REFERENCES:

1	Saeed Farokhi, Aircraft Propulsion, John Wiley & Sons, Inc ., 2009.
2	Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3	“Rolls Royce Jet Engine” – Third Edition – 1983.

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MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus						
Department	**Aeronautical Engineering**	**Programme Code & Name**			**1011 & Aeronautical Engineering**	
V Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14503	**ADVANCED AIRCRAFT STRUCTURES**	3	0	0	3	**100**
Objective(s)	The course should enable the students: ● To understand the behaviour of loads experience of aircraft components. ● To adopt with various methods for analysis of aircraft wings and fuselage. ● To provide conception design of major aircraft structural components. ● To provide the better understate the low weight structures.					
UNIT-I	**UNSYMMETRICAL BENDING**					**9**
Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – Generalized "K" method, Neutral axis method, and Principal axis method.						
UNIT-II	**SHEAR FLOW IN OPEN SECTIONS**					**9**
Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections.						
UNIT-III	**SHEAR FLOW IN CLOSED SECTIONS**					**9**
Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to combined bending torsion – with walls effective and ineffective in bending – shear Centre of closed sections.						
UNIT-IV	**BUCKLING OF PLATES**					**9**
Bending of thin plates – rectangular sheets under compression - local buckling stress of thin-walled sections – crippling strength estimation – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width.						
UNIT-V	**STRESS ANALYSIS OF WING AND FUSELAGE**					**9**
Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.						
Total hours to be taught	**45 PERIODS**					

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Outcome(s)

After completion of the course students will be able to

- Describe loads acting an aircraft.
- Identify & resolve the structural design& its limitations.
- Improve distribution their loads on aircraft member with safer limits.
- Explain the design of low weight to high strength panel member.
- Analyze the aircraft real structural components such as wings and fuselage.

TEXT BOOK :

1	Megson T M G , "Aircraft Structures for Engineering Students", Elsevier Ltd, 2007
2	Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw – Hill, N.Y., 1999
3	Bruhn. E.H., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985.

REFERENCES:

1	Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw Hill, 1993.
2	Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997

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MAHENDRA ENGINEERING COLLEGE
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Syllabus

Department	**Aeronautical Engineering**	**Programme Code**	**1101**

Professional Elective-II

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE15501	**AIRFRAME MAINTENANCE AND REPAIR**	**3**	**0**	**0**	**3**	**100**

Objective(s)	The course should enable the students : • To teach about the basic concepts of aircraft general engineering and maintenance practices.	
UNIT-I	**WELDING IN AIRCRAFT STRUCTURAL COMPONENTS & SHEET METAL REPAIR AND MAINTENANCE**	**8**
Equipments used in welding shop and their maintenance –Ensuring quality welds –Welding jigs and fixtures –Soldering and brazing Inspection of damage –Classification –Repair or replacement –Sheet metal inspection –N.D.T. Testing –Riveted repair design, Damage investigation –reverse technology		
UNIT-II	**PLASTICS AND COMPOSITES IN AIRCRAFT**	**10**
Review of types of plastics used in airplanes –Maintenance and repair of plastic components –Repair of cracks, holes etc., and various repair schemes –Scopes. Inspection and Repair of composite components –Special precautions –Autoclaves		
UNIT-III	**AIRCRAFT JACKING, ASSEMBLY AND RIGGING**	**8**
Airplane jacking and weighing and C.G. Location. Balancing of control surfaces –Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor		
UNIT-IV	**REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM**	**10**
Trouble shooting and maintenance practices –Service and inspection. –Inspection and maintenance of landing gear systems. –Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments –handling –Testing –Inspection. Inspection and maintenance of auxiliary systems –Fire protection systems –Ice protection system –Rain removal system –Position and warning system –Auxiliary Power Units		
UNIT-V	**SAFETY PRACTICES**	**7**

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Hazardous materials storage and handling, Aircraft furnishing practices –Equipments. Trouble shooting - Theory and practices.	
Total	**45 Periods**

Outcomes:

After completion of the course students can able to:

- Identify and apply the principles of function and safe operation as per FAA.
- Describe general airframe structural repairs, the structural repair manual and structural control programme.
- Explain the nature of airframe structural component inspection, corrosion repair and non-destructive inspection.
- Describe aircraft component disassembly, reassembly and troubleshooting Procedure.
- Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic, material structures.

TEXT BOOK :

1	KROES, WATKINS, DELP, "Aircraft Maintenance and Repair", McGraw-Hill, New York, 1992
2	BRIMM D.J. BOGGES H.E., "Aircraft Maintenance", Pitman Publishing corp. New York,

REFERENCES:

1	LARRY REITHMEIR, "Aircraft Repair Manual", Palamar Books, Marquette, 1992

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MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus						
Department	**Aeronautical Engineering**	**Programme Code & Name**				**1011 & Aeronautical Engineering**
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
22AE35505	**Basics of Computational Automotive analysis**	**L**	**T**	**P**	**C**	**100**
		2	0	2	3	
Objective(s)	The course should enable the students: • To understand the FEA Method for various Meshing. • To provide hands-on experience in applying FEA techniques to solve various structural mechanics problems. • Analyze the crashworthiness of vehicle structures and restraint systems.					
UNIT-I	**FINITE ELEMENT METHOD FOR MESHING**					**9**
Geometry Mesh-Middle Surface Extraction-Casting and Alignment - Batch Mesh for Shell Mesh-Batch Solid Mesh- Unstructured Solid Mesh - Solid Hexahedron Structured Mesh (Map Tool)- Hexa Block Tool- Direct Morphing- Morphing Basics						
UNIT-II	**CRASH ANALYSIS AND VEHICLE SAFETY USING EXPLICIT SOLVERS**					**9**
Introduction to crash safety- Types of crashes- Basics of explicit finite element methods- Material models under crash conditions- Crash pulse and energy absorption principles- Setting up frontal crash simulations- Side impact mechanisms and challenges- Rollover crash mechanics and simulation techniques- Optimization in crash design: DOE, topology optimization.						
UNIT-III	**FATIGUE ANALYSIS AND DURABILITY OF AUTOMOTIVE COMPONENTS**					**9**

