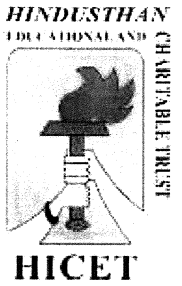

HINDUSTHAN

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Coimbatore – 641032

DEPARTMENT OF AERONAUTICAL ENGINEERING

Curriculum and ODD Semesters Syllabus for the Batch

2024 – 2028 (R2022)

2023 – 2027 (R2022)

2022 – 2026 (R2022)

2021 – 2025 (R2019 with Amendments)

(Board of Studies held on 20.05.2024)

(Academic Council Meeting held on 21.06.2024)

CURRICULUM R2022

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. AERONAUTICAL ENGINEERING (UG)

REGULATION-2022

For the students admitted during the academic year 2024-2025 and onwards

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA1101**	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	**22ME1201**	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3.	**22PH1153**	Physical Properties of Materials	BSC	2	0	2	3	4	50	50	100
4.	**22HE1151**	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	**22IT1151**	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6.	**22HE1072**	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
7.	**22HE1073**	Introduction To Soft Skills	SEC	2	0	0	0	1	100	0	100
MANDATORY COURSE											
8.	**22MC1093/ 22MC1094**	தமிழர்மரபு /HERITAGE OF TAMIL	MC	2	0	0	1	2	40	60	100
9.	**22MC1095**	Universal Human Values	MC	2	0	0	0	2	100	0	100
			TOTAL	**17**	**5**	**6**	**18**	**27**	**570**	**330**	**900**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA2101**	Differential Equations and Complex Analysis	BSC	3	1	0	4	4	40	60	100
2.	**22CY2101**	Environmental Studies	ESC	2	0	0	2	3	40	60	100
3.	**22AE2201**	Principles of Flight	BSC	2	0	0	2	3	40	60	100
4.	**22ME2101**	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	**22CY2152**	Applied Chemistry	BSC	2	0	2	3	4	50	50	100

6.	22HE2151	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
PRACTICAL											
7.	22ME2001	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8.	22HE2071	DESIGN THINKING	AEC	2	0	0	2	2	100	0	100
9.	22HE2072	SOFT SKILLS AND APTITUDE	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	22MC2094/ 22MC2095	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY	MC	2	0	0	1	2	40	60	100
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**19**	**1**	**8**	**23**	**27**	**560**	**440**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22MA3104	Fourier Analysis and Numerical Techniques	BSC	3	1	0	4	4	40	60	100
2.	22AE3202	Solid Mechanics	PCC	3	0	0	3	3	40	60	100
3.	22AE3203	Aircraft Materials and Manufacturing Process	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
4.	22AE3251	Aero Engineering Thermodynamics	PCC	3	0	2	4	5	50	50	100
5.	22AE3252	Engineering Fluid Mechanics	PCC	3	0	2	4	5	50	50	100
PRACTICAL											
6.	22AE3001	Strength of Materials Laboratory	ESC	0	0	4	2	4	60	40	100
7.	22AE3002	Aircraft Component Drawing Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8.	22HE3071	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	22AE3072	Introduction to MATLAB	AEC	2	0	0	2	2	100	0	100
MANDATORY COURSE											
10.	22MC3191	Indian Traditional Knowledge	MC	1	0	0	0	1	100	0	100
			TOTAL	19	1	12	25	32	640	360	1000

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	0	100	100
2.	22AE4201	Aerodynamics - I	PCC	3	0	0	3	3	40	60	100
3.	22AE4202	Mechanics of Machines	PCC	3	1	0	4	4	40	60	100
4.	22AE4203	Gas Turbine Propulsion	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	22MA4151	Probability And Statistics with R Programming	BSC	2	0	1	3	4	50	50	100
6.	22AE4251	Aircraft Structures-I	PCC	2	0	2	4	4	50	50	100
PRACTICAL											
7.	22AE4001	Aerodynamics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AE4002	Propulsion Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
			TOTAL	**16**	**1**	**11**	**24**	**29**	**440**	**460**	**1000**

* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.
If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22AE5201	Flight Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22AE5202	Aerodynamics - II	PCC	3	0	0	3	3	40	60	100
3.	22AE53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AE53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AE53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6.	22AE5251	Aircraft structures - II	PCC	3	0	2	3	5	50	50	100
PRACTICAL											
7.	22AE5001	Aircraft Systems and Maintenance Laboratory	PCC	0	0	3	2	3	60	40	100
EEC COURSES (SE/AE)											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**0**	**5**	**21**	**24**	**410**	**390**	**800**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22AE6201**	Finite Element Methods	PCC	3	0	0	3	3	40	60	100
2.	**22HE6101**	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3.	**22AE63XX**	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	**22AE63XX**	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	**22XX64XX**	Open Elective – I*	OEC	3	0	0	3	3	40	60	100
6.	**22XX64XX**	Open Elective – II*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
7.	**22AE6001**	UAV design and Aeromodelling Laboratory	PCC	0	0	4	2	4	60	40	100
8.	**22AE6002**	Structural Simulation Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE6071**	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**20**	**0**	**8**	**24**	**28**	**460**	**440**	**900**

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22AE73XX**	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
2.	**22XX74XX**	Open Elective – III*	OEC	3	0	0	3	3	40	60	100
3.	**22XX74XX**	Open Elective – IV*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
4.	**22AE7251**	Computational Fluid Dynamics	PCC	3	0	2	4	5	50	50	100
5.	**22AE7252**	Avionics	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
6.	**22AE7001**	Aircraft Design project	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7.	**22AE7701**	Internship*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**14**	**0**	**8**	**20**	**24**	**380**	**320**	**700**

* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1.	**22AE8901**	Project Work/Granted Patent	SEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Block chain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Introduction to Aeronautical Engineering	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio refinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22AE7401**	Introduction to Drones	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22LS7401**	General studies for competitive examinations	OEC	3	0	0	3	3
2	**22LS7402**	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	**22LS7403**	Indian ethos and Human values	OEC	3	0	0	3	3
4	**22LS7404**	Financial independence and management	OEC	3	0	0	3	3
5	**22LS7405**	Yoga for Human Excellence	OEC	3	0	0	3	3
6	**22LS7406**	Democracy and Good Governance	OEC	3	0	0	3	3
7	**22LS7407**	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Aerospace Structures & Materials	**Vertical II Aerodynamics**	**Vertical III Propulsion**	**Vertical IV Avionics and Drone Technology**	**Vertical V Aircraft Maintenance**	**Vertical VI Advanced Manufacturing Technology**
22AE5301 Theory of Elasticity	22AE5304 Wind Tunnel Techniques	22AE5307 Advanced Propulsion System	22AE5310 Control Engineering	22AE5313 Airframe Maintenance and Repair	22AE5316 Manufacturing Technology
22AE5302 Experimental Stress Analysis	22AE5305 Boundary layer Theory	22AE5308 Heat Transfer	22AE5311 Microprocessor and Applications	22AE5314 Civil Aviation Regulations	22AE5317 Additive Manufacturing and Tooling

22AE5303 Composite Materials and Structures	22AE5306 Helicopter Aerodynamics	22AE5309 Combustion in Aerospace Engineering	22AE5312 Drone Electronics	22AE5315 Aircraft Engine Maintenance and Repair	22AE5318 Lean Manufacturing
22AE6301 Structural Mechanics	22AE6303 Experimental Aerodynamics	22AE6305 Rocket and Missiles	22AE6307 Navigation and Communication systems	22AE6309 Air Traffic Control and Airport Planning	22AE6311 Industrial Design & Rapid Prototyping Techniques
22AE6302 Vibration and Aeroelasticity	22AE6304 Hypersonic Aerodynamics	22AE6306 Introduction to Cryogenics	22AE6308 Design of UAV Systems	22AE6310 Aviation management and Air Safety Engineering	22AE6312 Non-Destructive Testing
22AE7301 Fatigue and Fracture Mechanics	22AE7302 Industrial Aerodynamics	22AE7303 Satellite Technology	22AE7304 Aerospace Guidance and Control	22AE7305 Engine Systems and Control	22AE7306 Integrated Product Development

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Details of Vertical I: Aerospace Structures & Materials

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5301	Theory of Elasticity	PEC	3	0	0	3	3
2.	22AE5302	Experimental Stress Analysis	PEC	3	0	0	3	3
3.	22AE5303	Composite Materials and Structures	PEC	3	0	0	3	3
4.	22AE6301	Structural Mechanics	PEC	3	0	0	3	3
5.	22AE6302	Vibration and Aero elasticity	PEC	3	0	0	3	3
6.	22AE7301	Fatigue and Fracture Mechanics	PEC	3	0	0	3	3

Details of Vertical II: Aerodynamics

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5304	Wind Tunnel Techniques	PEC	3	0	0	3	3
2.	22AE5305	Boundary layer Theory	PEC	3	0	0	3	3
3.	22AE5306	Helicopter Aerodynamics	PEC	3	0	0	3	3
4.	22AE6303	Experimental Aerodynamics	PEC	3	0	0	3	3
5.	22AE6304	Hypersonic Aerodynamics	PEC	3	0	0	3	3
6.	22AE7302	Industrial Aerodynamics	PEC	3	0	0	3	3

Details of Vertical III: Propulsion

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5307	Advanced Propulsion System	PEC	3	0	0	3	3
2.	22AE5308	Heat Transfer	PEC	3	0	0	3	3
3.	22AE5309	Combustion in Aerospace Engineering	PEC	3	0	0	3	3
4.	22AE6305	Rocket and Missiles	PEC	3	0	0	3	3
5.	22AE6306	Introduction to Cryogenics	PEC	3	0	0	3	3
6.	22AE7303	Satellite Technology	PEC	3	0	0	3	3

Details of Vertical IV: Avionics and Drone Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5310	Control Engineering	PEC	3	0	0	3	3
2.	22AE5311	Microprocessor and Applications	PEC	3	0	0	3	3
3.	22AE5312	Drone Electronics	PEC	3	0	0	3	3
4.	22AE6307	Navigation and Communication systems	PEC	3	0	0	3	3
5.	22AE6308	Design of UAV Systems	PEC	3	0	0	3	3
6.	22AE7304	Aerospace Guidance and Control	PEC	3	0	0	3	3

Details of Vertical V: Aircraft Maintenance

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5313	Airframe Maintenance and Repair	PEC	3	0	0	3	3
2.	22AE5314	Civil Aviation Regulations	PEC	3	0	0	3	3
3.	22AE5315	Aircraft Engine Maintenance and Repair	PEC	3	0	0	3	3
4.	22AE6309	Air Traffic Control and Airport Planning	PEC	3	0	0	3	3
5.	22AE6310	Aviation management and Air Safety Engineering	PEC	3	0	0	3	3
6.	22AE7305	Engine Systems and Control	PEC	3	0	0	3	3

Details of Vertical VI: Advanced Manufacturing Technology

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5316	Manufacturing Technology	PEC	3	0	0	3	3
2.	22AE5317	Additive Manufacturing and Tooling	PEC	3	0	0	3	3
3.	22AE5318	Lean Manufacturing	PEC	3	0	0	3	3
4.	22AE6311	Industrial Design & Rapid Prototyping Techniques	PEC	3	0	0	3	3
5.	22AE6312	Non-Destructive Testing	PEC	3	0	0	3	3
6.	22AE7306	Integrated Product Development	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.
  Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5601	Sem 5: Fundamentals of Aeronautics	MDC	3	0	0	3	3
2.	22AE6601	Sem 6: Aircraft Systems and Instruments	MDC	3	0	0	3	3
3.	22AE6602	Sem6: Aircraft Materials and Processes	MDC	3	0	0	3	3
4.	22AE7601	Sem 7: Aircraft General Maintenance	MDC	3	0	0	3	3
5.	22AE7602	Sem 7: Introduction to Unmanned Aerial Vehicle Systems	MDC	3	0	0	3	3
6.	22AE8601	Sem 8: Introduction to Space Vehicles	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Green Technology
Introduction to Fintech	Financing New Business Ventures	Environmental Quality Monitoring and Analysis

B.E. (Hons) Aeronautical Engineering

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22AE5203	Sem 5: Space Flight Mechanics	PC	3	0	0	3	3	40	60	100
2.	22AE5204	Sem 5: Wind Engineering	PC	3	0	0	3	3	40	60	100
3.	22AE6202	Sem 6: Space Propulsion Systems	PC	3	0	0	3	3	40	60	100
4.	22AE6203	Sem 6: Heat Transfer in Aerospace Applications	PC	3	0	0	3	3	40	60	100
5.	22AE6204	Sem 6: Experimental methods in fluid mechanics	PC	3	0	0	3	3	40	60	100
6.	22AE6205	Sem 6: Introduction to turbulence	PC	3	0	0	3	3	40	60	100
7.	22AE7201	Sem 7: Missiles Guidance and Control	PC	3	0	0	3	3	40	60	100
8.	22AE7202	Sem 7: Satellite attitude dynamics and control	PC	3	0	0	3	3	40	60	100
9.	22AE7203	Sem 7: Space Vehicle Aerodynamics	PC	3	0	0	3	3	40	60	100
10.	22AE7204	Sem 7: Computational Heat Transfer and fluid flow	PC	3	0	0	3	3	40	60	100
11.	22AE8201	Sem 8: Electrical Propulsion	PC	3	0	0	3	3	40	60	100
12.	22AE8202	Sem 8: Aviation innovation and biomimicry	PC	3	0	0	3	3	40	60	100

SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	11
2	BSC	7	9	4	3	-	-	-	-	23
3	ESC	6	7	2	-	-	-	-	-	15
4	PCC	-	-	16	18	11	7	9	-	61
5	PEC	-	-	-	-	9	6	3	-	18
6	OEC	-	-	-	-	-	6	6	-	12
7	EEC	1	3	3	1	1	2	2	10	23
8	MCC	1	1	✓	✓	-	-	-	-	2
	Total	**18**	**23**	**25**	**24**	**21**	**24**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	24	21	24	20	10	165

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SYLLABUS

I SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MA1101	MATRICES AND CALCULUS (Common to all Branches)	3	1	0	4

Course Objective

The learner should be able to

1. Construct the characteristic polynomial of a matrix and use it to identify Eigen values and Eigenvectors
2. Impart the knowledge of single variate calculus.
3. Familiarize the student with functions of several variables.
4. Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. Make a vector differential operator for vector function and theorems to solve engineering problems

Unit	Description	Instructional Hours
I	**Matrices** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**Single Variate Calculus** Rolle's Theorem – Lagrange's Mean Value Theorem - Maxima and Minima – Taylor's and Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives - Total derivative - Jacobians – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.	12
IV	**Integral Calculus** Double integrals in Cartesian coordinates – Area enclosed by plane curves (excluding surface area) – Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates.	12
V	**Vector Calculus** Gradient, divergence and curl vectors - Green's theorem - Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	Total Instructional Hours	60

Course Outcome

At the end of the course, the learner will be able to

CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.
CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply multiple integral ideas in solving areas, volumes and other practical problems.
CO5: Apply the concept of vector calculus in two and three-dimensional spaces.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition, 2019.
T2 - K. P. Uma and S. Padma, "Engineering Mathematics I (Matrices and Calculus) ", Pearson Ltd,2022.

REFERENCE BOOKS:

R1 - Jerrold E. Marsden, Anthony Tromba, "Vector Calculus", W.H.Freeman, 2003-Strauss M. J, G. L Bradley and K. J .Smith, "Multivariable calculus", 6th edition, Prentice Hall, 2011.
R2 - Veerarajan T, "Engineering Mathematics", 5th edition, Mc Graw Hill Education(India) Pvt Ltd, New Delhi, 2016.
R3 - G. B. Thomas and R. L. Finney, "Calculus and Analytical Geometry", 9th Edition, Addison Wesley Publishing Company, 2016.

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PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	-	-	1	2	2	3	2
CO2	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO3	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO4	3	3	3	3	2	2	2	-	-	1	2	2	2	2
CO5	3	3	3	3	2	2	2	-	-	1	2	2	3	3
AVG	3	3	3	3	2.2	2	2			1	2	2	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22ME1201	**ENGINEERING DRAWING (AGRI, BME, (CHEM,AERO, AUTO, CIVIL,MECH, MECT,FT,EEE)**	1	4	0	3

Course Objective

1. To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves.
2. To learn about the orthogonal projections of straight lines and planes.
3. To acquire the knowledge of projections of simple solid objects in plan and elevation.
4. To learn about the projection of sections of solids and development of surfaces.
5. To study the isometric projections of different objects.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing; drafting instruments; drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales. Geometrical constructions, Engineering Curves Conic sections –Construction of ellipse, parabola and hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	12
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder, cone when the axis is perpendicular and inclined to one plane by rotating object method.	12
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves.
CO2: Draw the orthogonal projections of straight lines and planes.
CO3: Interpret the projections of simple solid objects in plan and elevation.
CO4: Draw the projections of section of solids and development of surfaces of solids.
CO5: Draw the isometric projections and the perspective views of different objects.

TEXT BOOK:

T1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5thedition New Age International Publishers, New Delhi 2016.
T2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.

REFERENCES:

R1. BasantAgrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing company Limited, New Delhi,2013.
R2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

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PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	2	3	2	-	1	-	1	-	-	1	1	1	1	2
CO2	3	3	2	1	1	-	1	-	-	1	1	1	1	2
CO3	3	3	3	-	1	1	1	-	-	1	1	-	1	1
CO4	3	3	3	1	1	2	1	-	-	1	1	1	1	1
CO5	3	3	3	1	1	3	1	-	-	1	1	1	1	1
Avg	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4

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Programme/ Semester	Course Code	Name of the Course	L	T	P	C
B.E. / I	22PH1153	**Physical properties of Materials** **(For AERO, AUTO, Mechanical& Mechatronics Engineering)**	2	0	2	3

Course Objective

The learner should be able to :

1. Have knowledge on the various phase diagrams of different materials and their applications
2. Acquire knowledge on various crystal structures.
3. Enhance the fundamental knowledge in mechanical properties of materials
4. Gain knowledge about thermal energy and their applications
5. Gain theknowledge on laser fundamentals and their applications

Unit	Description	Instructional Hours
I	**PHASE DIAGRAMS** Solid solutions - Hume Rothery's rules - the phase rule – singlecomponent system – binaryphase diagrams - isomorphous systems - the tie-line rule -the lever rule - application to isomorphous system – eutecticphase diagram - peritectic phase diagram.	6
II	**CONDENSED MATTER PHYSICS** Crystalline and Amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, characteristics of unit cell – number of atoms per unit cell, coordination number, atomic radius and Packing factor for SC, BCC, FCC and HCP structures – Miller indices and interplanar spacing.	6
III	**MECHANICAL PROPERTIES OF MATERIALS** Elasticity – Hooke's law –stress-strain diagram – bending moment – depression of a cantilever – derivation of young's modulus of the material of the beam by uniform bending - theory and experiment. Twisting couple - Torsion pendulum: theory and experiment. **Determination of Young's modulus by uniform bending method** **Determination of Rigidity modulus – Torsion pendulum**	12
IV	**THERMAL PHYSICS** Transfer of heat energy – thermal conduction, convection and radiation–Thermal expansion - expansion joints - bimetallic strips – thermal conductivity of a bad conductor: Lee's disc method to determine the thermal conductivity of bad conductor. Conduction through compound media (series and parallel) – applications: refrigerator and solar water heater. **Determination of thermal conductivity of a bad conductor – Lee's disc method** **V –Lab - https://vlab.amrita.edu/?sub=1&brch=194&sim=353&cnt=1**	9
V	**PHOTONICS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Type of lasers – Nd:YAG laser and CO_2laser. Laser Applications - Industrial applications of laser.Interference - Conditions for sustained Interference – air wedge and it's applications. **Determination of Wavelength and particle size using Laser** **Determination of thickness of a thin wire – Air wedge method** **V-Lab- https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1**	12
	Total Instructional Hours	**45**

Course Outcome

At the end of the course, the learner will be able to

CO1: Develop the various phase diagrams of different materials
CO2: Relate the basics of crystals and their structures
CO3: Illustrate the mechanical properties of materials
CO4: Relate the thermal properties of materials and applications
CO5:Familiarize the concepts of opticsin the field of Engineering

TEXTBOOKS:

T1-Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.
T2 - Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2015.