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Wöhler curves and fatigue testing methods- Basquin's equation, Goodman and Gerber diagrams-Mean stress correction models (Soderberg, Morrow, SWT)-Application to high-cycle fatigue in chassis and suspension parts- Manson-Coffin relationship-Total strain and elastic-plastic fatigue behavior- Fatigue analysis in welded joints, castings, and bolted connections- Fatigue life improvement techniques (surface treatments, redesign)

List of Experiments: **18 Hours**

1. Sheet Metal Drawing Using Planar, Flat, Flange, Extrude, Reliefs, Its Necessity, & Types, Types Of Bending Sheet Metal, Cut-Outs In Sheet-Metal, Rips, And Its Type Etc.
2. Assembly Drawing Using Bottom-Up And Top-Down Approach, Different Constraints In Assembly using Coincident, Distance, Normal, Parallel, Angle Offset Etc.
3. To Create Creo Drawing Sheet With Essential Elements Such as Bill Of Materials (BOM),Various View, Dimensioning, G&T, Notes In The Drawing Sheets, Ordinate Dimensions.
4. Meshing Strategies - Element Quality.
5. Plate with Hole - Stress Concentration.
6. Crash Box Axial Impact Simulation - Static Analysis.
7. Full Vehicle Frontal Impact.
8. Side Impact Simulation.
9. Roof Crush Test.
10. Rear Seat Belt Restraint Effectiveness Test.

Total hours to be taught	**45 PERIODS**

Outcome(s)

After completion of the course students will be able to

- Evaluate the impact of meshing strategies, element quality, and boundary condition assumptions on the accuracy, convergence, and computational cost of FEA simulations, and propose improvements.
- Model crash scenarios using explicit FE solvers like LS-DYNA or PAM-CRASH.
- Evaluate vehicle structural response to frontal, side, and rollover crashes.
- Assess safety performance through injury criteria and component deformation.

TEXT BOOK :

1	Reddy, J. N. (2019). *An Introduction to the Finite Element Method*. McGraw-Hill Education.
2	Logan, D. L. (2011). *A First Course in the Finite Element Method*. Cengage Learning

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3	Versteeg, H. K., & Malalasekera, W. (2007). An Introduction to Computational Fluid Dynamics: The Finite Volume Method. Pearson Education.
REFERENCES:	
1	Chandrupatla, T. R., & Belegundu, A. D. (2011). *Introduction to Finite Elements in Engineering*. Pearson Education
2	Anderson, J. D. (1995). Computational Fluid Dynamics: The Basics with Applications. McGraw-Hill.
3	LS-DYNA or PAM-CRASH User's Guides and Tutorials (software-specific documentation).

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DEPARTMENT OF AERONAUTICAL ENGINEERING

Regulations 2022						
Department		**Programme Code**				
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
22MBAT6S06	**Managerial Skills, Project and Quality Management**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	
Mandatory Credit Course to All UG Programmes to be offered in V/ VI/VII Semester						
Objectives	This course is designed to: 1. Develop knowledge and skills needed for the successful managerial performance. 2. Develop team building and communication skills in learners for working in multi-disciplinary teams. 3. Enable the learners to plan, schedule and manage projects. 4. Facilitate budgeting and finance, and evaluate projects 5. Understand the importance of quality concepts and principles.					
Outcomes	Upon completion of this course, the Learners will be able to : CO1: Demonstrate applicable knowledge and skills needed for managerial effectiveness. CO2: Demonstrate team building and communication skills for working in multi-disciplinary teams. CO3: Plan, schedule and manage projects CO4: Plan budgeting, manage finance and evaluate projects CO5: Summarize the quality concepts and principles.					
UNIT-I	**INTRODUCTION TO MANAGERIAL SKILLS**					**9**
Introduction to Self Awareness – Self Portrait – Self Assessment – Life-long learning. Definition of Life Skills and Managerial Skills – Need and Importance of Skills. Decision Making and Problem Solving: Problem Analysis –Techniques – Steps; Problem solving: Characteristics of Complex problems – Problem Solving Strategies – Barriers.; Lateral thinking Need and Importance of Lateral Thinking; Logic and Rationality – Functions – Personal and Work ethics.						
UNIT-II	**TEAM BUILDING AND EFFECTIVE COMMUNICATION**					**9**

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Team Building: Developing teams and team work, advantages of team, leading team, team membership, traits of working in multi-disciplinary teams. Effective Communication: Need and Importance – Techniques and Types - Verbal and Non-Verbal Communication - Barriers to communication – Overcoming barriers – Multiple Intelligences – 360 degree evaluation, Case Study.

UNIT-III	PROJECT MANAGEMENT	9

Project: Meaning and Importance of terms 'Event', Activity'. 'Time". Identification of project opportunities, Screening of Project Ideas. Criteria for project selection, Project planning and scheduling – Application of CPM and PERT – Examples and case studies.

UNIT-IV	BUDGETING AND FINANCE	9

Introduction to Budgeting and Finance, kinds of Project Evaluation, Evaluation Techniques – Non-discounted cash flow methods, Discounted cash flow Methods, Evaluation of Project cost, Capital budgeting and its methods. Financial management of Projects. Project Risk and its mitigation – Examples and case studies.