REFERENCEBOOKS:

R1-Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
R2 - William D.Callister Jr, David G. Rethwisch "Materials Science and Engineering - An Introduction", Wiley India (P) Ltd., 8th Edition, 2018.

WEB REFERENCES

1. https://nptel.ac.in/courses/112108150/
2. https://en.wikipedia.org/wiki/Aircraft

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3. https://en.wikipedia.org/wiki/Aerospace_materials
4. https://nptel.ac.in/courses/112106227/
5. https://nptel.ac.in/courses/104104085/

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	-	1	-	2	1	3	2
CO2	2	2	2	2	1	1	1	-	1	-	1	2	2	2
CO3	2	3	2	1	2	1	1	-	2	-	2	3	2	2
CO4	2	2	2	1	1	1	1	-	2	-	2	2	2	2
CO5	2	3	3	2	2	1	1	-	1	-	2	2	3	3
AVG	2	2.6	2.4	1.4	1.4	1	1	-	1.4	-	1.8	2.4	2.4	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/I	22HE1151	ENGLISH FOR ENGINEERS (Common to all Branches)	2	0	2	3

Course Objective

The student should be able

1. To help the students of engineering and technology develop a strong base in the use of English.
2. To help learners use language effectively in professional writing.
3. To impart basic English grammar and essentials of important language skills
4. To impart knowledge about the importance of vocabulary and grammar
5. To develop the communication skills of the students in both formal and informal situations

Unit	Description	Instructional Hours
I	**Language Proficiency:** Parts of Speech, Degrees of Comparison, Abbreviation& Acronyms **Writing**: Process Description, Instructions. **Vocabulary** – Words on Environment. **Practical Component: Listening**- Watching Short Videos and answer the questions, **Speaking**- Self introduction , Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts / interviews **Reading**- Purpose of Reading - Churning & Assimilation, Interpreting Ideas - Interpreting Graphs in Technical Writing.	7+2
II	**Language Proficiency**: Types of Sentences, Framing Question, One Word Substitution **Writing:** Writing Checklist, Reading Comprehension. **Vocabulary**– Words on Entertainment. **Practical Component: Listening**-Comprehensions based on TED talks **Speaking**- Story Telling **Reading** - Skimming – Scanning – Reading: Scientific Texts	7+2
III	**Language Proficiency:** Tenses, Conditional Clause ('If' clause), Active and Passive voices, **Writing:** Formal letter (invitation, acceptance, decline, Congratulation) Cloze test. **Vocabulary** – Words on Tools. **Practical Component: Listening**-Listening pre-recorded English language learning programme **Speaking** - Just a minute **Reading**- Reading feature articles (from newspapers and magazines) -Reading to identify point of view and perspective (opinion pieces, editorials etc.)	5+4
IV	**Language Proficiency:** Subject Verb Concord, Articles, The Use of Prefixes and Suffixes **Writing:** Preparing Agenda &Minutes, Writing Recommendations. **Vocabulary**– Words on Engineering process. **Practical Component: Listening**-An interview with someone who works for recruitment personnel. **Speaking**-Presentation on a general topic. **Reading**- Reading Comprehension - Literary Texts.	5+4
V	**Language Proficiency:** Prepositions, Phrasal Verbs, Modal Auxiliaries, **Writing:** Letter to the Editor, Sequencing of Sentences **Vocabulary** –Words on Engineering material **Practical Component: Listening**- Listening- Comprehensions based on Nat Geo/Discovery channel videos **Speaking**- Preparing posters and presenting as a team. **Reading**- Biographies, Travelogues, Technical blogs.	6+3
	Total Instructional Hours	45

Course Outcome

After completion of the course the learner will be able

CO1: Understand English and converse effectively.
CO2: Enable the students to write coherently and cohesively.
CO3: Enable the development of basic grammar to enhance language for a better communication
CO4: use suitable vocabulary and grammar with confidence and express their ideas both in speech and writing.
CO5: follow the etiquettes in formal and informal communication.

TEXT BOOKS:

T1- Raymond Murphy, "English Grammar in Use"-5thedition CambridgeUniversityPress, 2019.
T2-- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

REFERENCE BOOKS:

R1- Kapoor A.N., Business Letters for Different Occasions, New Delhi: S. Chand & Co. Pvt. Ltd., 2012.
R2-RaymondMurphy, " English Grammar For ESL Learners - Premium Fourth Edition.
R3- McCarthy, Michael et.al (2011) English Vocabulary in Use – advanced, Cambridge University Press.

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PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	-	3	2	1	-	-
CO2	-	-	-	-	2	3	2	3	1	3	1	-	-	-
CO3	-	-	-	3		2	-	2	2	3	2	2	-	-
CO4	-	-	-	-	-	2	-	2	1	3	1	1	-	-
CO5	-	-	-	2	-	-	-	2	3	3	3	1	-	-
AVG	-	-	-	2.5	2	2.3	2	2.2	1.8	3	1.8	1.3	-	-

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22IT1151	PYTHON PROGRAMMING AND PRACTICES (AGRI, CHEM,FT,AERO, AUTO, CIVIL,MECH, MECT,ECE,BME)	2	0	2	3

Course Objective

The learner should be able

1. To know the basics of algorithmic problem solving
2. To read and write simple Python programs
3. To develop Python programs with conditionals and loops and to define Python functions and call them
4. To use Python data structures — lists, tuples, dictionaries
5. To do input/output with files in Python

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). **Illustrative problems: To find the Greatest Common Divisor (GCD)oftwo numbers, Fahrenheit to Celsius, Perform Matrix addition.**	5+4
II	**DATA, STATEMENTS,CONTROL FLOW** Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if –elif-else); Iteration: state, while, for, break, continue, pass; **Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.**	5+4
III	**FUNCTIONS, STRINGS** Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. **Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension. **Illustrative programs: List Manipulation, Finding Maximum in a List, String processing.**	5+4
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages **Illustrative programs: Reading writing in a file, word count, Handling Exceptions**	9
	Total Instructional Hours	**45**

Course Outcome

At the end of the course, the learner will be able to

CO1: Develop algorithmic solutions to simple computational problems

CO2: Read, write, execute by hand simple Python programs

CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions

CO4: Represent compound data using Python lists, tuples, dictionaries

CO5: Read and write data from/to files in Python Programs.

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TEXT BOOKS:

T1: Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2, Shroff Publishers. First edition (2017).

T2:S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd. 2019.

REFERENCE BOOKS:

R1:CharlesDierbach, —Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition,2013.

R2:Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015

R3:Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
C04	2	3	3	-	2	-	-	-	2	-	-	2	2	2
C05	2	3	3	-	2	-	-	-	2	-	-	2	2	2
AVG	2	3	3	-	2	-	-	-	2	-	-	2	2	2

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rogramme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22HE1072	ENTREPRENEURSHIP & INNOVATION	1	0	0	1

(Common for all Branches)

Course Objectives

The student should be made

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

Module	Description
1	**Entrepreneurial Thinking**
2	**Innovation Management**
3	**Design Thinking**
4	**Opportunity Spotting / Opportunity Evaluation**
5	**Industry and Market Research**
6	**Innovation Strategy and Business Models**
7	**Financial Forecasting**
8	**Business Plans/ Business Model Canvas**
9	**Entrepreneurial Finance**
10	**Pitching to Resources Providers / Pitch Deck**
11	**Negotiating Deals**
12	**New Venture Creation**
13	**Lean Start-ups**
14	**Entrepreneurial Ecosystem**
15	**Velocity Venture**

TOTAL INSTRUCTIONAL HOURS **15**

Course Outcome

At the end of the course, the learner will be able to

CO1: Understandthenatureofbusinessopportunities,resources,andindustriesincriticalandcreative aspects.

CO2: Understand the processes by which innovation is fostered, managed, and commercialized.

CO3:Remember effectively and efficiently the potential of new business opportunities.

CO4:Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness..

CO5:Developabusiness model for a new venture, including revenue. Margins, operations, Working capital, and investment

TEXTBOOKS

T1:AryaKumar"Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization",Pearson,SecondEdition(2012).
T2:EmrahYayici"DesignThinkingMethodology", Artbiztech,FirstEdition(2016).

REFERENCEBOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen &Unwin Publication, Fourth Edition (2007).
R2: ThomasLockWood&EdgerPapke"InnovationbyDesign",Career Press.com,SecondEdition(2017).
R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, FirstEdition(2010).

WEBRESOURCES

W1:https://blof.forgeforward.in/tagged/startup-lessons
W2:https://blof.forgeforward.in/tagged/entrepreurship
W3:https://blof.forgeforward.in/tagged/minimum-viable-product
W4:https://blof.forgeforward.in/tagged/minimum-viable-product
W5:https://blof.forgeforward.in/tagged/innovation

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE1073	INTRODUCTION TO SOFT SKILLS	0	0	0	1

Course Objectives:

1. To develop and nurture the soft skills of the students through instruction, knowledge acquisition, demonstration and practice.
2. To enhance the students ability to deal with numerical and quantitative skills.
3. To identify the core skills associated with critical thinking.
4. To develop and integrate the use of English language skills.

Unit	Description	Instructional Hours
I	**Lessons on excellence** Skill introspection, Skill acquisition, consistent practice	2
II	**Logical Reasoning** Problem Solving - Critical Thinking- Lateral Thinking - Coding and Decoding – Series – Analogy - Odd Man Out - Visual Reasoning - Sudoku puzzles - Attention to detail	11
III	**Quantitative Aptitude** Addition and Subtraction of bigger numbers - Square and square roots - Cubes and cube roots - Vedic maths techniques - Multiplication Shortcuts - Multiplication of 3 and higher digit numbers – Simplifications - Comparing fractions - Shortcuts to find HCF and LCM - Divisibility tests shortcuts - Algebra and functions	11
IV	**Recruitment Essentials** Resume Building - Impression Management	2
V	**Verbal Ability** Nouns and Pronouns – Verbs - Subject-Verb Agreement - Pronoun-Antecedent – Agreement - Punctuations	4
	Total Instructional Hours	30

Course Outcome:

CO1: Students will analyze interpersonal communication skills. public speaking skills.
CO2: Students will exemplify tautology, contradiction and contingency by logical thinking.
CO3: Students will be able to develop an appropriate integral form to solve all sorts of quantitative problems.
CO4: Students can produce a resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity.
CO5: Students will be developed to acquire the ability to use English language with an error while making optimum use of grammar.

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அலகு I **மொழி மற்றும் இலக்கியம்:** 3
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை:** 3
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்** 3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்:** 3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம், மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:** 3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

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AERO - HiCET

HINDUSTHAN ACADEMIC COUNCIL COLLEGE OF ENGG & TECH Chairman

Dean (Academics)
HiCET

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech	22MC1094	**HERITAGE OF TAMIL**	2	0	0	0

Course Objective

The learner should be able to

1. Introduce students to the great History of Tamil literature.
2. Establish the heritage of various forms of Rock art and Sculpture art.
3. To study and understand the various folk and Martial arts of Tamil culture
4. Introduce students to Ancient Tamil concepts to understand the richness of Tamil literature.
5. To learn about the various influences or impacts of Tamil language in Indian culture.

Unit	Description	Instructional Hours
I	**Language and Literature** Language families in India – Dravidian Languages – Tamil as a classical language – Classical Literature in Tamil- Secular nature of Sangam Literature – Distributive justice in Sangam Literature – Management principles in Thirukural – Tamil epics and impacts of Buddhism & Jainism in Tamil and Bakthi literature of Azhwars and Nayanmars – Forms of minor poetry _ Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidasan.	6
II	**Heritage _ Rock Art Paintings to Modern Art – Sculpture** Hero Stone to Modern Sculpture – Bronze icons – Tribes and their handcrafts - Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar statue at Kanyakumari, Making of musical instruments – Mridangam, Parai, Yazh and Nadhaswaram - Role of Temples in social and economic life of Tamils.	6
III	**Folk and Martial Arts** Therukoothu, Karagattem, Villupattu, Kaniyan koothu, Oyilattam, Leather puppertry, Silambattam., Valari Tiger dance – Sports and Games of Tamils.	6
IV	**Thinai Concept of Tamils** Flora and Fauna of Tamils – Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram concept of Tamils – Education and Literacy during Sangam Age - Ancient cities and ports of Sangam age – Exporot and Import during Sangam age – Overseas conquest of Cholas.	6
V	**Contribution of Tamils to Indian National Movement and Indian Culture** Contribution of Tamils to Indian freedom struggle – The cultural influence of Tamils over the other parts of India – Self respect movement – Role of Siddha Medicine in indigenous systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil books.	6
	Total Instructional Hours	**30**

Course Outcome

At the end of the course, the learner will be able to

CO1: Learn about the works pertaining to Sangam age
CO2: Aware of our Heritage in art from Stone sculpture to Modern Sculpture.
CO3Appreciate the role of Folk arts in preserving, sustaining and evolution of Tamil culture.
CO4: Appreciate the intricacies of Tamil literature that had existed in the past.
CO5: Understand the contribution of Tamil Literature to Indian Culture

TEXTBOOKS:

T1: Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
T2: Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
T3: Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).

REFERENCEBOOKS:

R1-The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
R2- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
R3-Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./ B.Tech/	22HE1095	UNIVERSAL HUMAN VALUES (COMMON TO ALL BRANCHES)	2	0	0	0

Course Objectives

The student should be made

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslifeandprofession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implication s of such a Holistic understanding Interms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	Description	Instructional Hours
I	**Introduction to Value Education** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations	6
II	**Harmony in the Human Being and Harmony in the Family** Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body - Programme to ensure self-regulation and Health	6
III	**Harmony in the Family and Society** Harmony in the Family – the Basic Unit of Human Interaction.Values in Human to Human Relationship'Trust' – the Foundational Value in Relationship Values in Human to Human Relationship'Respect' – as the RightEvaluation Understanding Harmony in the Society	6
IV	**Harmony in the Nature / Existence** Understanding Harmony in the Nature.Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutually interacting units in all pervasivespace Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence. Vision for the Universal Human Order	6
V	**Implications of the Holistic Understanding – a Look at Professional Ethics** Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical CaseStudiesStrategies for Transition towards Value-based Life and Profession	6
	Total Instructional Hours	**30**

Course Outcome

At the end of the course, the learner will be able

CO1: To become more aware of holistic vision of life - themselves and their surroundings.

CO2: To become more responsible in life, in the Society and in handling problems with sustainable Solutions.

CO3: To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior.

CO4: To able to apply what have learnt to their own self in different day-to-day settings in real life and In handling problems with sustainable solutions.

CO5: To develop competence and capabilities for maintaining Health and Hygiene.

Reference Books:

R1.A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2.Teachers'ManualforAFoundationCourseinHumanValuesandProfessionalEthics,RRGaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-53-2

R3.JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak,1999.

R4.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

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Department of Aeronautical Engineering

R-2022

NEW COURSES INTRODUCED

S. No	Course code	Name of the Course
1.	22PH1153	Physical Properties of Materials

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CURRICULUM
R2022

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. AERONAUTICAL ENGINEERING (UG)

REGULATION-2022

For the students admitted during the academic year 2023-2024 and onwards

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA1101**	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	**22ME1201**	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3.	**22PH1151**	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	**22HE1151**	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	**22IT1151**	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6.	**22HE1072**	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
7.	**22HE1073**	Introduction To Soft Skills	SEC	2	0	0	0	1	100	0	100
MANDATORY COURSE											
8.	**22MC1093/ 22MC1094**	தமிழர்மரபு /HERITAGE OF TAMIL	MC	2	0	0	1	2	40	60	100
9.	**22MC1095**	Universal Human Values	MC	2	0	0	0	2	100	0	100
		TOTAL		**17**	**5**	**6**	**18**	**27**	**570**	**330**	**900**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA2101**	Differential Equations and Complex Analysis	BSC	3	1	0	4	4	40	60	100
2.	**22CY2101**	Environmental Studies	ESC	2	0	0	2	3	40	60	100
3.	**22PH2101**	Basics Of Material Science	BSC	2	0	0	2	3	40	60	100
4.	**22ME2101**	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	**22CY2152**	Applied Chemistry	BSC	2	0	2	3	4	50	50	100

6.	**22HE2151**	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
PRACTICAL											
7.	**22ME2001**	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8.	**22HE2071**	DESIGN THINKING	AEC	2	0	0	2	2	100	0	100
9.	**22HE2072**	Soft Skills -1	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	**22MC2094/ 22MC2095**	தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY	MC	2	0	0	1	2	40	60	100
11.	**22MC2093**	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**19**	**1**	**8**	**23**	**27**	**560**	**440**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA3104**	Fourier Analysis and Numerical Techniques	BSC	3	1	0	4	4	40	60	100
2.	**22AE3201**	Elements of Aeronautics	PCC	3	0	0	3	3	40	60	100
3.	**22AE3202**	Solid Mechanics	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
4.	**22AE3251**	Aero Engineering Thermodynamics	PCC	3	0	2	4	5	50	50	100
5.	**22AE3252**	Engineering Fluid Mechanics	PCC	3	0	2	4	5	50	50	100
PRACTICAL											
6.	**22AE3001**	Strength of Materials Laboratory	ESC	0	0	4	2	4	60	40	100
7.	**22AE3002**	Aircraft Component Drawing Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8.	**22HE3071**	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	**22AE3072**	Introduction to MATLAB	AEC	2	0	0	2	2	100	0	100
MANDATORY COURSE											
10.	**22MC3191**	Indian Traditional Knowledge	MC	1	0	0	0	1	100	0	100
			TOTAL	**19**	**1**	**12**	**25**	**32**	**640**	**360**	**1000**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22HE4101**	IPR and Start-ups	HSC	2	0	0	2	2	0	100	100
2.	**22AE4201**	Aerodynamics - I	PCC	3	0	0	3	3	40	60	100
3.	**22AE4202**	Mechanics of machines	PCC	3	1	0	4	4	40	60	100
4.	**22AE4203**	Gas Turbine Propulsion	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	**22MA4151**	Probability And Statistics with R Programming	BSC	2	0	1	3	4	50	50	100
6.	**22AE4251**	Aircraft Structures-I	PCC	2	0	2	4	4	50	50	100
PRACTICAL											
7.	**22AE4001**	Aerodynamics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	**22AE4002**	Propulsion Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE4071**	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	**22MC4191**	Indian Constitution	MC	1	0	0	0	1	100	0	100
			TOTAL	**17**	**1**	**11**	**24**	**29**	**440**	**460**	**1000**

* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.
If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22AE5201**	Flight Dynamics	PCC	3	0	0	3	3	40	60	100
2.	**22AE5202**	Aerodynamics - II	PCC	3	0	0	3	3	40	60	100
3.	**22AE53XX**	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	**22AE53XX**	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	**22AE53XX**	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6.	**22AE5251**	Aircraft structures - II	PCC	3	0	2	3	5	50	50	100
PRACTICAL											
7.	**22AE5001**	Aircraft Systems and Maintenance Laboratory	PCC	0	0	3	2	3	60	40	100
EEC COURSES (SE/AE)											
8.	**22HE5071**	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**0**	**5**	**21**	**24**	**410**	**390**	**800**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22AE6201**	Finite Element Methods	PCC	3	0	0	3	3	40	60	100
2.	**22HE6101**	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3.	**22AE63XX**	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	**22AE63XX**	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	**22XX64XX**	Open Elective – I*	OEC	3	0	0	3	3	40	60	100
6.	**22XX64XX**	Open Elective – II*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
7.	**22AE6001**	UAV design and Aeromodelling Laboratory	PCC	0	0	4	2	4	60	40	100
8.	**22AE6002**	Structural Simulation Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE6071**	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**20**	**0**	**8**	**24**	**28**	**460**	**440**	**900**

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22AE73XX**	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
2.	**22XX74XX**	Open Elective – III*	OEC	3	0	0	3	3	40	60	100
3.	**22XX74XX**	Open Elective – IV*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
4.	**22AE7251**	Computational Fluid Dynamics	PCC	2	0	2	4	4	50	50	100
5.	**22AE7252**	Avionics	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
6.	**22AE7001**	Aircraft Design project	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7.	**22AE7701**	Internship*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**14**	**0**	**8**	**20**	**24**	**380**	**320**	**700**

* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1.	**22AE8901**	Project Work/Granted Patent	SEC	0	0	20	10	20	100	100	200
		TOTAL		**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.
2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22AI6451**	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	**22CS6451**	Block chain Technology	OEC	2	0	2	4	3
3	**22EC6451**	Cyber security	OEC	2	0	2	4	3
4	**22EC6452**	IoT Concepts and Applications	OEC	2	0	2	4	3
5	**22IT6451**	Data Science and Analytics	OEC	2	0	2	4	3
6	**22BM6451**	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**22AE6401**	Introduction to Aeronautical Engineering	OEC	3	0	0	3	3
2	**22MT6401**	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	**22MT6402**	Industrial Safety and Environment	OEC	3	0	0	3	3
4	**22CE6401**	Climate Change and its Impact	OEC	3	0	0	3	3
5	**22CE6402**	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	**22ME6401**	Renewable Energy System	OEC	3	0	0	3	3
7	**22ME6402**	Additive Manufacturing systems	OEC	3	0	0	3	3
8	**22EI6401**	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	**22EI6402**	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	**22AU6401**	Fundamentals of Automobile	OEC	3	0	0	3	3

		Engineering						
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio refinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE7401	Introduction to Drones	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Aerospace Structures & Materials	Vertical II Aerodynamics	Vertical III Propulsion	Vertical IV Avionics and Drone Technology	Vertical V Aircraft Maintenance	Vertical VI Advanced Manufacturing Technology
22AE5301 Theory of Elasticity	22AE5304 Wind Tunnel Techniques	22AE5307 Advanced Propulsion System	22AE5310 Control Engineering	22AE5313 Airframe Maintenance and Repair	22AE5316 Manufacturing Technology

22AE5302 Experimental Stress Analysis	22AE5305 Boundary layer Theory	22AE5308 Heat Transfer	22AE5311 Microprocessor and Applications	22AE5314 Civil Aviation Regulations	22AE5317 Additive Manufacturing and Tooling
22AE5303 Composite Materials and Structures	22AE5306 Helicopter Aerodynamics	22AE5309 Combustion in Aerospace Engineering	22AE5312 Drone Electronics	22AE5315 Aircraft Engine Maintenance and Repair	22AE5318 Lean Manufacturing
22AE6301 Structural Mechanics	22AE6303 Experimental Aerodynamics	22AE6305 Rocket and Missiles	22AE6307 Navigation and Communication systems	22AE6309 Air Traffic Control and Airport Planning	22AE6311 Industrial Design & Rapid Prototyping Techniques
22AE6302 Vibration and Aero elasticity	22AE6304 Hypersonic Aerodynamics	22AE6306 Introduction to Cryogenics	22AE6308 Design of UAV Systems	22AE6310 Aviation management and Air Safety Engineering	22AE6312 Non-Destructive Testing
22AE7301 Fatigue and Fracture Mechanics	22AE7302 Industrial Aerodynamics	22AE7303 Satellite Technology	22AE7304 Aerospace Guidance and Control	22AE7305 Engine Systems and Control	22AE7306 Integrated Product Development

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Details of Vertical I: Aerospace Structures & Materials

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5301	Theory of Elasticity	PEC	3	0	0	3	3
2.	22AE5302	Experimental Stress Analysis	PEC	3	0	0	3	3
3.	22AE5303	Composite Materials and Structures	PEC	3	0	0	3	3
4.	22AE6301	Structural Mechanics	PEC	3	0	0	3	3
5.	22AE6302	Vibration and Aero elasticity	PEC	3	0	0	3	3
6.	22AE7301	Fatigue and Fracture Mechanics	PEC	3	0	0	3	3

Details of Vertical II: Aerodynamics

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5304	Wind Tunnel Techniques	PEC	3	0	0	3	3
2.	22AE5305	Boundary layer Theory	PEC	3	0	0	3	3
3.	22AE5306	Helicopter Aerodynamics	PEC	3	0	0	3	3
4.	22AE6303	Experimental Aerodynamics	PEC	3	0	0	3	3

5.	22AE6304	Hypersonic Aerodynamics	PEC	3	0	0	3	3
6.	22AE7302	Industrial Aerodynamics	PEC	3	0	0	3	3

Details of Vertical III: Propulsion

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5307	Advanced Propulsion System	PEC	3	0	0	3	3
2.	22AE5308	Heat Transfer	PEC	3	0	0	3	3
3.	22AE5309	Combustion in Aerospace Engineering	PEC	3	0	0	3	3
4.	22AE6305	Rocket and Missiles	PEC	3	0	0	3	3
5.	22AE6306	Introduction to Cryogenics	PEC	3	0	0	3	3
6.	22AE7303	Satellite Technology	PEC	3	0	0	3	3

Details of Vertical IV: Avionics and Drone Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5310	Control Engineering	PEC	3	0	0	3	3
2.	22AE5311	Microprocessor and Applications	PEC	3	0	0	3	3
3.	22AE5312	Drone Electronics	PEC	3	0	0	3	3
4.	22AE6307	Navigation and Communication systems	PEC	3	0	0	3	3
5.	22AE6308	Design of UAV Systems	PEC	3	0	0	3	3
6.	22AE7304	Aerospace Guidance and Control	PEC	3	0	0	3	3

Details of Vertical V: Aircraft Maintenance

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5313	Airframe Maintenance and Repair	PEC	3	0	0	3	3
2.	22AE5314	Civil Aviation Regulations	PEC	3	0	0	3	3
3.	22AE5315	Aircraft Engine Maintenance and Repair	PEC	3	0	0	3	3
4.	22AE6309	Air Traffic Control and Airport Planning	PEC	3	0	0	3	3
5.	22AE6310	Aviation management and Air Safety Engineering	PEC	3	0	0	3	3
6.	22AE7305	Engine Systems and Control	PEC	3	0	0	3	3

Details of Vertical VI: Advanced Manufacturing Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5316	Manufacturing Technology	PEC	3	0	0	3	3
2.	22AE5317	Additive Manufacturing and Tooling	PEC	3	0	0	3	3
3.	22AE5318	Lean Manufacturing	PEC	3	0	0	3	3
4.	22AE6311	Industrial Design & Rapid Prototyping Techniques	PEC	3	0	0	3	3
5.	22AE6312	Non-Destructive Testing	PEC	3	0	0	3	3
6.	22AE7306	Integrated Product Development	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.
  Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5231	Sem 5: Fundamentals of Aeronautics	MDC	3	0	0	3	3
2.	22AE6231	Sem 6: Aircraft Systems and Instruments	MDC	3	0	0	3	3
3.	22AE6232	Sem6: Aircraft Materials and Processes	MDC	3	0	0	3	3
4.	22AE7231	Sem 7: Aircraft General Maintenance	MDC	3	0	0	3	3
5.	22AE7232	Sem 7: Introduction to Unmanned Aerial Vehicle Systems	MDC	3	0	0	3	3
6.	22AE8231	Sem 8: Introduction to Space Vehicles	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Green Technology
Introduction to Fintech	Financing New Business Ventures	Environmental Quality Monitoring and Analysis

B.E. (Hons) Aeronautical Engineering

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22AE5203	Sem 5: Space Flight Mechanics	PC	3	0	0	3	3	40	60	100
2.	22AE5204	Sem 5: Wind Engineering	PC	3	0	0	3	3	40	60	100
3.	22AE6202	Sem 6: Space Propulsion Systems	PC	3	0	0	3	3	40	60	100
4.	22AE6203	Sem 6: Heat Transfer in Aerospace Applications	PC	3	0	0	3	3	40	60	100
5.	22AE6204	Sem 6: Experimental methods in fluid mechanics	PC	3	0	0	3	3	40	60	100
6.	22AE6205	Sem 6: Introduction to turbulence	PC	3	0	0	3	3	40	60	100
7.	22AE7201	Sem 7: Missiles Guidance and Control	PC	3	0	0	3	3	40	60	100
8.	22AE7202	Sem 7: Satellite attitude dynamics and control	PC	3	0	0	3	3	40	60	100
9.	22AE7203	Sem 7: Space Vehicle Aerodynamics	PC	3	0	0	3	3	40	60	100
10.	22AE7204	Sem 7: Computational Heat Transfer and fluid flow	PC	3	0	0	3	3	40	60	100
11.	22AE8201	Sem 8: Electrical Propulsion	PC	3	0	0	3	3	40	60	100
12.	22AE8202	Sem 8: Aviation innovation and biomimicry	PC	3	0	0	3	3	40	60	100

SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	3	-	-	-	-	**23**
3	ESC	6	7	2	-	-	-	-	-	**15**
4	PCC	-	-	16	18	11	7	9	-	**61**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	1	3	3	1	1	2	2	10	**23**
8	MCC	1	1	✓	✓	-	-	-	-	**2**
Total		**18**	**23**	**25**	**24**	**21**	**24**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	18	23	25	24	21	24	20	10	**165**

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AERO - HiCET

Dean Academics

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Principal

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SYLLABUS

III SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
B.E	22MA3104	FOURIER ANALYSIS AND NUMERICAL TECHNIQUES (AUTO , AERO)	3	1	0	4

Course Objective

The learner should be able to

1. Analyze Fourier series which is central to many applications in engineering.
2. Apply the effective tools for the solutions of one and two dimensional boundary value problems.
3. Apply Fourier transform techniques in various situations.
4. Explain single and multi step methods to solve Ordinary differential equations
5. Describe various methods to solve ordinary differential equations and partial differential equations

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Solutions of one dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges).Two dimensional heat equations-Steady state solution of two dimensional equation of heat conduction in infinite plate	12
III	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity (Statement only).	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods for solving first order equations: Taylor's series method – Euler and Modified Euler methods – Fourth order Runge-kutta method -Multi step method: Milne's predictor and corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Solution of second order ordinary differential equation by Finite difference method – Solution of partial differential equation: one dimensional heat equation by Bender schmidt method – One dimensional Wave equation by Explicit method– Laplace Equations and Poisson Equations.	12
	Total Instructional Hours	60

Course Outcome

At the end of the course, the learner will be able to

CO1: Understand the principles of Fourier series which helps them to solve physical problems of engineering.

CO2: Employ Fourier series in solving the boundary value problems.

CO3: Apply Fourier transform techniques which extend its applications.

CO4: Classify and solve ordinary differential equations by using single and multi step methods.

CO5: Illustrate various methods to find the solution of ordinary and partial differential equations.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018

T2 - Bali. N.P and Manish Goyal& Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007

REFERENCE BOOKS:

R1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd.,Second reprint, New Delhi, 2012.

R2 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi,2018.

R3 -Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 6th Edition, Khanna publishers, New Delhi 2015.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	1
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	3
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2
C04	3	3	3	1	2	2	-	-	-	-	-	2	2	2
C05	3	3	3	2	1	1	-	-	-	-	-	2	2	3
AVG	3	2.8	3	1.4	1.4	2	-	-	-	-	-	2.2	2.2	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE3201	**Elements of Aeronautics**	3	0	0	3

Course Objective

1. To introduce the history, concept of flying, aircraft components and materials.
2. To study about the various configurations, systems and instruments used in aircraft.
3. To understand the structure of atmosphere and concept of flight mechanics.
4. To impart the knowledge about various propulsion systems used in aircraft and rocket.
5. To comprehend the various structures and materials used in aircraft.

Unit	Description	Instructional Hours
I	**HISTORY AND INTRODUCTION OF FLIGHT** Balloon flight – ornithopters - Early Airplanes- Wright Brothers era-Biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years, Components of an Airplane and their functions - Introduction to rotorcraft - UAV and MAVs.	9
II	**AIRCRAFT CONFIGURATIONS** Different Types of Flight Vehicles - Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Digital fly by wire systems - Engine control systems– Auto pilot system – Instrument Landing Systems - Basic Instruments for flying.	10
III	**BASICS OF FLIGHT MECHANICS** Physical properties and structure of the atmosphere- Temperature, pressure and altitude relationships- Newton's law of motions applied to aeronautics, Evolution of Lift, Drag and Moment- Airfoils characteristics and nomenclature-Mach Number, Maneuvers.	8
IV	**AIRCRAFT PROPULSION** Basic Ideas about piston engine and jet engines - working principle and basic components, Use of Propeller and Jets for Thrust Production, -Comparative Merits - Principles of Operation of Rocket - Types of Rocket and typical applications – exploration into space.	10
V	**AIRCRAFT STRUCTURES AND MATERIALS** General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law-stress-strain diagrams-elastic constants-Factor of Safety.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the functions of aircraft components.
CO2: Able to identify the types of flight vehicles and control systems.
CO3: Understand the basic concepts of flight mechanics.
CO4: Understand the working principle of various aircraft propulsion system.
CO5: Acquire the knowledge about various materials used for aircraft construction.

TEXT BOOKS:

T1 - Anderson, J.D., "Introduction to flight", 8th edition, McGraw Hill, 2016.
T2 - E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", JohnWiley, NJ, 2021

REFERENCE BOOKS:

R1 - Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.
R2 - Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", 5th edition, Butterworth-Heinemann Publishers, London, 2003.
R3 - A.C. Kermode, "Flight without formulae", Pearson education, 5th edition, 2011.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	1
C04	3	-	-	-	-	-	-	-	-	-	-	-	2	1
C05	3	-	-	-	-	-	-	-	-	-	-	-	2	1
AVG	3	-	-	-	-	-	-	-	-	-	-	-	2	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE3202	Solid Mechanics	3	0	0	3

Course Objective

1. To understand the behavior of structural members under axial loading conditions.
2. To sketch the Shear Force and bending moment diagram for beams with various loadings.
3. To calculate the deflections of the beams under various loading conditions.
4. To determine the stresses in shafts and springs.
5. To describe the behavior of materials due to axial, bending, torsional and combined loads.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Definition of stress, strain and their relations – relations between material constants – axial loading - statically determinate and indeterminate problems in tension & compression.	9
II	**STRESSES IN BEAMS** Shear force & bending moment diagrams: bending and shear stress variation in beams of symmetric sections, beams of uniform strength	10
III	**DEFLECTION OF BEAMS** Double integration method – Macaulay's method – moment area method – conjugate beam method	9
IV	**TORSION – SPRINGS** Torsion of solid and hollow circular shafts – shear stress variation – open and closed-coiled helical springs – stresses in helical springs- deflection of helical springs.	9
V	**BIAXIAL STRESSES** Stresses in thin-walled pressure vessels – combined loading of circular shaft with bending, torsion and axial loadings – Mohr's circle and its construction – determination of principal stresses.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Ability to learn the behaviors of materials under axial loading conditions.
CO2: Ability to sketch the Shear Force and bending moment diagram for beams with various loadings.
CO3: Analyze the deflections of the beams under various loading conditions.
CO4: Evaluate the springs and to calculate the stresses in circular shafts.
CO5: Construct Mohr's circle for materials due to axial, bending, torsional and combined loads.

TEXT BOOKS:

T1 - William Nash, "Strength of Materials", Tata McGraw Hill, 6th edition, 2013.
T2 - Barry J. Goodno, James M. Gere, 'Mechanics of Materials,9th edition T.Van Nostrand Co. Inc., Princeton, N.J., 2017.

REFERENCE BOOKS:

R1 –R.K. Rajput., 'Strength of Materials', 6th edition. Lakshmi Publications., 2018.
R2 - Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, Third Edition, 2016.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C04	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C05	3	1	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	1.6	1.2	-	-	-	-	-	-	-	-	-	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE3251	Aero Engineering Thermodynamics	3	0	2	4

Course Objective

1. To understand the thermodynamic principles, basic concepts and laws of thermodynamics.
2. To impart the knowledge about reversible process and Carnot theorem.
3. To understand the thermodynamic cycles used for energy production.
4. To study the performance calculation of Refrigeration and Air-conditioning systems.
5. To understand the basic concepts of Aircraft Propulsion systems

Unit	Description	Instructional Hours
I	**FIRST LAW OF THERMODYNAMICS** Concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, State, Path and Process, Quasi-static Process, Work, modes of work, Zeroth law of thermodynamics - concept of temperature and heat, internal energy, specific heat capacities, enthalpy - concept of ideal and real gases. First law of thermodynamics - applications to closed and open systems - steady flow processes with references to various thermal equipment	10
II	**SECOND LAW OF THERMODYNAMICS AND ENTROPY** Second law of thermodynamics - Kelvin Planck and Clausius statements of second law. Reversibility and Irreversibility –Exergy - Carnot theorem, Carnot cycle efficiency - Clausius inequality, concept of entropy, Entropy change for various processes.	9
III	**AIR STANDARD CYCLES** Otto, Diesel, Dual and Brayton cycles - air standard efficiency - mean effective pressure, Actual and theoretical PV diagrams of Four stroke and Two stroke IC engines - **Valve timing of a Four stroke engine and port timing of a two stroke engine.**	12+2(P)
IV	**VAPOUR POWER CYCLES** Standard Rankine cycle – efficiency - Reversed Carnot cycle – Principles of refrigeration and Air conditioning- Tonne of refrigeration. -Vapor compression cycle - Vapor absorption cycle - Properties of refrigerants - Coefficient of performance - **Test on a vapor compression refrigeration test rig - Test on a vapor compression air-conditioning test rig**	10+4(P)
V	**BASICS OF PROPULSION** Classification of jet engines - simple jet propulsion system – Gaseous equations-thrust equation - specific impulse – fundamentals of rocket propulsion. Theoretical (Stoichiometric) air for combustion of fuels. Excess air, mass balance, Exhaust gas analysis, A/F ratio. **Determination of thermal conductivity of solid - Determination of thermal resistance of a composite wall**	9+4(P)
	Total Instructional Hours	**60 hours**

Course Outcome

CO1: Apply the thermodynamic principles to various thermal equipment.
CO2: Acquire the knowledge about Carnot theorem and reversibility.
CO3: Ability to interpret the various thermodynamic cycles used for energy production and analyze the performance of thermodynamic cycles.
CO4: Ability to determine the performance of Refrigeration and Air-conditioning systems
CO5: Understand the various aircraft propulsion systems.