UNIT-V	QUALITY CONCEPTS AND PRINCIPLES	9

Introduction - Need for Quality - Evolution of Quality - Definition of Quality - Dimensions of Manufacturing Quality and Service Quality. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward Performance appraisal - Continuous process improvement, 6σ, 5s, Kaizen - Case Study.

Total	**45 HOURS**

TEXTBOOKS:

1	David A.Whetten and Kim S.Cameron, Developing Management Skills, – PHI, 2011.
2	Harper, Nancy Life Skills: Essential for Personal Growth on the Ever Changing Road of Life. Bloomington, IN: Author House, 2011.
3	Adair, J. Decision Making and Problem Solving. UK: Kogan Page Publishers.2013.
4	James R Evans, Quality Management, Cengage Learning India Private Limited 2010.
5	Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

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REFERENCES:

1	Kallet, Michael Think Smarter: Critical Thinking to Improve Problem-Solving and Decision Making Skills. New Jersey: John Wiley & Sons, 2014.
2	Adair, J. & Allen, M. Time Management and Personal Development. London: Hawksmere, 1999.
3	Hattie, John Self-Concept. New York: Psychology Press, 2014.
4	Mcgrath E.H., S.J., Basic Managerial Skills for all, 9th Edition, PHI, 2012
5	Amitava Mitra, Fundamentals of Quality Control & Improvement, Wiley Publications, 2012.

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Syllabus						
Department	**Aeronautical Engineering**	**Programme Code**			**1011**	
V Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE26501	**MODELING AND SIMULATION LABORATORY**	0	0	3	1.5	**100**
Objective(s)	The course should enable the students to : • Recognize and navigate toolbars • Access workbenches • Efficiently create fully constrained sketches • Create and modify solid parts • Create basic surfaces					
Outcomes(s)	After completion of the course students can able to: After completion of the course students can able to: • Create and Save various types of CATIA V5 documents • Differentiate and switch between a selection of workbenches • Perform various tasks concerning 3D Navigation and geometry selection • Create and constrain sketches • Describe the functional capabilities and general usage of Part Design, Generative Shape Design and Assembly Design.					

	LISTOF EXPERIMENTS	
1.	Introduction to CATIA.	
2.	Creating the Swivel part using multiple Sketches.	
3.	Creating the Top U Joint using multiple Sketches	
4.	Creating the Bottom U Joint using multiple Sketches.	
5.	Assembling Part Drawings.	
	Total hours to be taught	**30 PERIODS**

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Syllabus						
Department	**Aeronautical Engineering**	**Programme Code**			**1011**	
V Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE24501	**PROPULSION LABORATORY**	0	0	2	1	**100**
Objective(s)	The course should enable the students ● To explore practically components of aircraft piston and gas turbine engines and their working principles. ● To impart practical knowledge of flow phenomenon of subsonic and supersonic jets. ● To determine practically thrust developed by rocket propellants.					
Outcomes(s)	After completion of the course students can able to: ● Identify components and information of piston and gas turbine engine. ● Analyze behavior of flow through ducts and jet engine components. ● Visualize flow phenomenon in supersonic flow. ● Recognizes performance parameters of rocket propellants. ● Distinguish subsonic and supersonic flow characteristics.					

	LISTOF EXPERIMENTS	
	1	Study of aircraft piston
	2	Study of an aircraft jet engine (includes study of assembly of sub systems, various components, their functions and operating principles
	3	Velocity profiles of free jets and wall jets.
	4	Dismantling and reassembly procedures for aircraft piston engines.
	5	Inspection procedures for various Aircraft Piston engine Components.
	6	Performance of 2d diffuser a) Stable Flow b) Separated flow

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	7	Study of performance of a propeller	
	8	Study of Camshaft operation, Fuel system, Ignition system and Lubrication system of Aircraft Piston engine.	
	9	Study Combustion performance studies in a duct (duct burner)	
	10	Non-Destructive Testing methods used for Aircraft engine components.	
		Total hours to be taught	**30PERIODS**

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Syllabus - Regulation 2022						
Department	**English**					
Semester – V (Common to all B.E./B.Tech. Programmes)						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22EN60002(R)	**INTERVIEW SKILLS AND SOFT SKILLS** (Common to all B.E./B.Tech. Degree Programmes)	0	1	2	2	**100**
Objectives	• To improve the learners reading fluency skills through extensive reading • To help the learners obtain speaking skills in both formal and informal situation. • To make them acquire presentation skills and interview skills to face challenges in the career aspects					
Outcomes	**At the end of the course, the learners will be able to :** • Analyse the content and apply knowledge and skills efficiently wherever necessary. • Create profile and other essential documents. • Demonstrate soft skills effectively at the time of interview and workplace.					

LIST OFEXERCISES

1.	Introduction to Employability Skills
2.	Reading Comprehension
3.	Listening Comprehension
4.	Professional Email Writing
5.	Preparing One Page Resume
6.	Interview Skills (Mock Interview & Interview Etiquette)

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7.	Corporate Skills (Polite Expressions, Telephone Etiquette, Online Etiquette & PPT Presentation)
8.	Group Discussion
9.	Soft Skills (Interpersonal, Intrapersonal, Leadership, Decision Making and Problem Solving)
10.	Public Speaking
	Total Hrs : 30

Textbook:	
1	Joshi, Manmohan, *Soft Skills*, 1st Edition. Bookboon, 2017
References:	
1	Raman, Meenakshi & Sangeeta Sharma, *Technical Communication: Principles and Practice*, Ed.III, Oxford University Press, New Delhi. 2015.
2	Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011
Online Websites:	
https:// www.ted.com/talks	
https://www.joshtalks.com	
https://quizziz.com	
www.pdfdrive.com	
www.talking books.com	