TEXT BOOKS:

T1 - Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 6th Edition 2017
T2 - Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2005.

REFERENCE BOOKS:

R1 - Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
R2 – Yunus A.Cengal."Thermodynamics an Engineering Approach", Tata McGraw-Hill Co.Ltd.,8th Edition, 2017.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	2	2	1	-	-	-	-	-	-	-	-	3	2
C05	3	1	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2.2	1.6	1	-	-	-	-	-	-	-	-	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22 AE3252	Engineering Fluid Mechanics	3	0	2	4

Course Objective

1. To familiarize with the fluid properties and flow characteristics
2. To understand the importance of conservation laws to flow through circular conduits.
3. To comprehend the importance of dimensional analysis
4. To examine the performance of Pumps
5. To examine the performance of Turbines

Unit	Description	Instructional Hours
I	FLUID PROPERTIES AND FLOW CHARACTERISTICS Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications. Determination of the Coefficient of discharge using venturi meter	11 + 2(P)
II	**FLOW THROUGH PIPES AND BOUNDARY LAYER** Incompressible Fluid Flow- Viscous flow - Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation – friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness. ***Calculation of rate of flow using water meter and rotameter*** ***Determination of friction factor for a given set of pipes***	11 + 4(P)
III	**DIMENSIONAL ANALYSIS AND MODEL STUDIES** Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.	8
IV	**TURBINES** Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines. ***Conducting experiments and drawing the characteristics curves for the given turbines***	10 + 2(P)
V	**PUMPS** Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and its variations - Work saved by fitting air vessels - Rotary pumps. ***Conducting experiments and drawing the characteristics curves for the centrifugal pump***	10 + 2(P)
	Total Instructional Hours	60

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Course Outcome

CO1: Apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO2: Capacity in working with the conservative laws and flow through circular conduits
CO3: Proficiency in Dimensional Analysis
CO4: Capability to analyze the performance of pumps
CO5: Ability to evaluate the performance of turbines

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

REFERENCES:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata-McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	1
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	1
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	1
C04	3	3	2	3	-	-	-	-	-	-	-	2	2	2
C05	3	3	2	3	-	-	-	-	-	-	-	2	2	2
AVG	3.0	2.8	2.0	2.7	-	-	-	-	-	-	-	2.0	2.6	1.4

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE3001	Strength of materials Laboratory	0	0	3	2

Course Objective
1. To enhance the basic knowledge on strength behavior of various materials.
2. To determine the compressive strength on helical springs and deflection of beams.

Expt. No.	Description of the Experiments
1.	Tension test on mild steel rod.
2.	Double shear test on mild steel and Aluminum rods.
3.	Torsion test on mild steel rod.
4.	Impact test on metal specimen.
5.	Hardness test on metals -Brinell and Rockwell Hardness Number
6.	Compression test on helical spring.
7.	Deflection of a simply supported beam and cantilever beam.
8.	Strain Measurement using Rosette strain gauge.
9.	Tempering- Improvement Mechanical properties Comparison (i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen.
10.	Microscopic Examination of (i) Hardened samples and (ii) Hardened and tempered samples.
11.	Study of photoelsticity and DIC measurement techniques

Total Practical Hours;45

Course Outcome
CO1: Understand the structural behavior of various materials.
CO2: Able to experimentally evaluate the structural characteristics of helical spring and beams.

List of Equipment (for a batch of 30 students)

Sl. No.	Name of the Equipment	Qty.	Exp. No.
1.	400 kN Universal Testing Machine	1	1,2
2.	Torsion testing machine (60 NM capacity)	1	3
3.	Impact testing machine (300 J Capacity)	1	4
4.	Brinell Hardness testing machine	1	5
5.	Rockwell Hardness testing machine	1	5
6.	Spring Testing Machine for tensile and compressive loads (2500 N)	1	6
7.	Metallurgical Microscopes	3	5
8.	Beams with weight hangers and dial gauges	2	7
9.	Muffle Furnace (800° C)	1	9,10

	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	2	-	-	-	-	-	-	-	-	3	3
AVG	3	3	2	2	-	-	-	-	-	-	-	-	3	3

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Programme	Course Code	Name of the Course	L T P C
B.E.	22AE3002	Aircraft Component Drawing Laboratory	0 0 3 2

Course Objective

1. To familiarize the knowledge of modelling software package and tools used.
2. To design and draft the different aircraft components and aircraft control system.
3. To introduce the knowledge on operations using CNC machine and 3D printing machine.

Expt. No. **Description of the Experiments**

1. Study of modeling softwares
2. Design and modeling of riveted and welded joints.
3. Design and modeling of truss and beam.
4. Design and modeling of various structural components of wing and fuselage.
5. Layout of Landing gear structure.
6. Layout of aircraft conventional control system components (cam, bell crank, push pull rod and gears)
7. Drafting three views of a typical aircraft
8. Design of engine cowl using sheet metal module.
9. Study of basic principles of geometric dimensioning and tolerance.
10. Study of CNC Machine and 3D printing machine.

Total Practical Hours 45

Course Outcome

CO1: Ability to identify the tools used in modelling software.

CO2: Ability to design various aircraft components and control systems.

CO3: Acquire the knowledge on operations using CNC machine and 3D printing machine.

List of Equipment (for a batch of 30 students)

Sl.No.	Name of the Equipment	Qty.	Exp. No.
1	Computer nodes	30	All
2	Modeling Packages	30 licenses	1-9
3	FEA&CAM SOFTWARE	30 licenses	8,9,10
4	UPS	1	-
5	CNC Machine	1	10
6	Printer	2	-

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	-	-	-	-	2	3	2	3
CO2	3	3	2	3	3	2	-	-	-	-	2	3	2	3
CO3	3	2	1	2	3	2	-	-	-	-	2	2	1	3
AVG	3	2.7	1.7	2.7	3.0	2.0	-	-	-	-	2.0	2.7	1.7	3

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Course code	Course title	L	T	P	C
21HE3072	Soft Skills-II	2	0	0	1
Pre-requisite	None	Syllabus version 1			

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Display good writing skills while dealing with essays [SLO 12]

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.

Student Learning Outcomes (SLO): 6, 7, 8, 12

Module:1 Logical Reasoning **6 hours** **SLO:6**

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

Module:2 Quantitative Aptitude **7 hours** **SLO: 7**

Time and work

- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

Time, Speed and Distance

- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on races

Profit and loss, Partnerships and averages

- Basic terminologies in profit and loss
- Partnership
- Averages
- Weighted average

Module:3 Verbal Ability **5 hours** **SLO: 8**

Sentence Correction

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons

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- Prepositions
- Determiners

Sentence Completion and Para-jumbles

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Module:4 Writing skills for placements **2 hours** **SLO:** 12

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

Total Lecture hours: 20 hours

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	22AE3072	INTRODUCTION TO MATLAB	0	0	3	2

Course objectives:

1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. To understand MATLAB graphic feature and its applications.
4. To use MATLAB as a programming and simulation tool.
5. To understand the mathematical computing with MATLAB

Unit 1	**Introduction**	**7 hrs**
The MATLAB Environment-MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output-Vectors, Arrays – Matrices		
Unit 2	**MATLAB Functions**	**5 hrs**
Built-in Functions-User defined Functions		
Unit 3	**Graphics with MATLAB**	**5 hrs**
Files and File Management – Import/Export-Basic 2D, 3D plots-Graphic handling		
Unit 4	**Programming with MATLAB**	**7 hrs**
Conditional Statements, Loops-MATLAB Programs – Programming and Debugging-Applications of MATLAB Programming-Case study		
Unit 5	**Mathematical computing**	**6 hrs**
Algebraic equations-Basic Symbolic Calculus and Differential equations-Numerical Techniques and Transforms- Case study		

Course Outcome:

CO1: Ability to carry out basic functions in MATLAB.
CO2: Capable of Understanding the MATLAB functions.
CO3: Ability to perform graphic handling and File management.
CO4: Able to do programming with MATLAB software.
CO5: Ability to do mathematical computing with MATLAB.

References:

1. "A Guide to MATLAB - for Beginners and Experienced Users", 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006).
2. "Essentials of MATLAB Programming", 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
3. "MATLAB Demystified", David McMahon, The McGraw-Hill Companies, (2007).
4. "MATLAB® for Engineers", 3rd Ed., Holly Moore, Pearson Education, Inc., (2012).
5. "Engineering computation with MATLAB", 2nd Ed., David M. Smith, Pearson Education, Inc. (2010)

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CURRICULUM R2022

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. AERONAUTICAL ENGINEERING (UG)

REGULATION-2022

For the students admitted during the academic year 2022-2023 and onwards

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA1101**	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	**22ME1201**	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3.	**22PH1151**	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	**22HE1151**	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	**22IT1151**	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6.	**22HE1071**	UHV	AEC	2	0	0	2	3	40	60	100
7.	**22HE1072**	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
8.	**22MC1091**	தமிழரும் தொழில் நுட்பமும்	MC	2	0	0	0	2	100	0	100
			TOTAL	**15**	**5**	**6**	**19**	**27**	**470**	**330**	**800**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA2101**	Differential Equations and Complex Analysis	BSC	3	1	0	4	4	40	60	100
2.	**22CY2101**	Environmental Studies	ESC	2	0	0	2	3	40	60	100
3.	**22PH2101**	Basics Of Material Science	BSC	2	0	0	2	3	40	60	100
4.	**22ME2101**	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	**22CY2152**	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6.	**22HE2151**	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100

PRACTICAL											
7.	**22ME2001**	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8.	**22HE2071**	Design Thinking	AEC	1	0	2	2	2	100	0	100
9.	**22HE2072**	Soft Skills -1	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	**22MC2091**	தமிழர் மரபு	MC	2	0	0	0	2	100	0	100
11.	**22MC2093**	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**18**	**1**	**10**	**22**	**27**	**620**	**380**	**1000**

SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA3104**	Fourier Analysis and Numerical Techniques	BSC	3	1	0	4	4	40	60	100
2.	**22AE3201**	Elements of Aeronautics	PCC	3	0	0	3	3	40	60	100
3.	**22AE3202**	Solid Mechanics	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
4.	**22AE3251**	Aero Engineering Thermodynamics	PCC	3	0	2	4	5	50	50	100
5.	**22AE3252**	Engineering Fluid Mechanics	PCC	3	0	2	4	5	50	50	100
PRACTICAL											
6.	**22AE3001**	Strength of Materials Laboratory	ESC	0	0	4	2	4	60	40	100
7.	**22AE3002**	Aircraft Component Drawing Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8.	**22HE3071**	Soft Skills -2	SEC	1	0	0	1	1	100	0	100
9.	**22AE3072**	Introduction to MATLAB	AEC	2	0	0	2	2	100	0	100
MANDATORY COURSE											
10.	**22MC3191**	Indian Traditional Knowledge	MC	2	0	0	0	2	100	0	100
			TOTAL	**18**	**2**	**10**	**25**	**30**	**640**	**360**	**1000**

SEMESTER IV

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22HE4101**	IPR and Start-ups	HSC	2	0	0	2	2	0	100	100

2.	22AE4201	Aerodynamics - I	PCC	3	0	0	3	3	40	60	100
3.	22AE4202	Mechanics of machines	PCC	3	1	0	4	4	40	60	100
4.	22AE4203	Gas Turbine Propulsion	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	22MA4151	Probability And Statistics with R Programming	BSC	2	0	2	3	4	50	50	100
6.	22AE4251	Aircraft Structures-I	PCC	2	0	2	4	4	50	50	100
PRACTICAL											
7.	22AE4001	Aerodynamics Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22AE4002	Propulsion Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
			TOTAL	**16**	**1**	**12**	**24**	**29**	**440**	**460**	**900**

* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same will be evaluated in Semester IV.
If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed with Internship II (Total: 4 weeks-2 credits)

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22AE5201	Flight Dynamics	PCC	3	0	0	3	3	40	60	100
2.	22AE5202	Aerodynamics - II	PCC	3	0	0	3	3	40	60	100
3.	22AE53XX	Professional Elective-1	PEC	3	0	0	3	3	40	60	100
4.	22AE53XX	Professional Elective-2	PEC	3	0	0	3	3	40	60	100
5.	22AE53XX	Professional Elective-3	PEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6.	22AE5251	Aircraft structures - II	PCC	3	0	2	3	5	50	50	100
PRACTICAL											
7.	22AE5001	Aircraft Systems and Maintenance Laboratory	PCC	0	0	3	2	3	60	40	100
EEC COURSES (SE/AE)											
8.	22HE5071	Soft Skills -4/Foreign languages	SEC	1	0	0	1	1	100	0	100
			TOTAL	**19**	**0**	**5**	**21**	**24**	**410**	**390**	**800**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22AE6201	Finite Element Methods	PCC	3	0	0	3	3	40	60	100

2.	**22HE6101**	Professional Ethics	HSC	3	0	0	3	3	40	60	100
3.	**22AE63XX**	Professional Elective-4	PEC	3	0	0	3	3	40	60	100
4.	**22AE63XX**	Professional Elective-5	PEC	3	0	0	3	3	40	60	100
5.	**22XX64XX**	Open Elective – I*	OEC	3	0	0	3	3	40	60	100
6.	**22XX64XX**	Open Elective – II*	OEC	3	0	0	3	3	40	60	100
PRACTICAL											
7.	**22AE6001**	UAV design and Aeromodelling Laboratory	PCC	0	0	4	2	4	60	40	100
8.	**22AE6002**	Structural Simulation Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	**22HE6071**	Soft Skills – 5	SEC	2	0	0	2	2	100	0	100
			TOTAL	**20**	**0**	**8**	**24**	**28**	**460**	**440**	**900**

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22AE73XX**	Professional Elective-6	PEC	3	0	0	3	3	40	60	100
2.	**22XX74XX**	Open Elective – III*	OEC	3	0	0	3	3	40	60	100
3.	**22XX74XX**	Open Elective – IV*	OEC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
4.	**22AE7251**	Computational Fluid Dynamics	PCC	2	0	2	4	4	50	50	100
5.	**22AE7252**	Avionics	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
6.	**22AE7001**	Aircraft Design project	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
7.	**22AE7701**	Internship*	SEC	0	0	0	2	2	100	0	100
			TOTAL	**14**	**0**	**8**	**20**	**24**	**380**	**320**	**700**

* - Two weeks internship carries 1 credit and it will be done during Semester VI summer vacation/placement training and same will be evaluated in Semester VII.

SEMESTER VIII

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
EEC COURSES (SE/AE)											
1.	**22AE8901**	Project Work/Granted Patent	SEC	0	0	20	10	20	100	100	200
			TOTAL	**0**	**0**	**20**	**10**	**20**	**100**	**100**	**200**

Note:

1. *As per the AICTE guideline, in Semesters I, II, III & IV NCC one credit subject is added as Value Added Course with Extra Credit. Further, the students who enrolled his/her name in HICET NCC and Air Wing are eligible to undergo this subject. The earned extra credits printed in the Consolidated Mark sheet as per the regulation.

2. NCC course level 1 & Level 2 will be added in the list of open elective subjects in the appropriate semester. Further, the students' who have opted NCC subjects in Semester I, II, III & IV are eligible to undergo NCC Open Elective Subjects.
3. The above-mentioned NCC Courses will be offered to the students who are going to be admitted in the Academic Year 2021 – 22.

OPEN ELECTIVE I AND II (EMERGING TECHNOLOGIES)

To be offered for the students other than CSE, IT, AI&ML, ECE & BIOMEDICAL

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AI6451	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	22CS6451	Block chain Technology	OEC	2	0	2	4	3
3	22EC6451	Cyber security	OEC	2	0	2	4	3
4	22EC6452	IoT Concepts and Applications	OEC	2	0	2	4	3
5	22IT6451	Data Science and Analytics	OEC	2	0	2	4	3
6	22BM6451	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVE I AND II

To be offered for the students other than AUTO, AERO, AGRI, MECH, MCTS, CIVIL, EEE, CHEMICAL, FOOD TECH, E&I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE6401	Introduction to Aeronautical Engineering	OEC	3	0	0	3	3
2	22MT6401	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3	22MT6402	Industrial Safety and Environment	OEC	3	0	0	3	3
4	22CE6401	Climate Change and its Impact	OEC	3	0	0	3	3
5	22CE6402	Environment and Social Impact Assessment	OEC	3	0	0	3	3
6	22ME6401	Renewable Energy System	OEC	3	0	0	3	3
7	22ME6402	Additive Manufacturing systems	OEC	3	0	0	3	3
8	22EI6401	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
9	22EI6402	Graphical Programming using Virtual Instrumentation	OEC	3	0	0	3	3
10	22AU6401	Fundamentals of Automobile Engineering	OEC	3	0	0	3	3
11	22AU6402	Automotive Vehicle Safety	OEC	3	0	0	3	3
12	22EE6401	Digital Marketing	OEC	3	0	0	3	3
13	22EE6402	Research Methodology	OEC	3	0	0	3	3
14	22FT6401	Traditional Foods	OEC	3	0	0	3	3
15	22AG6401	Urban Agriculture and Organic Farming	OEC	3	0	0	3	3
16	22CH6401	Biomass and Bio refinery	OEC	3	0	0	3	3

Note: Non-Circuit Departments can add one Open Elective course in the above list to offer for the circuit branches

OPEN ELECTIVE III

Students shall choose any one of the open elective courses such that the course content or title not belong to their own programme.