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VI Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22AE14601	Flight Dynamics	PC	3	0	0	3
2	22AE14602	Rocket Propulsion	PC	3	0	0	3
3	22AE14603	Heat Transfer in Aircraft	PC	3	0	0	3
4	-	Professional Elective-III	PE	3	0	0	3
5	-	Open Elective- VI	OE	3	0	0	3
6	22MC60001	Constitution of India	MC	3	0	0	0
PRACTICAL							
7	22AE24601	Airframe and Aero-Engine Laboratory	PC	0	0	4	2
8	22AE56601	Aircraft Design Project	EEC	0	0	3	1.5
9	22AE56602	Industrial Training	EEC	0	0	3	1.5
10	22AE26601	UAV Design and Aeromodelling Laboratory	EEC	0	0	4	2
			TOTAL	**18**	**0**	**14**	**22**

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Syllabus

Department	**Aeronautical Engineering**	**Programme Code**	**1101**

VI Semester

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14601	**FLIGHT DYNAMICS**	3	0	0	3	**100**

Objective(s)	The course should enable the students • To understand better about the performance of flight during cruise • To enhance the performance during Maneuvering • To understand static longitudinal stability of airplanes different conditions. • To provide the fundamental understanding of lateral and directional stability. • To introduce the concept dynamic stability control under various operating conditions.

UNIT-I	**CRUISING FLIGHT PERFORMANCE**	**9**

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

UNIT-II	**MANOEUVRINGS FLIGHT PERFORMANCE**	**9**

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

UNIT-III	**STATIC LONGITUDINAL STABILITY**	**9**

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability -

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Basic equilibrium equation - Stability criterion - - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick force per 'g' - Aerodynamic balancing.		
UNIT-IV	**LATERAL AND DIRECTIONAL STABILITY**	**9**
Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.		
UNIT-V	**DYNAMIC STABILITY**	**9**
Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional. Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.		
	Total	**45 Periods**

Outcomes:

After completion of the course students can able to:

- Describe the forces and moments that are acting on an aircraft, the different types of drag, and drag polar.
- Analyze the performance in level flight, minimum drag and power required, climbing, gliding and turning flight, v-n diagram and load factor.
- Analyze about degrees of stability, stick fixed and stick free stability, stability criteria, effect of fuselage and CG location, stick forces, aerodynamic balancing.
- Explain about lateral control, rolling and yawing moments, static directional stability, rudder and aileron control requirements and rudder lock.
- Describe about dynamic longitudinal stability, stability derivatives, modes and stability criterion, lateral and directional dynamic stability.

TEXT BOOK :

1	Mc Cornick. W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1979.
2	Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.
3	Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, NY, 1988.

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REFERENCES:	
1	Babister, A.W. Aircraft Stability and response, Pergamon Press, 1980
2	Etkin, B., Dynamics of Flight Stability and Control, John Wiley, New York, 1982.
3	Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004
4	Mc Cornick B. W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1995.

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Syllabus

Department	**Aeronautical Engineering**	**Programme Code**	**1101**

VI Semester

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14602	**ROCKET PROPULSION**	3	0	0	3	**100**

Objective(s)	The course should enable the students: • To understand the concept of Ramjet and Scramjet Propulsion. • To enhance the idea of chemical rocket propulsion. • To introduce the knowledge of solid rocket propulsion • To understand the principles of hybrid propulsion systems • To gain more knowledge in Advance propulsion.

UNIT-I	**RAMJET AND SCRAMJET PROPULSION**	**9**

Introduction, Principle, working, Characteristics, Performance of Ramjet engine –- Introduction to hypersonic air breathing propulsion, hypersonic vehicles and supersonic combustion- need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles – various types scramjet combustors – fuel injection schemes in scramjet combustors.

UNIT-II	**CHEMICAL ROCKET PROPULSION**	**9**

Operating principle – specific impulse of a rocket – internal ballistics – performance characteristics of rockets – simple rocket design problems – types of igniters- Rocket nozzle classification - preliminary concepts in nozzle-less propulsion – air augmented rockets – pulse rocket motors – static testing of rockets & instrumentation –safety considerations

UNIT-III	**SOLID ROCKET PROPULSION**	**9**

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Salient features of solid propellant rockets – selection criteria of solid propellants – estimation of solid propellant adiabatic flame temperature - propellant grain design considerations – erosive burning in solid propellant rockets – combustion instability – strand burner and T-burner – applications and advantages of solid propellant rockets.		
UNIT-IV	**LIQUID AND HYBRID ROCKET PROPULSION**	**9**
Salient features of liquid propellant rockets – selection of liquid propellants – various feed systems and injectors for liquid propellant rockets -thrust control and cooling in liquid propellant rockets and the associated heat transfer problems – combustion instability in liquid propellant rockets – peculiar problems associated with operation of cryogenic engines - Introduction to hybrid rocket propulsion – standard and reverse hybrid systems- combustion mechanism in hybrid propellant rockets – applications and limitations.		
UNIT-V	**ADVANCED PROPULSION SYSTEMS**	**9**
Electric rocket propulsion– types of electric propulsion techniques - Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems – future applications of electric propulsion systems - Solar sail – current scenario of advanced propulsion projects worldwide.		
	Total	**45Periods**

Outcomes:

After completion of the course students can able to:

- Describe the basics of Ramjet Propulsion
- Explain characteristic of chemical propulsion
- Describe propellants of solid rockets
- Differentiate principles of solid-liquid propulsion systems.
- Describe advanced propulsion technique used for interplanetary mission.

TEXT BOOK :

1	David H. Heiser and David T. Pratt., "Hypersonic Air breathing Propulsion", AIAA Education Series, 1999.
2	Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.
3	Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010

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REFERENCES:	
1	Martin J. Chiaverini and Kenneth K. Kuo, "Fundamentals of Hybrid Rocket Combustion and Propulsion", Progress in Astronautics and Aeronautics, 2007.
2	Ramamurthi K, "Rocket Propulsion", Macmillian publishers India Ltd, 1st edition, 2010.

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Syllabus

Department	**Aeronautical Engineering**	**Programme Code**	**1101**

VI Semester

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14603	**HEAT TRANSFER IN AIRCRAFT**	3	0	0	3	**100**

Objective(s)	The course should enable the students: • To understand the heat conduction behavior of various solids. • To give mathematical knowledge of convection heat transfer for various ambience. • To analyze various heat exchanger design and their performance. • To give analytical knowledge in Radiation heat transfer. • To provide the basic knowledge about heat transfer problems in the Aerospace field.

UNIT-I	**FUNDAMENTAL OF HEAT CONDUCTION**	**09**

Basic Modes of Heat Transfer – One dimensional steady state heat conduction: Composite Medium – Critical thickness – Effect of variation of thermal Conductivity – Extended Surfaces Unsteady state. Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.

UNIT-II	**CONVECTIVE HEAT TRANSFER**	**09**

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

UNIT-III	**RADIATIVE HEAT TRANSFER**	**09**

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Introduction to Physical mechanism – Radiation properties – Radiation shape factors – Heat exchange between non – black bodies – Radiation shields		
UNIT-IV	**HEAT EXCHANGERS**	**09**
Introduction and Classification of Heat Exchangers – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method.		
UNIT-V	**APPLICATION OF HEAT TRANSFER IN AERONAUTICAL ENGINEERING**	**09**
Phase change materials- Thermal Coating Materials - High-Speed flow Heat Transfer, Aerodynamic heating – Ablative heat transfer, Interplanetary Mission and reentry mission.		
	Total	**45Periods**

Outcomes:

After completion of the course students can able to:

- Explain the basic laws of heat transfer and the Concepts used in Heat Conduction.
- Apply various correlation used in Natural and Forced Convective Heat transfer.
- Describe the concepts of Black Body, Grey Body, View factor, Radiation shielding.
- Design the Heat Exchanger performance by using the method of log mean temperature difference and the method of heat exchanger effectiveness.
- Apply various technique used for high speed flow heat transfer in Aeronautical Engineering.

TEXT BOOK :

1	R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2017
2	Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
3	Yunus A. Cengel., "Heat Transfer – A practical approach", Second Edition, Tata McGraw Hill,2002.

REFERENCES:

1	Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2017
2	S P Sukhatme., " A text book of heat transfer" 4th edition, Universities Press,2005.

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MAHENDRA ENGINEERING COLLEGE (Autonomous)						
Syllabus						
Department	**Aeronautical Engineering**	**Programme Code & Name**			**1011 & Aeronautical Engineering**	
VI Semester						
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22AE24601	**AIRFRAME AND AERO ENGINE LABORATORY**	**0**	**0**	**4**	**2**	**100**
Objective(s)	• To introduce the knowledge of the maintenance and repair procedures followed for overhaul of aero engines.					
Outcome(s)	After completion of the course students can able to • Identify the repair and maintain the aero engines • Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic, material structures • Explain the nature of airframe structural component inspection, corrosion repair and non-destructive inspection.					

LIST OF EXERCISES

1.	Dismantling and reassembling of an aircraft piston engine.
2.	Study of Camshaft operation, firing order and magneto, valve timing
3.	Study of lubrication and cooling system
4.	Study of auxiliary systems, pumps and carburettor
5.	Aircraft wood gluing-single and double scarf joints
6.	Study on MIG, TIG & PLASMA welding of aircraft components
7.	Welded single and double V-joints.
8.	Fabric and Riveted Patch repairs
9.	Tube bending and flaring
10	Sheet metal forming
11	Preparation of glass epoxy of composite laminates and specimens
	Total hours to be taught **30 PERIODS**

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Syllabus			
Department	**Aeronautical Engineering**	**Programme Code & Name**	**1011 & Aeronautical Engineering**

VI Semester

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE56601	**AIRCRAFT DESIGN PROJECT**	**0**	**0**	**3**	**1.5**	**100**

Objective(s)	To make the student work in groups and understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of different types of airplanes 1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken. 2. Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection. 3. Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration. 4. Drag estimation, Performance calculations, Stability analysis and V-n diagram
Outcome(s)	Upon completion of the Aircraft Design Project, I students will be in a position • Compare different types of airplanes and their specifications • Select the design parameters, power plant, aerofoil, fixing the geometry of Wing, tail, control surfaces Landing gear. • Design aircraft and demonstrate the performance of the design

DETAILS OF WORK TO BE CARRIED OUT

1. Literature survey of different Aircrafts
2. Design parameters considerations
3. Schematics diagrams of the Designed aircraft

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4. Estimation and performance calculation	
Total hours to be taught	**30 PERIODS**

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Syllabus						
Department	**Aeronautical Engineering**	**Programme Code & Name**			**1011 & Aeronautical Engineering**	
VI SEMESTER						
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE56602	**INDUSTRIAL TRAINING**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	• Industrial training, where a student undertakes a period of training with an organization usually during a semester, plays an important role in preparing the student for a professional career. From the hands-on training, the student learns about the skill sets required, demands of the industry and also work ethics. At the same time it gives the student an opportunity to put into practice what he or she has learned at university.					
Outcome(s)	• To prepare students to **compete** for a successful career in Aeronautical Engineering profession through global education standards. • To enable the students to **apply** their acquired knowledge in basic sciences and mathematics in solving Aeronautical Engineering problems. • To produce skillful graduates to **analyze, design** and develop a system/component/ process for the required needs under the realistic constraints. • To train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts • To **create** an awareness among the students about the need for life long learning to succeed in their professional career as Aeronautical Engineers.					
				Total hours for Training	**30 PERIODS**	