(Note: Each programme in our institution is expected to provide one course only)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22AE7401	Introduction to Drones	OEC	3	0	0	3	3

OPEN ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	22LS7401	General studies for competitive examinations	OEC	3	0	0	3	3
2	22LS7402	Human Rights, Women Rights and Gender equity	OEC	3	0	0	3	3
3	22LS7403	Indian ethos and Human values	OEC	3	0	0	3	3
4	22LS7404	Financial independence and management	OEC	3	0	0	3	3
5	22LS7405	Yoga for Human Excellence	OEC	3	0	0	3	3
6	22LS7406	Democracy and Good Governance	OEC	3	0	0	3	3
7	22LS7407	NCC Level - II	OEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Aerospace Structures & Materials	Vertical II Aerodynamics	Vertical III Propulsion	Vertical IV Avionics and Drone Technology	Vertical V Aircraft Maintenance	Vertical VI Advanced Manufacturing Technology
22AE5301 Theory of Elasticity	22AE5304 Wind Tunnel Techniques	22AE5307 Advanced Propulsion System	22AE5310 Control Engineering	22AE5313 Airframe Maintenance and Repair	22AE5316 Manufacturing Technology
22AE5302 Experimental Stress Analysis	22AE5305 Boundary layer Theory	22AE5308 Heat Transfer	22AE5311 Microprocessor and Applications	22AE5314 Civil Aviation Regulations	22AE5317 Additive Manufacturing and Tooling
22AE5303 Composite Materials and Structures	22AE5306 Helicopter Aerodynamics	22AE5309 Combustion in Aerospace Engineering	22AE5312 Drone Electronics	22AE5315 Aircraft Engine Maintenance and Repair	22AE5318 Lean Manufacturing
22AE6301 Structural Mechanics	22AE6303 Experimental Aerodynamics	22AE6305 Rocket and Missiles	22AE6307 Navigation and Communication systems	22AE6309 Air Traffic Control and Airport Planning	22AE6311 Industrial Design & Rapid Prototyping Techniques
22AE6302 Vibration and Aero elasticity	22AE6304 Hypersonic Aerodynamics	22AE6306 Introduction to Cryogenics	22AE6308 Design of UAV Systems	22AE6310 Aviation management and Air Safety Engineering	22AE6312 Non-Destructive Testing

22AE7301 Fatigue and Fracture Mechanics	22AE7302 Industrial Aerodynamics	22AE7303 Satellite Technology	22AE7304 Aerospace Guidance and Control	22AE7305 Engine Systems and Control	22AE7306 Integrated Product Development

Students are permitted to choose all Professional Electives from a particular vertical or from different verticals.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Details of Vertical I: Aerospace Structures & Materials

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5301	Theory of Elasticity	PEC	3	0	0	3	3
2.	22AE5302	Experimental Stress Analysis	PEC	3	0	0	3	3
3.	22AE5303	Composite Materials and Structures	PEC	3	0	0	3	3
4.	22AE6301	Structural Mechanics	PEC	3	0	0	3	3
5.	22AE6302	Vibration and Aero elasticity	PEC	3	0	0	3	3
6.	22AE7301	Fatigue and Fracture Mechanics	PEC	3	0	0	3	3

Details of Vertical II: Aerodynamics

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5304	Wind Tunnel Techniques	PEC	3	0	0	3	3
2.	22AE5305	Boundary layer Theory	PEC	3	0	0	3	3
3.	22AE5306	Helicopter Aerodynamics	PEC	3	0	0	3	3
4.	22AE6303	Experimental Aerodynamics	PEC	3	0	0	3	3
5.	22AE6304	Hypersonic Aerodynamics	PEC	3	0	0	3	3
6.	22AE7302	Industrial Aerodynamics	PEC	3	0	0	3	3

Details of Vertical III: Propulsion

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5307	Advanced Propulsion System	PEC	3	0	0	3	3
2.	22AE5308	Heat Transfer	PEC	3	0	0	3	3
3.	22AE5309	Combustion in Aerospace Engineering	PEC	3	0	0	3	3
4.	22AE6305	Rocket and Missiles	PEC	3	0	0	3	3

5.	22AE6306	Introduction to Cryogenics	PEC	3	0	0	3	3
6.	22AE7303	Satellite Technology	PEC	3	0	0	3	3

Details of Vertical IV: Avionics and Drone Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5310	Control Engineering	PEC	3	0	0	3	3
2.	22AE5311	Microprocessor and Applications	PEC	3	0	0	3	3
3.	22AE5312	Drone Electronics	PEC	3	0	0	3	3
4.	22AE6307	Navigation and Communication systems	PEC	3	0	0	3	3
5.	22AE6308	Design of UAV Systems	PEC	3	0	0	3	3
6.	22AE7304	Aerospace Guidance and Control	PEC	3	0	0	3	3

Details of Vertical V: Aircraft Maintenance

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5313	Airframe Maintenance and Repair	PEC	3	0	0	3	3
2.	22AE5314	Civil Aviation Regulations	PEC	3	0	0	3	3
3.	22AE5315	Aircraft Engine Maintenance and Repair	PEC	3	0	0	3	3
4.	22AE6309	Air Traffic Control and Airport Planning	PEC	3	0	0	3	3
5.	22AE6310	Aviation management and Air Safety Engineering	PEC	3	0	0	3	3
6.	22AE7305	Engine Systems and Control	PEC	3	0	0	3	3

Details of Vertical VI: Advanced Manufacturing Technology

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5316	Manufacturing Technology	PEC	3	0	0	3	3
2.	22AE5317	Additive Manufacturing and Tooling	PEC	3	0	0	3	3
3.	22AE5318	Lean Manufacturing	PEC	3	0	0	3	3
4.	22AE6311	Industrial Design & Rapid Prototyping Techniques	PEC	3	0	0	3	3
5.	22AE6312	Non-Destructive Testing	PEC	3	0	0	3	3
6.	22AE7306	Integrated Product Development	PEC	3	0	0	3	3

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech. Minor Degree.
  Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22AE5231	Sem 5: Fundamentals of Aeronautics	MDC	3	0	0	3	3
2.	22AE6231	Sem 6: Aircraft Systems and Instruments	MDC	3	0	0	3	3
3.	22AE6232	Sem6: Aircraft Materials and Processes	MDC	3	0	0	3	3
4.	22AE7231	Sem 7: Aircraft General Maintenance	MDC	3	0	0	3	3
5.	22AE7232	Sem 7: Introduction to Unmanned Aerial Vehicle Systems	MDC	3	0	0	3	3
6.	22AE8231	Sem 8: Introduction to Space Vehicles	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Green Technology
Introduction to Fintech	Financing New Business Ventures	Environmental Quality Monitoring and Analysis

B.E. (Hons) Aeronautical Engineering

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	22AE5203	Sem 5: Space Flight Mechanics	PC	3	0	0	3	3	40	60	100
2.	22AE5204	Sem 5: Wind Engineering	PC	3	0	0	3	3	40	60	100
3.	22AE6202	Sem 6: Space Propulsion Systems	PC	3	0	0	3	3	40	60	100
4.	22AE6203	Sem 6: Heat Transfer in Aerospace Applications	PC	3	0	0	3	3	40	60	100
5.	22AE6204	Sem 6: Experimental methods in fluid mechanics	PC	3	0	0	3	3	40	60	100
6.	22AE6205	Sem 6: Introduction to turbulence	PC	3	0	0	3	3	40	60	100
7.	22AE7201	Sem 7: Missiles Guidance and Control	PC	3	0	0	3	3	40	60	100
8.	22AE7202	Sem 7: Satellite attitude dynamics and control	PC	3	0	0	3	3	40	60	100
9.	22AE7203	Sem 7: Space Vehicle Aerodynamics	PC	3	0	0	3	3	40	60	100
10.	22AE7204	Sem 7: Computational Heat Transfer and fluid flow	PC	3	0	0	3	3	40	60	100
11.	22AE8201	Sem 8: Electrical Propulsion	PC	3	0	0	3	3	40	60	100
12.	22AE8202	Sem 8: Aviation innovation and biomimicry	PC	3	0	0	3	3	40	60	100

SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES										
S.No.	Course Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	3	3	-	2	-	3	-	-	**11**
2	BSC	7	9	4	3	-	-	-	-	**23**
3	ESC	6	7	2	-	-	-	-	-	**15**
4	PCC	-	-	16	18	11	7	9	-	**61**
5	PEC	-	-	-	-	9	6	3	-	**18**
6	OEC	-	-	-	-	-	6	6	-	**12**
7	EEC	3	3	3	1	1	2	2	10	**25**
8	MCC	✓	✓	✓	✓	-	-	-	-	-
Total		**19**	**22**	**25**	**24**	**21**	**24**	**20**	**10**	**165**

Credit Distribution R2022

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	19	22	25	24	21	24	20	10	165

Chairman BoS

Chairman - BoS
AERO - HiCET

Dean Academics

Dean (Academics)
HiCET

Principal

ACADEMIC COUNCIL * Chairman * HICET

SYLLABUS

V SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5201	Flight Dynamics	3	0	0	3

Course Objective

1. To familiarize students with the cruising flight performance.
2. To describe the performance of flight under different maneuvering conditions.
3. To familiarize with various Aircraft motions and related stability.
4. To analyze the longitudinal, lateral, directional stability modes of an aircraft.
5. To familiarize with the concept of dynamic stability of Aircraft.

Unit	Description	Instructional Hours
I	**CRUISING FLIGHT PERFORMANCE** 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	9
II	**MANOEUVERING FLIGHT PERFORMANCE** 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) - Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.	10
III	**STATIC LONGITUDINAL STABILITY** 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 - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic balancing.	10
IV	**LATERAL AND DIRECTIONAL STABILITY** 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.	8
V	**DYNAMIC STABILITY** 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.	8
	Total Instructional Hours	**45**

Course Outcome

C01: Predict the aerodynamic characteristics of the airplane, the engine performance and how flight altitude affects the airplane performance.
C02: Design aircraft parameters according to the mission requirement.
C03: Perform preliminary design computations to meet static stability and trim requirements
C04: Identify the lateral and longitudinal modes and relate the important physical Influences of aircraft properties on these modes.
C05: Determine the aircraft dynamic stability characteristics.

TEXT BOOKS:

T1: Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, NY, Fourth edition, 2017.
T2: John David Anderson, Jr., 'Aircraft Performance and Design', First Edition, Tata McGraw Hill, 2010.

REFERENCE BOOKS:

R1. Nelson, R.C., 'Flight Stability and Automatics Control', Second Edition, McGraw Hill,1997.
R2. E. L. Houghton, P. W. Carpenter, Steven H Collicott, and Daniel T Valentine, 'Aerodynamic for Engineering Students', Sixth Edition,Butterworth-Heinemann, 2012.

Chairman - BoS
AERO - HiCET

ACADEMIC COUNCIL Chairman

Dean (Academics)
HiCET

R3. L. J. Clancy, 'Aerodynamics', 6th edition, Sterling book house, 2006.
R4. Barnes W. McCormick, 'Aerodynamics. Aeronautics and Flight Mechanics', Second Edition, John Wiley, New York, 1994.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	2	1	1	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	1	-	-	-	-	-	-	-	-	3	2
AVG	3	2	1.4	1.2	-	-	-	-	-	-	-	-	3	2

Chairman - BoS
AERO - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5202	Aerodynamics - II	3	0	0	3

Course Objective

1. To introduce the concept of compressibility.
2. To understand about the formation of normal and oblique shocks.
3. To understand the flow properties behind expansion waves.
4. To introduce the fundamental differential equations for compressible flow.
5. To understand the methodology of measurements in supersonic flow.

Unit	Description	Instructional Hours
I	**REVIEW OF COMPRESSIBLE FLOW** Continuity, Momentum, Energy and state equations, velocity of sound, adiabatic steady state flow equations, Flow through convergent- divergent passage, Performance under various back pressures.	9
II	**NORMAL AND OBLIQUE SHOCKS** Prandtl equation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks, Rankine – Hugonoit relation and corresponding equations, Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak and detached shocks.	12
III	**EXPANSION WAVES** Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion waves, Method of Characteristics -Two-dimensional supersonic nozzle contours.	9
IV	**DIFFERENTIAL EQUATION OF STEADY COMPRESSIBLE FLOW** Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert rule - affine transformation relations for subsonic flows, Linearised two-dimensional supersonic flow theory - Lift, drag, pitching moment and center of pressure of supersonic profiles. Rayleigh flow & Fanno flow, Critical Mach number, swept back effect.	7
V	**HIGH SPEED TUNNELS** Blow down, indraft and induction tunnel layouts and their design features, Transonic, supersonic and hypersonic tunnels and their peculiarities, Helium and gun tunnels, Shock tubes, Optical methods of flow visualization- Interferometer, Schlieren method and Shadowgraph method.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand characteristics of compressible fluid flows.
CO2: Estimate the properties across normal and oblique shocks.
CO3: Identify the flow patterns across expansion waves.
CO4: Compare the effect of compressible and incompressible flow.
CO5: Handle wind tunnels for evaluating high-speed flow behaviors.

TEXT BOOKS:

T1 - Radhakrishnan, Ethirajan., Gas Dynamics, 6th Edition, PHI Learning Pvt. Limited Delhi,2017
T2 - Anderson J. D., Jr., Modern Compressible Flow with Historical Perspective, 3rd edition, McGraw Hill Publishing Co., 2003.

REFERENCE BOOKS:

R1 - Yahya, S. M., Fundamentals of Compressible flow with Aircraft and Rocket Propulsion, 3rd edition, New Age

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International Ltd. Publishers, 2003.
R2 - Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.
R3 - L J Clancy., "Aerodynamics", Sterling book house,2006.
R4 - Zucrow, M.J. and Anderson, J.D.. "Elements of gas dynamics", McGraw-Hill Book Co.,New York, 1989.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	1
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	1
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1
C04	3	3	3	2	-	-	-	-	-	-	-	-	3	1
C05	3	2	2	2	2	-	-	-	-	-	-	2	3	2
AVG	3.0	2.8	2.3	2.0	2.0	-	-	-	-	-	-	2.0	3.0	1.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5251	Aircraft Structures-II	3	0	2	3

Course Objective

1. To Calculate the Bending Stress for Unsymmetrical Bending.
2. To Sketch the Shear Flow Distribution for Open Section shear loads.
3. To Sketch the Shear Flow Distribution for Closed Section due torsional and shear loads.
4. To Predict the Buckling Loads of the Thin Plates.
5. To prepare students for designing structural elements of the wing and fuselage sections with minimum weight.

Unit	Description	Instructional Hours
I	**UNSYMMETRICAL BENDING** Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method, Advantages and Disadvantages of three methods. ***Unsymmetrical Bending of a Cantilever Beam, Constant strength Beam***	10+4
II	**SHEAR FLOW IN OPEN SECTIONS** Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections –shear flow variation in idealized sections. ***Shear Centre of an open Channel Section***	9+2
III	**SHEAR FLOW IN CLOSED SECTIONS** Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to bending – with walls effective and ineffective – shear centre of closed sections. ***Combined bending and Torsion of a Hollow Circular Tube***	9+2
IV	**BUCKLING OF PLATES** Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength estimation – load carrying capacity of sheet stiffener panels – effective width-Integrally stiffened panels-cutouts- Lightly loaded beams. ***Material Fringe Constant of a Photo elastic Models***	10+2
V	**STRESS ANALYSIS OF WING AND FUSELAGE** 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. ***Tension field beam***	10+2
	Total Instructional Hours	**60**

Course Outcome	Upon successful completion of this course, the student will be able to: CO1: Determine the Bending stress for wing and fuselage structural component. CO2: Analyze the shear flow distribution for open section. CO3: Analyze the shear flow distribution for closed section subjected to torsion and shear. CO4: Construct the Aircraft skin with stiffener and their location. CO5: Identify design features of aircraft wing and fuselage structures, and to calculate load factors and margins of safety for various loading conditions.

TEXT BOOKS:

T1 - Megson T M G , "Aircraft Structures for Engineering Students", Elsevier Ltd, 2012

T2 - Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw Hill, 1993.

REFERENCE BOOKS:

R1 - Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997

R2 - Bruhn. E.H., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985.

R3 - Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw – Hill, N.Y., 1999

R4 - Michael Chun-Yung Niu, "Airframe structural Design ",Conmilit Press Ltd,1998.

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List of Equipment (for a batch of 30 students)

S.No.	Name of the Equipment	Quantity
1	Unsymmetrical bending set up	1
2	Constant strength beam	1
3	Channel section Beams with weight hangers and dial gauges	1
4	Set up for combined bending and torsion	1
5	Wagner beam	1
6	Photo elasticity set up	1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
C04	3	3	2	2	-	-	-	-	-	-	-	1	3	2
C05	3	3	3	3	-	-	-	-	-	-	-	1	3	2
AVG	3	2.8	2.5	2.5	-	-	-	-	-	-	-	1	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5001	Aircraft Systems and Maintenance Laboratory	0	0	3	2

Course Objective

1. To introduce the knowledge of the maintenance and repair procedures followed for overhaul of aero engines.
2. To train the students "ON HAND" experience in maintenance of various airframe systems in aircraft and rectification of common snags.
3. To understand safety on maintenance and practice procedures.

Expt. No. **Description of the Experiments**

1. Dismantling and reassembling of an aircraft piston engine.
2. Aircraft wood gluing-single & double scarf joints
3. Fabric & Riveted Patch repairs
4. Tube bending and flaring
5. Welded single & double V-joints.
6. Preparation of glass epoxy of composite laminates and specimens.
7. Control System "Rigging check" procedure
8. Aircraft "Symmetry Check" procedure
9. "Flow test" to assess of filter element clogging
10. "Functional Test" to adjust operating pressure
11. "Pressure Test" procedure on fuel system components
12. "Brake Torque Load Test" on wheel brake units
13. Maintenance and rectification of snags in hydraulic and fuel systems

Total Practical Hours;45

Course Outcome

CO1: Ability to maintain and repair the aero engines.
CO2: Ability to understand to procedure involved in maintenance of various airframe systems.
CO3: Apply the principles of function and ensure safe operation to aircraft as per FAA.

List of Equipment (for a batch of 30 students)

Sl. No	Equipments	Qty.	Experiment No.
1.	Aircraft with Piston engine	1	1,7,8,9,10,13
2.	Set of basic tools for dismantling and assembly	1 set	1
3.	Micrometers, depth gauges, Vernier calipers	2 sets	13
4.	Shear cutter pedestal type	1	3,4
5.	Drilling Machine	1	2,3
6.	Bench Vices	1	2,3,4
7.	Radius Bend bars, Pipe Flaring Tools	1	4
8.	Welding machine	1	5
9.	Glass fibre, epoxy resin	1	6
10.	Strain gauges and strain indicator	1	9,10,12,13
11.	Hydraulic Jacks (Screw Jack)	5	7,8,11,12
12.	Trestle adjustable	5	7,8,11

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13.	Adjustable Spirit Level	2	7,8,11
14.	Levelling Boards	2	11
15.	Cable Tensiometer	1	7
16.	Plumb Bob	1	8

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	-	2	1	-	1	-	-	1	-	-	1	1	2
CO 2	2	-	2	1	-	1	-	-	1	-	-	2	1	2
CO 3	2	-	2	1	-	1	-	-	1	-	-	2	1	2

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE5071	**Soft Skills - IV**	1	0	0	1

Course Objectives:

1. To employ soft skills to enhance employability and ensure workplace and career success.
2. To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	**Introduction to Soft Skills:** Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self management-Critical thinking-Reflective thinking and writing- p2p Interaction	10
II	**Art of Communication:** Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve non verbal Communication - Importance of feelings in communication - dealing with feelings in communication.	10
III	**World of Teams:** Self Enhancement - importance of developing assertive skills- developing self confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	10
	Total Instruction Hours	30

Course Outcome:

CO1: Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.

CO2: Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others

CO3: Students will understand how teamwork can support leadership skills

REFERENCE BOOKS:

R1:	*Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz*
R2:	*Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent – by Bruce Tulgan*
R3:	*Soft Skills Training: A Workbook to Develop Skills for Employment – by Frederick H. Wentz*

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PROFESSIONAL ELECTIVE COURSES

Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5301	Theory of Elasticity	3	0	0	3

Course Objective

1. To analyze some real problem and to formulate the conditions of theory of elasticity application
2. To understand the elastic behavior of different structural components under various loadings and boundary conditions.
3. To analyze the result of solution by standard computational programs
4. To execute a reasonable choice of parameters of the model (geometry, material properties, boundary conditions)
5. To understand the theoretical concepts of material behavior with particular emphasis on their elastic property.

Unit	Description	Instructional Hours
I	**BASIC EQUATIONS OF ELASTICITY** Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants	9
II	**PLANE STRESS AND PLANE STRAIN PROBLEMS** Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.	9
III	**POLAR COORDINATES** Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.	9
IV	**TORSION** Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.	9
V	**INTRODUCTION TO THEORY OF PLATES AND SHELLS** Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: use mathematical knowledge to solve problem related to structural elasticity.
CO2: identify stress-strain relation in 3D, principal stress and principal strain
CO3: analyze a structure using Elasticity concepts
CO4: use analytical techniques to predict deformation, internal force and failure of simple solids and structural components.
CO5: solve aerospace-relevant problems in plane strain and plane stress in Cartesian and polar coordinates

TEXT BOOKS:

T1 - Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Prentice Hall, New Jersey, 2003.
T2 - Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.

REFERENCE BOOKS:

R1 - Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw – Hill Ltd., Tokyo, 1990.
R2 - Barber, J. R., "Elasticity", Kluwer Academic Publishers, 2004.
R3 - Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991.
R4 – Wang, C. T., "Applied Elasticity", McGraw – Hill Co., New York, 1993.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	3	1
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	1
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1
C04	3	3	3	2	-	-	-	-	-	-	-	-	3	1
C05	3	3	3	2	-	-	-	-	-	-	-	-	3	1
AVG	3	3	2.2	1.8	-	-	-	-	-	-	-	-	3	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5302	Experimental Stress Analysis	3	0	0	3

Course Objective

1. To bring awareness on experimental method of finding the response of the structure to different types of load.
2. To analyze experimental data and develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.
3. To gain knowledge about the photo elastic materials and their testing.
4. To analyze the failure pattern in different materials.
5. To know about the various non-destructive testing methods

Unit	Description	Instructional Hours
I	**EXTENSOMETERS AND DISPLACEMENT SENSORS** Principles Of Measurements - Accuracy, Sensitivity and Range Of Measurements – Mechanical – Optical - Acoustical and Electrical Extensometers and Their Uses - Advantages and Disadvantages - Capacitance Gauges.	8
II	**ELECTRICAL RESISTANCE STRAIN GAUGES** Principle Of Operation and Requirements - Types and Their Uses -Materials For Strain Gauges - Calibration and Temperature Compensation - Cross Sensitivity - Wheatstone Bridge and Potentiometer Circuits For Static and Dynamic Strain Measurements - Strain Indicators - Rosette Analysis, stress gauges, load cells, Data acquisition, six component balance.	10
III	**PHOTOELASTICITY** Two Dimensional Photo Elasticity - Photo Elastic Materials - Concept Of Light - Photoelastic Effects - Stress Optic Law - Transmission Photoelasticity - Plane and Circular Polariscopes - Interpretation Of Fringe Pattern - Calibration Of Photoelastic Materials - Compensation and Separation Techniques - Introduction to Three Dimensional Photo Elasticity.	10
IV	**BRITTLE COATING AND MOIRE TECHNIQUES** Relation Between Stresses In Coating And Specimen - Use of Failure Theories In Brittle Coating - Moire Method of Strain Analysis.	8
V	**NON – DESTRUCTIVE TESTING** Fundamentals of NDT - Acoustic Emission Technique – Radiography – Thermography – Ultrasonics - Eddy Current Testing - Fluorescent Penetrant Testing - Magnetic Particle Inspection - Guided Wave Testing - Electromagnetic Testing.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Understand the strain measurement techniques in structures using mechanical and other means.
CO2. Determine strain in structures using electrical strain gauges.
CO3. Acquire knowledge in testing and evaluation of stress in photoelastic materials.
CO4. Calculate of failure stress in coatings using different failure theories.
CO5. Use extensive knowledge in using non-destructive testing for testing purpose.

TEXT BOOKS:

T1 - Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "Experimental Stress Analysis", Tata McGraw-Hill, New Delhi, 1984.
T2 - Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 1996.

REFERENCE BOOKS:

R1 - Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw-Hill Inc., NewYork,IV edition,2005.
R2 - Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall,1993.
R3 - Durelli. A.J., "Applied Stress Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1970.
R4 - Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	-	-	2	3	3
CO2	3	2	2	2	3	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	3	-	-	-	-	-	-	2	3	3
C04	3	2	2	2	3	-	-	-	-	-	-	2	3	3
C05	3	2	2	2	3	-	-	-	-	-	-	2	3	3
AVG	3	2	2	2	3	-	-	-	-	-	-	2	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5303	Composite Materials and Structures	3	0	0	3

Course Objective

1. To understand the micromechanical behavior of composite material.
2. To acquire knowledge in material structure and failure theories of lamina.
3. To understand the mathematical foundations of laminated plates.
4. To give exposure in various methods of fabrication of composite laminates.
5. To impart the knowledge in failure of sandwich construction

Unit	Description	Instructional Hours
I	**MICROMECHANICS** 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.	10
II	**MACROMECHANICS** 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.	10
III	**LAMINATED PLATE THEORY** 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	11
IV	**FABRICATION PROCESS AND REPAIR METHODS** 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.	7
V	**SANDWICH CONSTRUCTIONS** Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels - bending stress and shear flow in composite beams. Multifunctional Composite materials, natural reinforced polymer composites and its characters.	7
	Total Instructional Hours	**45**

Course Outcome

CO1: understand the mechanics of composite materials.
CO2: identify and analyze the failure modes based on failure theories.
CO3: calculate the stresses and strains in a laminate.
CO4: apply knowledge in manufacturing and repair of composites.
CO5: solve the structural problems of sandwich panels.

TEXT BOOKS:

T1 - Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.
T2 - Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004.

REFERENCE BOOKS:

R1 - Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 3rd edition, 2006..
R2 - Robert Jones., "Mechanics of Composite materials" second edition., CRC press, 2015.
R3 - Michael F. Ashley, "Material Selection in Mechanical Design", 5th edition, Butterworth-Heiner, 2016
R4 - Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, 2ndEdition, 2004.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	3	3
CO2	3	3	3	2	1	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	1	-	-	-	-	-	-	1	3	3
C04	3	2	2	2	1	-	-	-	-	-	-	1	3	3
C05	3	3	3	2	1	-	-	-	-	-	-	1	3	3
AVG	3	2.4	2.2	2	1	-	-	-	-	-	-	-	3	3

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5304	Wind Tunnel Techniques	3	0	0	3

Course Objective

1. To study about the basics of subsonic wind tunnels.
2. To understand the operating principle of high speed tunnels.
3. To learn basic ideas about hypersonic tunnels.
4. To learn the basic measurement procedure involving wind tunnel testing
5. To study the various flow visualization methods in wind tunnels.

Unit	Description	Instructional Hours
I	**SUBSONIC WIND TUNNELS** Introduction to wind tunnels – Classifications-Models and its scale effects- Layout of open circuit and closed circuit subsonic wind tunnels – design parameters-energy ratio - HP calculations, Calibration methods.	10
II	**HIGH SPEED WIND TUNNELS** Blow down, in draft and induction tunnel layouts and their design features -Transonic, and supersonic tunnels- peculiar features of these tunnels and operational difficulties - calibration methods.	9
III	**SPECIAL PURPOSE WIND TUNNELS** Types of Special Wind Tunnels – Hypersonic, Gun and Shock Tunnels – Design features and calibration methods- Intake tests – store carriage and separation tests - wind tunnel model design for these tests.	8
IV	**WIND TUNNEL MEASUREMENTS** Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances, calibration of measuring instruments.	9
V	**FLOW VISUALIZATION** Smoke and Tuft grid techniques – Dye injection special techniques – Oil flow visualization and PSP techniques - Optical methods of flow visualization – PIV and Laser Doppler techniques.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: understand the principles and operation of low speed wind tunnels
CO2: understand the operating principle of high speed tunnels.
CO3: explain the procedure involved in operating hypersonic tunnels.
CO4: understand the working principle of component axis balance and internal balances.
CO5: visualize the flow over the component by using various techniques.

TEXT BOOKS:

T1 - Rae, W.H. and Pope, A. "Low Speed Wind Tunnel Testing", John Wiley Publication, 1984.
T2 - NAL-UNI Lecture Series 12:" Experimental Aerodynamics", NAL SP 98 01 April 1998

REFERENCE BOOKS:

R1 - Pope, A., and Goin, L., "High Speed wind Tunnel Testing", John Wiley, 1985.
R2 - Lecture course on "Advanced Flow diagnostic techniques" 17-19 September 2008 NAL, Bangalore.
R3 - Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRC Press – Taylor & Francis, 2007.
R4 - Short term course on Flow visualization techniques, NAL , 2009

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	1	2	2	1	-	-	-	-	-	-	-	-
CO3	3	3	1	2	2	1	-	-	-	-	-	-	-	-
C04	3	3	1	2	2	1	-	-	-	-	-	-	-	-
C05	3	2	1	2	2	1	-	-	-	-	-	-	-	-
AVG	3	2.8	1	2	2	1	-	-	-	-	-	-	-	-

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5305	Boundary Layer Theory	3	0	0	3

Course Objective

1. To gain knowledge about the concepts of basic flow equations.
2. To impart knowledge on the growth of boundary layer.
3. To understand the various boundary layer profile.
4. To gain knowledge on the wake formation.
5. To understand about various boundary layer control techniques.

Unit	Description	Instructional Hours
I	**FUNDAMENTAL EQUATIONS OF VISCOUS FLOW** Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum- Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non-dimensionalising the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow	8
II	**SOLUTIONS OF VISCOUS FLOW EQUATIONS** Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.	10
III	**LAMINAR BOUNDARY LAYER** Laminar boundary layer equations, Flat plate Integral analysis of Karman–Integral analysis of energy equation–Laminar boundary layer equations–boundary layer over a curved body-Flow separation-similarity solutions, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature–Reynold's analogy, Integral equation of Boundary layer –Pohlhausen method–Thermal boundary layer calculations.	10
IV	**TURBULENT BOUNDARY LAYER** Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations—Velocity profiles–The law of the wall –The law of the wake–Turbulent flow in pipes and channels–Turbulent boundary layer on a flat plate–Boundary layers with pressure gradient.	10
V	**BOUNDARYLAYER CONTROL** Boundary layer control in laminar flow-Methods of Boundary layer control: Motion of the solid wall-Acceleration of the boundary layer-Suction- Injection of different gas-Prevention of transition-Cooling of the wall-Boundary layer suction-Injection of a different gas.	7
	Total Instructional Hours	**45**

Course Outcome

CO1. Capable of identifying the flow types.
CO2. Manipulating the growth of boundary layer thickness.
CO3. Capable of evaluating the effect of boundary layer.
CO4. Ability to understand the effect of wake in turbulent flow.
CO5. Acquire knowledge on control of boundary layer growth.

TEXT BOOKS:

T1 - White,F.M., Viscous Fluid Flow, McGraw-Hill &Co.Inc.,New York 2008.
T2 - NASA Technical reports, Numerical Simulation of Boundary Layers, 1986.

REFERENCE BOOKS:

R1 - Schlicting, H.,Boundary Layer Theory, McGraw-Hill,New York,1979.
R2 - Reynolds, A, J., TurbulentFlowsEngineering, JohnWileyandSons,1980.
R3 - Stephen B.Pope,Turbulent flows, Cambridge University Press, 2008.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	2	-	-	-	-	-	-	-	-	3	2
C05	3	3	2	1	-	-	-	-	-	-	-	2	2	2
AVG	3	2.8	2.0	1.6	-	-	-	-	-	-	-	2.0	2.6	2.0

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5306	Helicopter Aerodynamics	3	0	0	3

Course Objective

1. To understand the introductory concepts of types of rotorcraft.
2. To have knowledge on the fundamental aspects of helicopter aerodynamics.
3. To impart the basic knowledge on the performance of helicopters.
4. To inculcate the stability and control aspects of helicopters.
5. To explore the basic aerodynamic design aspects of helicopters.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO ROTOR DYNAMICS** Types of rotorcraft – autogyro, gyrodyne, helicopter, Main rotor system – articulated, semi rigid, rigid rotors, Collective pitch control, cyclic pitch control, anti-torque pedals.	9
II	**AERODYNAMICS** Momentum / actuator disc theory, Blade element theory, combined blade element and momentum theory, vortex theory, rotor in hover, rotor model with cylindrical wake and constant circulation along blade, free wake model, Constant chord and ideal twist rotors, Lateral flapping, Coriolis forces, reaction torque, compressibility effects, Ground effect.	9
III	**PERFORMANCE CHARACTERISTICS** Hover and vertical flight, forward level flight, Climb in forward flight, optimum speeds, Maximum level speed, rotor limits envelope – performance curves with effects of altitude	9
IV	**STABILITY AND CONTROL** Helicopter Trim, Static stability – Incidence disturbance, forward speed disturbance, angular velocity disturbance, yawing disturbance, Dynamic Stability- Hover aerodynamics.	9
V	**DESIGN** Blade section design, Blade tip shapes, Drag estimation – Rear fuselage upsweep, vibration problem of Helicopter blades.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Students are able to understand and compare possible helicopter structures and configurations.
CO2: Students are able to identify features of aerodynamic components of rotary wing aircraft and its performance.
CO3: Students are able to investigate the aerodynamic characteristics that affect rotary wing flight.
CO4: Students are able to analyze the factors that influence helicopter stability.
CO5: Students are able to familiarize the knowledge of helicopter controls and vibration analysis of helicopter blades.

TEXT BOOKS:

T1. Gessow.A and Meyers,GC,"Aerodynamics of the Helicopter", Macmillan and Co., New York,1982.
T2. J. Gordon Leishman, "Principles of Helicopter Aerodynamics", Cambridge University Press, 2016.

REFERENCE BOOKS:

R1 - Lalit Gupta, "Helicopter Engineering", Himalayan Books, New Delhi, 1996.
R2 - Seddon,J,"Basic Helicopter Aerodynamics", AIAA Education series, Blackwell scientific publications, U.K, 1990.

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PO&PSO ⟶	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	2	1
CO2	2	1	1	-	-	-	-	-	-	-	-	1	2	2
CO3	2	1	2	1	-	-	-	-	-	-	-	1	2	1
CO4	2	1	1	-	-	-	-	-	-	-	-	-	2	1
CO5	2	1	2	1	-	-	-	-	-	-	-	1	2	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5307	Advanced Propulsion System	3	0	0	3

Course Objective

1. To understand the basic concepts of nozzles used in aircraft and missiles.
2. To know about the operation of ramjet and scramjet.
3. To recognize the types of propellants used in non-air breathing engines and to familiarize about solid rocket propulsion.
4. To identify the various types of liquid propellants and its characteristics.
5. To understand the concept of advanced propulsion systems.

Unit	Description	Instructional Hours
I	**NOZZLES** Theory of flow in isentropic nozzles – nozzles choking – Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust vectoring and thrust reversal – classification of rocket nozzles – nozzle cooling - preliminary concepts in nozzle less propulsion.	9
II	**RAMJET AND SCRAMJET** Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet engine – Ramjet performance – Simple ramjet design calculations – Introduction to scramjet - salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – various types scramjet combustors – fuel injection schemes in scramjet combustors.	9
III	**FUNDAMENTALS OF CHEMICAL ROCKET PROPULSION** Operating principle – performance considerations of rockets – types of igniters – air augmented rockets – pulse rocket motors – static testing of rockets - Salient features of solid propellant rockets – selection criteria of solid propellants – Tripropellants ; Metalized Propellants - propellant grain design considerations – erosive burning in solid propellant rockets – combustion instability – Strand burner and T-burner – applications and advantages of solid propellant rockets.	10
IV	**LIQUID AND HYBRID ROCKET PROPULSION** Salient features of liquid propellant rockets – selection of liquid propellants – various feed systems and injectors for liquid propellant rockets – combustion instability in liquid propellant rockets - Propellant slosh – introduction to cryogenics - introduction to hybrid rocket propulsion – standard and reverse hybrid systems- combustion mechanism in hybrid propellant rockets – Performance comparison with solid and liquid rocket systems– applications and limitations.	9
V	**ADVANCED PROPULSION TECHNIQUES** 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.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Students are able to understand about the various nozzles and its flow characteristics.
CO2: Students are able to gain knowledge about the high-speed jet engines.
CO3: Students are able to understand the basic concepts in non-air breathing engines and solid propellant rockets.
CO4: Students are able to expand their knowledge on liquid propellants used in rockets.
CO5: Students are able to familiarize about the advanced propulsion systems used in space missions.

TEXT BOOKS:

T1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.
T2. David H. Heiser and David T. Pratt., "Hypersonic Air breathing Propulsion", AIAA Education Series, 1999.

REFERENCE BOOKS:

R1 - Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
R2 - James Award, "Aerospace Propulsion System", Wiley, 2010.
R3 - Martin J. Chiaverini and Kenneth K. Kuo, "Fundamentals of Hybrid Rocket Combustion and Propulsion", Progress in Astronautics and Aeronautics, 2007.
R4- Robert G.Jahn, "Physics of Electric Propulsion", Dover Publications, 2006.

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PO&PSO ⟶	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	2	-	-	-	-	2	3	2
CO4	3	3	2	2	-	-	2	-	-	-	-	2	3	2
CO5	3	-	-	-	-	-	2	-	-	-	-	2	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5308	Heat Transfer	3	0	0	3

Course Objective

1. To understand the heat conduction behavior of various solids.
2. To give mathematical knowledge of convection heat transfer for various ambience.
3. To learn the design of various heat exchanger and analyze their performance.
4. To give analytical knowledge in Radiation heat transfer.
5. To provide the basic knowledge about heat transfer problems in the Aerospace field.

Unit	Description	Instructional Hours
I	**HEAT CONDUCTION** 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.	12
II	**CONVECTIVE HEAT TRANSFER** 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.	9
III	**HEAT EXCHANGERS** Classification – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method.	8
IV	**RADIATIVE HEAT TRANSFER** Basic definitions – concept of black body - laws of black body radiation-radiation between black surfaces – radiation heat exchange between grey surfaces – radiation shielding – shape factor-electrical network analogy in thermal radiation systems - Solar heat Pipe.	8
V	**HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING** High-Speed flow Heat Transfer, Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Ability to understand different modes of heat transfer and solve the heat conduction problems.
CO2: Ability to apply various correlation used in Convective Heat Transfer problems
CO3: Ability to design different types of heat exchangers.
CO4: Ability to understand the concepts of Radiation, shielding and solar heat pipe.
CO5: Ability to describe various heat transfer problems in aerospace engineering.