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Syllabus

Department	Aeronautical Engineering	Programme Code & Name	1011 & Aeronautical Engineering

VI Semester

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22AE26601	UAV DESIGN AND AEROMODELLING LABORATORY	0	0	4	2	100

LIST OF EXPERIMENTS

1.	Study of UAV classifications.
2.	Study of UAV components.
3.	Design and Fabrication of Glider using Balsa Wood.
4.	Selection of Wing parameters, design and Fabrication of wing for an RC model aircraft. (using suitable materials)
5.	Selection of Fuselage parameters, design and Fabrication of Fuselage for an RC model aircraft. (using suitable materials)
6.	Power plant selection, Weight estimation and C.G calculations of Fixed wing UAV.
7.	Assembly of Wings, Fuselage and Landing gear.
8.	Fabrication and Assembly of various components of a Quadcopter.
9.	Power plant selection, Weight estimation and other technical specifications of Quadcopter.
10	Flight Simulator practice.
11	Flying practice with Nano and Micro models.
12	Study of aircraft maneuvering using FLIGHT GEAR.
	Total hours to be taught **45 PERIODS**

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VII Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22AE14701	Composite Materials and Structures	PC	3	0	0	3
2	22AE14702	Finite Element Method	PC	3	0	0	3
3	22AE14703	Vibrations and Elements of Aero Elasticity	PC	3	0	0	3
4	22AE14704	Avionics	PC	3	0	0	3
5	-	Professional Elective-VI	PE	3	0	0	3
PRACTICAL							
6	22AE24701	Avionics Laboratory	PC	0	0	2	1
7	22AE24702	Aircraft System Laboratory	PC	0	0	2	1
8	22AE36701	Project Work (Phase – I)	EEC	0	0	6	3
			TOTAL	**15**	**0**	**10**	**20**

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MAHENDRA ENGINEERING COLLEGE
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Syllabus

Department	Aeronautical Engineering	Programme Code	1101

VII Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22AE14701	COMPOSITE MATERIALS AND STRUCTURES	3	0	0	3	100

Objective(s)	The course should enable the students: • To understand the micromechanical behavior of composite material. • To acquire knowledge in material structure and failure theories of lamina. • To understand the mathematical foundations of laminated plates. • To give exposure in various methods of fabrication of composite laminates. • To impart the knowledge in failure of sandwich construction

UNIT-I	MICROMECHANICS	10

Introduction - advantages and application of composite materials – types of reinforcements and matrices - micro mechanics – mechanics of materials approach, elasticity approach- fiber volume ratio – mass fraction – effect of voids in composites.

UNIT-II	MACROMECHANICS	10

Generalized Hooke's Law - elastic constants for anisotropic, orthotropic and isotropic materials - macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina - Failure theories of a lamina.

UNIT-III	LAMINATED PLATE THEORY	11

Governing differential equation for a laminate. Stress – strain relations for laminate - Different types of laminates - In plane and flexural constants of a laminate. Hygrothermal stresses and strains in a laminate. Impact resistance and interlaminar stresses. Netting analysis

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UNIT-IV	**FABRICATION PROCESS AND REPAIR METHODS**	**7**
Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods		
UNIT-V	**SANDWICH CONSTRUCTIONS**	**7**
Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels - bending stress and shear flow in composite beams.		
	Total	**45 Periods**

Outcomes:

After completion of the course students can able to:

- Explain the mechanics of composite materials.
- Identify and analyze the failure modes based on failure theories.
- Calculate the stresses and strains in a laminate.
- Apply knowledge in manufacturing and repair of composites.
- Solve the structural problems of sandwich panels.

TEXT BOOK :

1	Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.
2	Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004.

REFERENCES:

1	Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 3rd edition, 2006..
2	Robert Jones., "Mechanics of Composite materials" second edition., CRC press, 2015.

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Syllabus

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VII Semester

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14702	**FINITE ELEMENT METHODS**	**3**	**0**	**0**	**3**	**100**

Objective(s)	The course should enable the students: • To give exposure to various methods of solution, in particular the finite element method • To expose the student to a wide variety of problems involving discrete and continuum elements • To impart knowledge in the basic theory of finite element formulation. • To allow the student to learn and understanding how element characteristic matrices are general • To impart knowledge in assembly of finite element equations, and solve for the unknowns.

UNIT-I	**INTRODUCTION**	**8**
Review of basic analysis–Gaussian elimination–Governing equations and convergence criteria for continuum–Classical Techniques in FEM–Weighted residual method–Ritz method		
UNIT-II	**ONE DIMENSIONAL PROBLEMS**	**10**
Finite element modeling–Coordinates and shape functions-Assembly of stiffness matrix and load vector–Finite element equations – Application bar element – beam element–Applications to plane trusses-Temperature effects.		
UNIT-III	**TWO DIMENSIONAL CONTINUUM**	**8**
Introduction–Finite element modeling–Scalar valued problem–Application to plane stress, plane strain problems –CST element - Element stiffness matrix–Force vector–Stress calculation–Temperature effects.		
UNIT-IV	**AXISYMMETRIC CONTINUUM**	**9**

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Axisymmetric formulation–Element stiffness matrix and force vector–Stress calculations–Application to the heat transfer problems.		
UNIT-V	**ISOPARAMETRIC ELEMENTS FOR TWO-DIMENSIONAL CONTINUUM**	**10**
Introduction - four node quadrilateral element –Shape functions–Element stiffness matrix–Numerical integration.		
	Total	**45 Periods**

Outcomes:

After completion of the course students can able to:

- **Explain** the principles involved in discretization and finite element approach
- **Formulate** and solve problems in one dimensional structures including trusses, beams and frames.
- **Interpret** two-dimensional finite element analysis with examples.
- **Formulate** FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems.
- **Interpret** Isoparametric two-dimensional finite element analysis with examples

TEXT BOOK :

1	Reddy J.N., "An Introduction to Finite Element Method", McGraw Hill, third edition, 2005.
2	Tirupathi.R. Chandrapatha and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India, Fourth edition, 2012.