TEXT BOOKS:

T1 - Yunus A.Cengel.,"Heat Transfer – A practical approach", Second Edition, Tata McGraw-Hill, 2003.
T2 - Sachdeva, S.C., "Fundamentals of Engineering Heat & Mass Transfer", New Age Science Ltd.,, New Delhi, 2009 .

REFERENCE BOOKS:

R1 - Mathur, M. and Sharma, R.P. "Gas Turbine and Jet and Rocket Propulsion", Standard Publishers, New Delhi 2001.
R2 - Holman,J.P., "Heat Transfer", McGraw Hill Book Co.,Inc., New York, Sixth Edition,1991.
R3 - Lienhard,J.H., A Heat Transfer Text Book, 3rd edition, Prentice Hall Inc., 2006.
R4 – S P Sukhatme., " A text book of heat transfer" 4th edition, Universities Press,2005.

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PO&PSO ⟶	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	-	-	-	-	-	-	-	1	1	2
CO2	3	3	2	1	-	-	-	-	-	-	-	1	1	2
CO3	3	3	2	1	-	-	-	-	-	-	-	1	1	2
CO4	3	3	1	1	-	-	-	-	-	-	-	1	1	1
CO5	3	3	1	1	-	-	-	-	-	-	-	1	1	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5309	Combustion in Aerospace Engineering	3	0	0	3

Course Objective

1. To understand the fundamental principle of combustion.
2. To demonstrate the process of ignition and the types of flame holder in the combustion process.
3. To familiarize with the combustion chamber design.
4. To understand the various cooling process and instability in the combustor.
5. To explore advanced and future techniques for combustion.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO COMBUSTION** Overview of combustion in aerospace applications - Thermodynamics and chemical kinetics of combustion - Ignition and flame types - Conservation equations for reacting flows - Premixed and diffusion flames - Flame temperature and equilibrium composition.	9
II	**COMBUSTION CHARACTERISTICS** Combustion Processes in Turbojet Engines - Combustor design and performance considerations - Flame stabilization techniques - Combustor efficiency and emissions control - Afterburners and Reheat - Effects on thrust and fuel consumption - Pulse detonation engines (PDEs) and their combustion characteristics - Continuous detonation engines (CDEs) and their potential in aerospace propulsion.	10
III	**COMBUSTION CHAMBERS** Chamber geometry and sizing considerations - Injector design and types - chamber material selection and cooling techniques - Combustion Processes in Rocket Chambers - Turbulent vs. laminar combustion - Flame stabilization mechanisms - Combustion efficiency and performance metrics.	9
IV	**INSTABILITY AND THERMAL MANAGEMENT** Causes and characteristics of instabilities - Methods for predicting and controlling instabilities - Case studies of past rocket engine instability issues - Regenerative cooling methods - Film cooling and ablative cooling techniques - Thermal analysis and modeling of combustion chamber components.	9
V	**ADVANCED TOPICS AND APPLICATIONS** Microgravity combustion - Combustion technologies for deep space missions - Green Propellants and Alternative Fuels - Combustion in Electric Propulsion - Interaction between combustion and electric propulsion technologies - Future trends in combustion..	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Students are able to analyze thermodynamics of an engine and calculate the performance measures.
CO2: Students are able to apply the knowledge to analyze the suitable combustor for the given conditions.
CO3: Students are able to ability to choose a suitable combustion chamber for various aircraft.
CO4: Students are able to acquire knowledge of instability in the combustor.
CO5: Students are able to familiarize the knowledge of alternative fuels and electrical propulsion.

TEXT BOOKS:

T1. Stephen R. Turns, "Aerospace Propulsion: Thermodynamics, Combustion, and Engines", Wiley, 2012.

REFERENCE BOOKS:

R1 - A.S. Ram and T. John Tharakan, "Fundamentals of Combustion Processes", CRC Press, 2018.
R2 - Arthur H. Lefebvre and Dilip R. Ballal, "Gas Turbine Combustion: Alternative Fuels and Emissions", CRC Press, 2010.
R3 - George P. Sutton and Oscar Biblarz, "Rocket Propulsion Elements", Wiley, 2016.
R4 - Gary L. Borman and Kenneth W. Ragland, "Combustion Engineering", McGraw-Hill Education, 2008.

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PO&PSO ⟶	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2	-	-	-	-	-	-	-	-	2	2	1
CO2	2	1	-	-	-	-	1	-	-	-	-	1	2	1
CO3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	1
CO5	2	1	-	-	-	-	1	-	-	-	-	1	2	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5310	Control Engineering	3	0	0	3

Course Objective

1. To introduce the mathematical modeling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.
2. To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain.
3. To introduce sampled data control system.
4. To explain the concept of stability.
5. To understand about digital controllers.

Unit	Description	Hours
I	**INTRODUCTION TO CONTROL ENGINEERING** Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.	9
II	**OPEN AND CLOSED LOOP SYSTEMS** Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios	9
III	**CHARACTERISTIC EQUATION AND FUNCTIONS** Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.	9
IV	**CONCEPT OF STABILITY** Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response	9
V	**SAMPLED DATA SYSTEMS** Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply mathematical knowledge to model the systems and analyse the frequency domain.
CO2: Check the stability of the both time and frequency domain.
CO3: Solve simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies-based problems.
CO4: Solve the Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph and problems based on it.
CO5: Explain the digital control system, Digital Controllers and Digital PID Controllers.

TEXT BOOKS:

T1 - Azzo, J.J.D. and C.H. Houpis Feedback control system analysis and synthesis, McGraw-Hill international 3rs Edition, 1998.
T2 - OGATO, Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.

REFERENCES:

R1. Houpis, C.H. and Lamont, G.B. "Digital control Systems", McGraw Hill Book co., New York, U.S.A. 1995.
R2. Kuo, B.C. "Automatic control systems", Prentice-Hall of India Pvt. Ltd., New Delhi, 1998. 3. Naresh K Sinha, "Control Systems", New Age International Publishers, New Delhi, 1998

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COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	2	-	-	-	-	-	-	-	-	1	1	-
2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
4	3	2	2	-	-	-	-	-	-	-	-	1	1	-
5	3	2	2	1	1	-	-	-	-	-	-	1	1	-
Avg.	3	2	2	1	1	-	-	-	-	-	-	1	1	-

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5311	Microprocessor and Applications	3	0	0	3

Course Objective

1. To understand the Microprocessor Architecture.
2. To gain proficiency in Interfacing and I/O Devices.
3. To Design and Implementation of Peripheral Devices.
4. To gain programming proficiency in 8085 Assembly Language.
5. To apply theoretical knowledge to practical application development and system integration..

Unit	Description	Hours
I	**INTRODUCTION** Organization of Micro Computers – Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes – instruction and machine cycles with states and timing diagram. Methods of 8085 programs and 8085 assembly language.	10
II	**INTERFACING AND I/O DEVICES** Need for Interfacing - /Memory Interfacing: address space partitioning – address map – Address decoding – Designing decoders circuit for the given address map – Bus connection and Z – line Control – Access Time Computations. I/O Interfacing: Data transfer schemes – programmed Synchronous and asynchronous – Interrupt driven Transfer – Multiple devices and multiple interrupt levels – enabling disabling and masking of interrupts. DMA transfer: Cycle stealing – Burst mode – Multiple DMA devices – DMA transfer in 8085 system – serial data transfer.	9
III	**INTERFACING DEVICES** Programmable peripheral device – programmable interval timer (8253) – Programmable communication interface (USART) – Programmable interrupt controller – Programmable DMA Controller (8257)- Programmable Keyboard/display controllers.	9
IV	**DESIGN USING PERIPHERAL DEVICES** Interfacing A/D and D/A converters – Matrix Keyboard design using 8255 using 8085 programs. Designing real time clock, detecting power failure, detecting presence of objects using 8253 - Design of Keyboard and display interfacing using 8279 – Design of digital transmission with modems and telephone lines using 8251 A.	9
V	**MICROPROCESSOR APPLICATIONS** Temperature monitoring system – Automotive applications – Closed loop process control – Stepper motor control.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the Microprocessor Architecture.
CO2: Proficiency in Interfacing and I/O Devices.
CO3: Ability to Design and Implementation of Peripheral Devices.
CO4: Programming Proficiency in 8085 Assembly Language
CO5: Apply theoretical knowledge to practical application development and system integration.

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TEXT BOOKS:

T1 - Introduction to Microprocessor – Third Edition – Aditya P Mathur Tata McGraw – Hill Publishing Company Ltd., New Delhi 3rd Edition 2003.

T2 - Microprocessor Architecture. Programming and Applications with the 8085 Ramesh Goankar, fifth edition – Penram International Publishing (India) Private Limited..

REFERENCE BOOKS:

R1 - "Microprocessors and Interfacing, Programming and Hardware" Douglas V. Hall.Tata McGraw – Hill Publishing Company Ltd., New Delhi. 1997.

R2 - Advance microprocessor and peripheral –A.K. Ray and K. M. Bhurchandi, Tata Mcgraw Hill, 2017.

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	2	-	-	-	-	-	-	-	-	1	1	-
2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	1	-
4	3	2	2	1	1	-	-	-	-	-	-	1	1	-
5	3	2	2	1	1	-	-	-	-	-	-	1	1	-
Avg.	3	2	2	1	1	-	-	-	-	-	-	1	1	-

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5312	DRONE ELECTRONICS	3	0	0	3

Course Objective

1. To introduce students to the basic concepts of payloads in UAV.
2. To understand the various sensor systems of a UAV.
3. To introduce the concepts of data algorithms and architectures.
4. To introduce the concepts of artificial neural networks.
5. To expose students to the concept of fuzzy logic..

Unit	Description	Hours
I	PAYLOAD FOR UAV Introduction – Types – Non-dispensable Payloads - Electro-optic Payload Systems - Radar Imaging Payloads – LiDAR - Thermal Imaging Payload - Swappable Payloads - Multi-spectral – Dispensable Payloads - Payload Development.	9
II	SENSOR Data fusion applications to multiple sensor systems - Selection of sensors - Benefits of multiple sensor systems - Influence of wavelength on atmospheric attenuation - Fog characterization - Effects of operating frequency on MMW sensor performance - Absorption of MMW energy in rain and fog - Backscatter of MMW energy from rain - Effects of operating wavelength on IR sensor performance - Visibility metrics - Atmospheric and sensor system computer simulation models.	9
III	DATA FUSION ALGORITHMS AND ARCHITECTURES Definition of data fusion - Level 1 processing - Detection, classification, and identification algorithms for data fusion - State estimation and tracking algorithms for data fusion - Level 2, 3, and 4 processing - Data fusion processor functions - Definition of an architecture - Data fusion architectures - Sensor-level fusion - Central-level fusion - Hybrid fusion.	9
IV	ARTIFICIAL NEURAL NETWORKS Applications of artificial neural networks - Adaptive linear combiner - Linear classifiers - Capacity of linear classifiers - Nonlinear classifiers - Madaline - Feedforward network - Capacity of nonlinear classifiers - Supervised and unsupervised learning - Supervised learning rules - Voting Logic Fusion.	9
V	FUZZY LOGIC AND FUZZY NEURAL NETWORKS Conditions under which fuzzy logic provides an appropriate solution - Illustration of fuzzy logic to implement autonomous system in UAVs - Basic elements of a fuzzy system - Fuzzy logic processing - Fuzzy centroid calculation	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to
CO1 Calculate the payloads in UAV.
CO2 Explain the concepts of sensor systems.
CO3 Predict the data fusion algorithms and architectures.
CO4 Learn the basics of neural network systems
CO5 Design various network schemes.

TEXTBOOKS:

1. Reg Austin Aeronautical Consultant, AJohn "Unmanned aircraft systems UAVs design, development, and deployment" Wiley and Sons, Ltd., Publication, 2010
2. David L. Hall, Sonya A. H. McMullen "Mathematical Techniques in Multi-sensor Data Fusion", by Artech, 2004

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3 Martin Liggins II David Hall, James "Handbook of Multisensor Data Fusion: Theory and Practice", Second Edition (Electrical Engineering & Applied Signal Processing Series), 2008.

REFERENCES:

1. Lawrence A. Klein, "Sensor and Data Fusion: A Tool for Information Assessment and DecisionMaking", Second Edition, SPIE Press, 2013.

2. Jitendra R. Raol, "Multi-Sensor Data Fusion with MATLAB", CRC Press, 2010.

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	-	-	-	-	-	-	-	-	-	1	2	-
2	3	1	2	-	-	-	-	-	1	-	-	1	1	2
3	3	1	-	1	-	-	-	-	-	-	-	1	2	2
4	3	1	1	-	1	-	-	-	-	-	-	1	-	2
5	3	1	2	1	1	-	-	-	-	-	-	1	2	-
Avg	3	1	1.6	1	1	-	-	-	1	-	-	1	1.7	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5313	AIRFRAME MAINTENANCE AND REPAIR	3	0	0	3

Course Objective

1. To make the students to understand the Airframe components.
2. Aware of the tools and equipment used to maintain the components.
3. To know the basics to aerodrome maintenance for aircraft and helicopter.
4. To carry out trouble shooting and maintenance for aircraft systems.
5. To understand safety on maintenance and practice procedures.

UNIT I	**MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS** Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding. Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Riveted repair design - Damage investigation - Reverse engineering.	9
UNIT II	**PLASTICS AND COMPOSITES IN AIRCRAFT** Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes. Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves.	9
UNIT III	**AIRCRAFT JACKING, ASSEMBLY AND RIGGING** Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.	9
UNIT IV	**REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM** Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).	9
UNIT V	**SAFETY PRACTICES** Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting. Theory and practices.	9
	Total Instructional Hours	**45**

Students who successfully complete this course will be able to:

CO1: Describe general airframe structural repairs, the structural repair manual and structural control programme.
CO2: Explain the nature of component inspection, corrosion repair and non-destructive inspection.
CO3: Able to the basic operations in Aerodrome for Maintenance and repair of components.
CO4: Evaluate aircraft component disassembly, reassembly and troubleshooting.
CO5: Identify and apply the principles of function and safe operation to aircraft as per FAA.

TEXT BOOK:

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1992.

REFERENCES:

1. Brimm D.J. Bogges H.E., "Aircraft Maintenance", Pitman Publishing corp., New York, 1940.
2. Delp. Bent and Mckinely "Aircraft Maintenance Repair", McGraw Hill, New York, 1987.
3. Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2												2	
CO 2	2		1				1		1				2	
CO 3	3	1					1		1	1	2	1	3	2
CO 4	2	1							1				2	1
CO 5	2												2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5314	CIVIL AVIATION REGULATIONS	3	0	0	3

Course Objective

1. Understand the requirement of airworthiness certification in civil aircraft
2. Can understand how to record the various data for future investigation in civil aircraft.
3. Can know the basic requirements and knowledge for institution certification.
4. To provide basic knowledge of eligibility and requirements for maintenance licensing.
5. Explore the various flight testing and basic requirements for safe flying.

Unit	Description	Hours
I	C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS VIS-À-VIS AIR WORTHINESS RECTORA To introduce the civil aviation regulations followed by directorate general of civil aviation. module I c.a.r series 'a' - procedure for civil air worthiness requirements and responsibility operators vis-à-vis air worthiness directorate.	9
II	C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING Defect recording, reporting, investigation, rectification and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-fight readings & recordings; maintenance control by reliability method. 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 Total Hours and component tbos initial & revisions.	9
III	C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS Approval of organizations in categories A, B, C, D, E, F, & G; requirements of infrastructure at stations other than parent base. C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS: Procedure relating to registration of aircraft; procedure for issue / revalidation of type certificate of aircraft and its engines / propeller; issue / revalidation of certificate of airworthiness; requirements for renewal of certificate of airworthiness.	9
IV	C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINE LICENSING Issue of AME license, its classification and experience requirements, complete Series 'L'. 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.	9
V	C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT Flight testing of (series) aircraft for issue of C of A; fight testing of aircraft for which C or A had been previously issued. 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.	9
	Total Instructional Hours	**45**

Course Outcome

Students will be able to

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

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TEXT BOOK:

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

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	2	1	-	1	-	-	1	-	-	2	1	3	1
CO 2	3	2	1	-	1	-	-	1	-	-	2	1	3	1
CO 3	3	3	1	1	1	-	-	2	-	-	2	2	3	1
CO 4	3	2	1	-	2	-	-	1	-	-	2	2	3	1
CO 5	3	3	1	1	2	-	-	1	-	3	-	2	3	1
Avg.	3	2.4	1	1	1.4	-	--	1.2	--	0.6	2	1.6	3	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5315	AIRCRAFT ENGINE MAINTENANCE AND REPAIR	3	0	0	3

Course Objective

1. To learn the concepts of Piston engines.
2. To make students aware of aircraft propellers and repair.
3. To make students responsive of aircraft jet engines and repair.
4. To acquire knowledge of basics of inspection and testing engine components.
5. To familiarize with the Aircraft engine overhauling procedure and practice.

Unit	Description	Hours
UNIT I	**PISTON ENGINES** Carburation and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Inspection and maintenance and troubleshooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.	9
UNIT II	**PROPELLERS** Propeller theory - operation, construction assembly and installation - Pitch change mechanismPropeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.	9
UNIT III	**JET ENGINES** Bearings and seals – classification and types of lubrication and fuels - Materials used – Details of control, starting around running and operating procedures – Inspection and Maintenance-permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures - Foreign Object Damage - Blade damage.	9
UNIT IV	**TESTING AND INSPECTION** Symptoms of failure - Fault diagnostics - Case studies of different engine systems –Tools and equipments requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection methods and instruments for non-destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation – Online maintenance.	9
UNIT V	**OVERHAULING** Engine Overhaul - Overhaul procedures - Inspections and cleaning of components – Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.	9
	Total Instructional Hours	**45**

Students who successfully complete this course will be able to:

CO1: Apply maintenance procedure to Aircraft piston engines
CO2: Identify the propeller related components and faults
CO3: Apply non-destructive testing procedures to identify the defects
CO4: Apply testing and inspecting procedures to new engines
CO5: Relate the overhauling and troubleshooting of engines

TEXT BOOK:

1. Kroes & Wild, "Aircraft Power plants ", 7th Edition - McGraw Hill, New York, 1994.

REFERENCES:

1. Turbomeca, "Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.

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2. United Technologies' Pratt & Whitney, "The Aircraft Gas Turbine Engine and its Operation", The English Book Store, New Delhi

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2												2	
CO 2	2		1				1		1				2	
CO 3	3	1					1		1	1	2	1	3	2
CO 4	2	1							1				2	1
CO 5	2												2	2

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Programme	Course code	Name of the course	L T P C
B.E.	22AE5316	MANUFACTURING TECHNOLOGY	3 0 0 3

Course Objective

The student should be able to

1. Introduce the concepts of some basic metal casting processes and techniques.
2. Understand the metal joining & forging process
3. Impart knowledge on the working and various functions of turning operations
4. Know about shaping, milling and gear cutting machines.
5. Learn the basic concepts in CNC machines.