REFERENCES:

1	Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
2	Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000
3	Rao. S.S., "Finite Element Methods in Engineering," Butterworth and Heinemann, 2001.

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Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14703	**VIBRATION AND ELEMENTS OF AERO ELASTICITY**	**3**	**0**	**0**	**3**	**100**

Objective(s)	The course should enable the students: • To study the effect of time dependent forces on mechanical systems • To learn the Eigen value and vector problems • To understand about the natural characteristics of continuous system. • To Familiarize with the Approximate Methods • To study the Aero elastic effects of aircraft wing

UNIT-I	**SINGLE DEGREE OF FREEDOM SYSTEMS**	**10**
Introduction to simple harmonic motion, D'Alembert's principle, free vibrations – damped vibrations – forced vibrations, with and without damping – support excitation – transmissibility - vibration measuring instruments – Introduction to helicopter vibration and methods for measurement and control		
UNIT-II	**MULTI DEGREE OF FREEDOM SYSTEMS**	**10**
Two degrees of freedom systems - static and dynamic couplings - vibration absorber- Multi degree of freedom systems - principal co-ordinates - principal modes and orthogonal conditions - Eigen value problems - Hamilton's principle - Lagrangean equations and application		
UNIT-III	**CONTINUOUS SYSTEMS**	**11**
Vibration of elastic bodies - vibration of strings – longitudinal, lateral and torsional vibrations		
UNIT-IV	**APPROXIMATE METHODS**	**7**
Approximate methods - Rayleigh's method - Dunkerley's method – Rayleigh-Ritz method		
UNIT-V	**ELEMENTS OF AERO-ELASTICITY**	**7**

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Concepts- Coupling - Aero elastic instabilities and their prevention- Collars triangle - Basic ideas on wing divergence, loss and reversal of aileron control- Flutter and its prevention	
Total	**45 Periods**

Outcomes:

After completion of the course students can able to:

- Explain the single degree vibrating system
- Solve multi-degree vibrating systems
- Differentiate types of vibrations according to dampness and particle motion.
- Use numerical techniques for vibration problems
- Describe the formation of Aileron reversal, flutter and wing divergence

TEXT BOOK :

1	William Weaver, Stephen P. Timoshenko, Donovan H. Yound, Donovan H. Young. 'Vibration Problems in Engineering' – John Wiley and Sons, New York, 2001
2	Grover. G.K., ―Mechanical Vibrations‖, 7th Edition, Nem Chand Brothers, Roorkee, India, 2003

REFERENCES:

1	Leonard Meirovitch, "Elements of Vibration Analysis". McGraw Hill International Edition,2007
2	Bisplinghoff R.L., Ashely H and Hogman R.L., "Aeroelasticity", Addision Wesley Publication, New York, 1983.

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VII Semester

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE14704	**AVIONICS**	**3**	**0**	**0**	**3**	**100**

Objective(s)	The course should enable the students: • To introduce the basic of avionics and its need for civil and military aircraft • To impart knowledge about the avionic architecture, various avionics data buses • To gain more knowledge on flight decks and cockpits • To impart knowledge about the navigation systems • To gain more knowledge on air data systems and autopilot

UNIT-I	**INTRODUCTION TO AVIONICS**	**9**

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT-II	**DIGITAL AVIONICS ARCHITECTURE**	**9**

Avionics Bus architecture–Data buses MIL–RS 232- RS422- MIL STD 1553 B–ARINC 429–ARINC 629-Aircraft system Interface, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation.

UNIT-III	**FLIGHT DECK AND COCKPITS**	**9**

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT-IV	**INTRODUCTION TO NAVIGATION SYSTEMS AND**	**9**

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	AUTOPILOT SYSTEMS	
Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS– Inertial Navigation Systems (INS) – Satellite navigation systems. Auto pilot – Basic principles, Longitudinal and lateral auto pilot.		
UNIT-V	**MAINTENANCE AND COST OF AVIONICS**	**9**
Built in Test equipments, speed maintenance ATLAS, Remote diagnostics, Maintenance support-life cycle cost for Military and civil avionics systems, Cash flow analysis and software cost- Establishing spare levels.		
	Total	**45Periods**

Outcomes:

After completion of the course students can able to:

- Describe avionics sub systems used in civil and military aircrafts.
- Build Digital avionics architecture
- Design flight decks and cockpits
- Design Navigation system
- Design and perform analysis on air system
- Analyze the performance of various cockpit display Technologies

TEXT BOOK :

1	Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
2	Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.

REFERENCES:

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

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Professional Elective-VI

Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE15703	**AIR TRANSPORTAION AND AIRCRAFT MAINTENANCE**	**3**	**0**	**0**	**3**	**100**

Objective(s)	The course should enable the students • To study the concepts of air transportation and the maintenance management of aircraft. • To improve existing repair methods by employing adaptive machining technology	
UNIT-I	**INTRODUCTION**	**8**
Development of air transportation, comparison with other modes of transport –Role of IATA, ICAO –The general aviation industry airline –Factors affecting general aviation, use of aircraft, airport: airline management and organization –levels of management, functions of management, Principles of organization planning the organization –chart, staff departments & line departments		
UNIT-II	**AIRLINE ECONOMICS & FLEET PLANNING**	**10**
Forecasting –Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. –Passenger fare and tariffs –Influence of geographical, economic & political factors on routes and route selection. The aircraft selection process –Fleet commonality, factors affecting choice of fleet, route selection and Capitol acquisition –Valuation & Depreciation –Budgeting, Cost planning –Aircrew evaluation –Route analysis –Aircraft evaluation		
UNIT-III	**PRINCIPLES OF AIRLINES SCHEDULING**	**10**
Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule –hub & spoke scheduling, advantages / disadvantages &		

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preparing flight plans –Aircraft scheduling in line with aircraft maintenance practices.		
UNIT-IV	**AIRCRAFT RELIABILITY**	**9**
Aircraft reliability –The maintenance schedule & its determinations –Condition monitoring maintenance – Extended range operations (EROPS) & ETOPS –Ageing aircraft maintenance production		
UNIT-V	**TECHNOLOGY IN AIRCRAFT MAINTENANCE**	**8**
Airlines scheduling (with reference to engineering) –Product support and spares –Maintenance sharing – Equipments and tools for aircraft maintenance –Aircraft weight control –Budgetary control. On board maintenance systems –Engine monitoring –Turbine engine oil maintenance –Turbine engine vibration monitoring in aircraft –Life usage monitoring –Current capabilities of NDT –Helicopter maintenance – Future of aircraft maintenance		
Total hours to be taught		**45 PERIODS**

Outcomes:

After completion of the course students can able to

- Explain airline management and organizations
- Illustrate economical fleet planning.
- Describe the principles of airlines scheduling.
- Illustrate aircraft reliability and extended operations
- Explain about aircraft maintenance technology.

TEXT BOOK :

1	FEDRIC J.H., "Airport Management", 2000.
2	C.H. FRIEND, "Aircraft Maintenance Management", 2000

REFERENCES:

1	GENE KROPF, "Airline Procedures".
2	PHILIP LOCKLIN D, "Economics of Transportation".

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Department	Aeronautical Engineering	Programme Code	1101

VII Semester

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22AE24701	AVIONICS LABORATORY	0	0	3	1.5	100

Objective(s)	This laboratory enable students to learn about basic digital electronics circuits, programming with microprocessors, design and implementation of data buses in Avionics with MIL –Std. 1553B and remote terminal configuration and their importance in different applications in the field of Avionics.
Outcome(s)	After completion of the course students can able to: • Perform addition & subtraction using digital electronics circuit. • Prepare Multiplexer/demultiplexer, Encoder/decoder, timer & shift register circuits. • Identify the different types of avionics data buses.

LISTOF EXERCISES

1.	Addition/Subtraction of 8 bit and 16 bit data for control surface deflection.
2.	Sorting of Data in Ascending & Descending order for voting mechanism.
3.	Sum of a given series with and without carry for identifying flap data
4.	Greatest in a given series &Multi-byte addition in BCD mode.
5.	Addition/Subtraction of binary numbers using adder and Subtractor circuits.
6.	Sorting of Data in Ascending & Descending order.
7.	Sum of a given series with and without carry.
8.	Greatest in a given series &Multi-byte addition in BCD mode.

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9.	Interface programming with 4 digit 7 segment Display & Switches & LED's.	
10.	Study of Different Avionics Data Buses.	
	Total hours to be taught	**30 PERIODS**

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VII Semester						
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE24702	**AIRCRAFT SYSTEMS LABORATORY**	**0**	**0**	**3**	**1.5**	**100**
Objective(s)	The course should enable the students • To train the students "ON HAND" experience in maintenance of various air frame systems in aircraft. • To train the students "ON HAND" experience in rectification of common snags.					
Outcome(s)	After completion of the course students can able to • Describe the procedure involved in maintenance of various air frame systems • Demonstrate rigging and symmetry check on an aircraft • Report and analyze results for Flow test, Pressure test, Functional test and brake torque load test.					

LISTOF EXPERIMENTS

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

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10.	Maintenance and rectification of snags in hydraulic and fuel systems.	
	Total hours to be taught	**30 PERIODS**

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VII SEMESTER

Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22AE36701	**PROJECT WORK PHASE – I**	**0**	**0**	**6**	**3**	**100**

Objective(s)	• The objective of the phase –I of the students project work is to prepare themselves to undertake lively project which will found end application to the industry / society
Outcome(s)	On Completion of the project work students will be in a position to • Discuss and identify the real world applications and to solve with core engineering knowledge • Analyze and work on multidisciplinary tasks, Choose latest tools, software and equipment to solve real world problems • Formulate model and design prototype for the same

PREPARATION FOR THE PROJECT WORK INVOLVE

- Form a team of like minded students (not more than 4 in number) to carryout the project.
- Make a preliminary survey and data collection or literature review of the project proposed in the next semester.
- Conduct a thorough literature survey and publish or present a paper of the proposed work in any one of the forthcoming National seminars.
- Plan for necessary supports, facilities, analytical tools and fixation of faculties /supervisors for the final semester project work.

Total hours to be taught	**45 PERIODS**

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Regulation-2022 Curriculum (CBCS)							
VIII Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	-	Professional Elective-V	PE	3	0	0	3
2	-	Professional Elective-VI	PE	3	0	0	3
PRACTICAL							
3	22AE36801	Project Work (Phase – II)	EEC	0	0	12	6
			TOTAL	**6**	**0**	**12**	**12**

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VIII SEMESTER

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22AE36801	PROJECT WORK PHASE – II	0	0	12	6	100

Objective(s)	• The objective of the phase –II of the students project work is to prepare themselves to undertake lively project which will found end application to the industry / society
Outcome(s)	On Completion of the project work students will be in a position to • Discuss and identify the real world applications and to solve with core engineering knowledge • Analyze and work on multidisciplinary tasks, Choose latest tools, software and equipment to solve real world problems • Formulate model and design prototype for the same

PREPARATION FOR THE PROJECT WORK INVOLVE

- The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total hours to be taught	**180 PERIODS**

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