Unit	Description	Instructional Hours
I	METAL CASTING PROCESSES	9

Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces: Blast and Cupola Furnaces; special casting processes : Shell - investment – Pressure die casting - Centrifugal Casting – CO_2 process – Stir casting; Defects in casting

II	JOINING & BULK DEFORMATION PROCESSES	9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics, Arc welding-Metal Inert gas welding (MIG)-Tungsten Inert gas welding(TIG)- Submerged arc welding-Electro slag welding-Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: Forging processes ,forging operations, Rolling of metals, Extrusion.

III	CENTRE & SPECIAL PURPOSE LATHE	9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.

IV	SPECIAL MACHINES	9

Shaper - Types of operations. Planer,Slotter,Milling operations-Types of milling cutter. Drilling machine - constructional features, specification, operations ,Reaming,Broaching,Hobbing.

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V CNC MACHINING 9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining center, part programming fundamentals CNC – manual part programming – computer assisted part programming .

Total Instructional Hours 45

Course Outcome

Upon completion of the course, the students will be able to:

CO1: Understand the different casting processes and use them in industry for component production.
CO2: Remember the functions and applications of different joining processes.
CO3: Fabricate engineering components using various lathes and special attachments.
CO4: Conduct experiments on conventional machining processes in Special Machines
CO5: Demonstrate the understanding of surface finishing process in the CNC machine tools.

TEXT BOOK:

T1 - HajraChoudhury, "Elements of Workshop Technology", Vol.II., Media Promoters, 2015.
T2 - Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2013.
T3 - Gary F. Benedict 'Nontraditional Manufacturing Processes' , Taylorfrancis, Boca Raton 2019

REFERENCES:

R1 - HMT, "Production Technology", Tata McGraw Hill, 2015.
R2 - GeofreyBoothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 2014.
R3 - Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education, 2016.

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

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Programme	Course code	Name of the course	L T P C
B.E.	22AE5317	LEAN MANUFACTURING	3 0 0 3

Course Objective

The student should be able

1. To introduce the basics of 6 SIGMA
2. To learn about the lean manufacturing
3. To study about the Lean manufacturing tools
4. To study the lean concepts and its elements.
5. To learn implementation and challenges of lean manufacturing.

Unit	Description	Instructional Hours
I	BASICS OF 6 SIGMA	9

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality

II	INTRODUCTION TO LEAN MANUFACTURING	9

Introduction Lean Manufacturing: Introduction, Definitions of Lean manufacturing, explaining basic concepts. Overview of historical development. Management theory. Process Capability , Introduction to FMEA, 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements.

III	LEAN MANUFACTURING TOOLS & METHODOLOGIES	9

Tools of Lean manufacturing: 5-S, Workplace organization, Total Productive Maintenance, Process mapping/ Value stream mapping, Poka yoke, Kanban, Cause and Effect diagram, Control Charts, Automation, Single minute exchange of die (SMED), Design for manufacturing and assembly, Just in time (JIT) , Deming cycle, PDCA, Introduction to Toyota Production System, Production System integration.

IV	ELEMENTS IN LEAN MANUFACTURING	9

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, and Cost. Building Zero defect capabilities, Cultural and Organizational aspects.

V	IMPLEMENTATION AND CHALLENGES	9

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Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

Total Instructional Hours 45

Course Outcome

Upon completion of the course, the students will be able to:

CO1: Discuss the basics of 6 SIGMA

CO2: Elaborate the lean manufacturing.

CO3: Illustrate about tools of Lean manufacturing.

CO4: Discuss lean concepts and its elements.

CO5: Describe the implementation and challenges of lean manufacturing.

TEXT BOOK:

T1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill

T2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia

T3. The Toyota Way: 14 Management Principles

T4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai

REFERENCES:

R1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/

R2. International Society of Six Sigma Professionals: https://isssp.org/about-us/

R3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).

R4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.

R5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones.

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5318	Additive Manufacturing and Tooling	3	0	0	3

COURSE OBJECTIVES

1. To Classify the concepts and terminologies of additive manufacturing
2. To Apply the reverse engineering concepts for design development
3. To Identify the variety of additive manufacturing techniques based on end product applications
4. To Design and develop newer tooling models
5. To Familiarize with cutting edge technologies in rapid tooling and manufacturing

UNIT I INTRODUCTION 9

Need - Development of AM systems – AM process chain - Impact of AM on Product Development -Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits Applications.

UNIT II REVERSE ENGINEERING & CAD MODELING 9

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation- Software for AM- Case studies.

UNIT III ADDITIVE MANUFACTURING SYSTEMS 9

Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV SINTERING BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications; Selective Laser Melting, Binder Jetting – Case Studies

UNIT V TOOLING 9

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications of Additive Manufacturing, Design for Additive Manufacturing (DfAM), Four dimensional printing, Development of lattice and light weight structures for aerospace applications, Case studies.

TOTAL: 45 Hours

COURSE OUTCOME

CO1: Ability to understand the concepts and terminologies of additive manufacturing
CO2: Ability to Apply the reverse engineering concepts for design development
CO3: Ability to Identify the variety of additive manufacturing techniques based on end product applications
CO4: Ability to Design and develop newer tooling models
CO5: Ability to Familiarize with cutting edge technologies in rapid tooling and manufacturing

Text Books

T1 - Ian Gibson, David Rosen, and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer, New York, NY, 2015.
T2 - Frank W. Liou, Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, CRC Press, Taylor and Francis Group, 2007.
T3 - Duc Pham, S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", Springer-Verlag London, 2001.

Reference Books

R1 - "Rapid prototyping: Principles and applications", Chua, C.K., Leong K.F. and Lim C.S.,second edition, World Scientific Publishers, 2010.
R2 - Rapid Tooling: Technologies and Industrial Applications, Hilton, P.D. and Jacobs, P.F., CRCpress, 2005.

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PO&PSO →	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	1	2
CO2	3	-	1	-	-	-	-	-	-	-	-	1	1	2
CO3	3	1	1	-	-	-	-	-	-	-	-	1	1	2
CO4	3	1	1	-	-	-	-	-	-	-	-	1	1	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1	1	1

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SYLLABUS

Honors

SEMESTER V

Programme	Course Code	Name of the Course	L	T	P	C
B.E	22AE5203	Space Flight Mechanics	3	0	0	3

Course objectives:

CO1: Understand the basic concepts of space mechanics and its laws

CO2: To understand orbital elements and solve N- body and Two body problems in orbital mechanics

CO3: Study of satellite injection and satellite orbit perturbations.

CO4: Study various applications of orbital mechanics such as planetary motions and interplanetary trajectories.

CO5: Acquire the knowledge of ballistic missile trajectories and spacecraft materials

UNIT- 1 BASIC CONCEPTS **8**

Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time. The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws –Newton's universal law of gravitation - the many body problem -The Celestial Sphere.

UNIT -2 THE GENERAL N-BODY PROBLEM **8**

The Ecliptic Motion of Vernal Equinox – Sidereal Time – Solar Time –Standard Time – The Earth's Atmosphere. Study the basic concepts of orbital Mechanics with particular emphasis on interplanetary trajectories. The many bodies Problem – Lagrange, Jacobian identity The Circular Restricted Three Body Problem – Libration Points – Relative Motion in the N-body Problem – Two – Body Problem – Satellite Orbits – Relations Between Position and Time – Orbital Elements.

UNIT 3 SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS 8

General Aspects of satellite Injections, Satellite Orbit Transfer, Various Cases – Orbit Deviations Due to Injection – Errors – Special and General Perturbations – Cowell's Method – Encke's Method - Method of vibrations of Orbital Elements- General Perturbations Approach.

UNIT 4 INTERPLANETARY TRAJECTORIES **8**

Two Dimensional Interplanetary Trajectories – Fast Interplanetary Trajectories – Three Dimensional Interplanetary Trajectories – 3-Dimensional Interplanetary Trajectories – Launch if Interplanetary Spacecraft – Trajectory estimation about the Target Planet. Concept of the sphere of influence. Lamberts theorem.

UNIT 5 BALLISTIC MISSILE TRAJECTORIES AND MATERIALS **8**

The Boost Phase – The Ballistic Phase – Trajectory Geometry – Optimal Flights – Time of Flight – Re-entry Phase – The Position of the Impact Point – Influence Coefficients. Space Environment - Peculiarities - Effect of Space Environment, the Selection of Spacecraft Material

Course outcomes:

CO1: Understand classical orbital elements, physical principles of orbital motion and various coordinate systems used

CO2: Orbit element determination from position and velocity vectors for N-body and Two Body

CO3: Understand about satellite injection and satellite orbit perturbations.

CO4: To calculate orbital parameters and perform conceptual trajectory designs for interplanetary missions.

CO5: Understand about ballistic missile trajectories and materials.

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Text Books:

1. Cornelisse, J.W. "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 1984.
2. Thomson, Introduction to Space Dynamics, Dover Publications, Revised edition,2012.
3. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 9th edition, 2016.

Reference Books:

1. Van de Kamp, P., "Elements of Astro-mechanics", Pitman, 1979.
2. Parker E.R., "Material for Missiles and Spacecraft", McGraw – Hill Book Co., Inc., 1982.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C05	3	3	2	1	-	-	-	-	-	-	-	-	3	2
AVG	3	3	2	1	-	-	-	-	-	-	-	-	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22AE5204	Wind Engineering	2	1	0	3

Course Objective

1. To understand the Fundamentals of Atmosphere
2. To understand the fundamental principles and concepts of wind energy
3. To evaluate Wind Resources
4. To understand the basic principles of wind turbines
5. To provide knowledge about wind generators and its equipment.

Unit	Description	Instructional Hours
I	**The Atmosphere** – Atmospheric Boundary Layer-Atmospheric stability and turbulence-Wind profiles and wind velocity measurements-Boundary layer flows and boundary layer theory.	9
II	**Wind Energy Fundamentals** -Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Wind Farms and maintenance of wind turbines, Power Content, Turbulence.	9
III	**Wind Measurements**-Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Turbulence Analysis-Biological indicators, Rotational anemometers, other anemometers, Wind direction	9
IV	**Wind Turbine Power, Energy and Torque**- Class of wind turbines, Power output from an ideal turbine, Aerodynamics, Power output from practical turbines, Betz's Limit, Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.	9
V	**Wind Turbines with Asynchronous Electric Generators** Piston water pumps, Centrifugal pumps, Paddle wheel heaters, Batteries, Hydrogen economy, and Electrolysis cells.	9
	Total Instructional Hours	**45**

Course Outcome

CO1- Attain knowledge about the atmosphere properties
CO2- Develop more understanding on the basics of wind energy.
CO3- Introduced to gain information of the wind measurements.
CO4- acquired various methods to determine parameters on wind energy.
CO5- Improve the knowledge about the various equipment of wind turbines

TEXT BOOKS:

T1- S. Ahmad, Wind Energy: Theory and Practice, Prentice Hall of India Pvt. Ltd., 2011.
T2- J F Walker, and N Jenkins, Wind Energy Technology, John Wiley and Sons, 1997.

REFERENCE BOOKS:

R1- D M Eggleston, and F S Stoddard, Wind Turbine Engg. Design, Von Nostrand, New York, 1987.
R2- L L Freris, (Ed.), Wind Energy Conversion Systems, Prentice Hall, London, 2007.
R3- D M Simmons, Wind Power, Noyes Data Corp. New Jersey, 1975.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	-	-
CO 2	3	3	1	2	2	1	-	-	-	-	-	-	-	-
CO 3	3	3	1	2	2	1	-	-	-	-	-	-	-	-
C04	3	3	1	2	2	1	-	-	-	-	-	-	-	-
C05	3	2	1	2	2	1	-	-	-	-	-	-	-	-
AV G	3	2.8	1	2	2	1	-	-	-	-	-	-	-	-

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SYLLABUS

Minor

SEMESTER V

Programme	Course Code	Name of the Course	L	T	P	C
BE	22AE5231	Fundamentals of Aeronautics	3	0	0	3

Course Objective

1. To introduce the history, concept of flying, aircraft components and materials.
2. To study about the various configurations, systems and instruments used in aircraft.
3. To understand the structure of atmosphere and concept of flight mechanics.
4. To impart the knowledge about various propulsion systems used in aircraft and rocket.
5. To comprehend the various structures and materials used in aircraft.

Unit	Description	Instructional Hours
I	**HISTORY OF FLIGHT** Early Airplanes by Wright Brothers - Balloon flight- Ornithopers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years. Introduction to rotorcraft - UAV and MAVs-Overview of Aviation Industries.	7
II	**AIRCRAFT CONFIGURATIONS AND ITS CONTROLS** Different types of flight vehicles, Classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for Flying-Typical systems for control actuation.	9
III	**BASICS OF AERODYNAMICS** Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.	10
IV	**BASICS OF PROPULSION** Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production-Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.	9
V	**BASICS OF AIRCRAFT STRUCTURES** Stresses and Strains-Hooke's law- stress-strain diagrams - elastic Constants-Factor of Safety. General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminum alloy, titanium, stainless steel and composite materials.	10
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the functions of aircraft components.
CO2: Able to identify the types of flight vehicles and control systems.
CO3: Understand the basic concepts of flight mechanics.
CO4: Understand the working principle of various aircraft propulsion system.
CO5: Acquire the knowledge about various materials used for aircraft construction.

TEXT BOOKS:

T1 - Anderson J.D., Introduction to Flight, McGraw-Hill 8th edition, 2015.
T2 - Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCE BOOKS:

R1 - Kermode A.C, "Flight without formulae", Pearson Education,, Fifth edition,2011.
R2 - Kermode A.C," Mechanics of Flight", Pearson Education, 12 th edition,2012.
R3 - Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
R4 - Handbooks of Airframe and Power Plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, the English Book Store, New Delhi, 1995.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
C04	3	-	-	-	-	-	-	-	-	-	-	-	2	-
C05	3	-	-	-	-	-	-	-	-	-	-	-	2	-
AVG	2.6	-	-	-	-	-	-	-	-	-	-	-	1.8	-

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Department of Aeronautical Engineering

R-2022
NEW COURSES INTRODUCED

S. No	Course code	Name of the Course
1.	22AE5201	Flight Dynamics
2.	22AE5202	Aerodynamics - II
3.	22AE5251	Aircraft structures - II
4.	22AE5001	Aircraft Systems and Maintenance Laboratory
5.	22HE5071	Soft Skills -4/Foreign languages
6.	22AE5301	Theory of Elasticity
7.	22AE5302	Experimental Stress Analysis
8.	22AE5303	Composite Materials and Structures
9	22AE5304	Wind Tunnel Techniques
10.	22AE5305	Boundary layer Theory
11.	22AE5306	Helicopter Aerodynamics
12.	22AE5307	Advanced Propulsion System
13.	22AE5308	Heat Transfer
14.	22AE5309	Combustion in Aerospace Engineering
15.	22AE5310	Control Engineering
16.	22AE5311	Microprocessor and Applications
17.	22AE5312	Drone Electronics
18.	22AE5313	Airframe Maintenance and Repair
19.	22AE5314	Civil Aviation Regulations
20.	22AE5315	Aircraft Engine
21.	22AE5316	Manufacturing Technology
22.	22AE5317	Additive Manufacturing and Tooling
23.	22AE5318	Lean Manufacturing
24.	22AE5231	Fundamentals of Aeronautics
25.	22AE5203	Space Flight Mechanics
26.	22AE5204	Wind Engineering

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CURRICULUM
R2019

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. AERONAUTICAL ENGINEERING (UG)

REGULATION-2019

For the students admitted during the academic year 2021-2022 and onwards

The course code 21 indicates that the students joined in the academic year 2021

SEMESTER I

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2.	21MA1102	Calculus and Linear Algebra	BS	3	1	0	4	40	60	100
THEORY & LAB COMPONENT										
3.	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4.	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5.	21CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6.	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7.	21HE1071	Language Competency Enhancement Course-I	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
8.	21HE1072	**Career Guidance Level** – I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
9.	21HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
			Total:	**15**	**2**	**12**	**20**	**580**	**320**	**900**
As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course										

SEMESTER II

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2.	21MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	40	60	100
3.	21EE2103	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	40	60	100
4.	21ME2101	Engineering Mechanics	ES	3	0	0	3	40	60	100
THEORY & LAB COMPONENT										
4.	21PH2151	Material Science	BS	2	0	2	3	50	50	100
5.	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICALS										

7.	21ME2001	Engineering Practices Lab	ES	0	0	4	2	60	40	100
8.	21HE2071	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
9.	21HE2072	**Career Guidance Level – II** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
			Total:	**17**	**2**	**10**	**22**	**520**	**380**	**900**

SEMESTER III

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21MA3103	Fourier Analysis and Numerical Methods	BS	3	1	0	4	40	60	100
2.	21AE3201	Elements of Aeronautics	PC	3	1	0	4	40	60	100
3.	21AE3202	Engineering Fluid Mechanics	PC	3	0	0	3	40	60	100
4.	21AE3203	Solid Mechanics	PC	3	0	0	3	40	60	100
THEORY AND LAB COMPONENT										
5.	21AE3251	Aero Engineering Thermodynamics	PC	2	0	2	3	50	50	100
PRACTICALS										
6.	21AE3001	Aircraft Component Drawing Laboratory	PC	0	0	3	1.5	50	50	100
7.	21AE3002	Fluid mechanics and Solid mechanics Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8.	21MC3191	Indian Constitution	MC	2	0	0	0	100	0	100
9.	21HE3072	**Career Guidance Level – III** Personality, Aptitude and CareerDevelopment	EEC	2	0	0	0	100	0	100
10.	21HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
			Total	**19**	**2**	**8**	**20**	**610**	**390**	**1000**

SEMESTER IV

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	21MA4101	Numerical Methods	BS	3	1	0	4	40	60	100
2.	21AE4201	Aerodynamics	PC	3	1	0	4	40	60	100
3.	21AE4202	Gas Turbine Propulsion	PC	3	0	0	3	40	60	100
4.	21AE4203	Mechanics of Machines	PC	3	0	0	3	40	60	100
THEORY AND LAB COMPONENT										

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5.	21AE4251	Aircraft Structures - I	PC	3	0	2	4	50	50	100
PRACTICALS										
6.	21AE4001	Aerodynamics Laboratory	PC	0	0	3	1.5	50	50	100
7.	21AE4002	Propulsion Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8.	21MC4191	Essence of Indian tradition knowledge/Value Education	MC	2	0	0	0	100	0	100
9.	21HE4072	**Career Guidance Level – IV** Personality, Aptitude andCareer Development	EEC	2	0	0	0	100	0	100
10.	21HE4073	Ideation Skills	EEC	2	0	0	0	100	0	100
			Total	**21**	**2**	**8**	**21**	**610**	**390**	**1000**

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
1.	21AE5201	Advanced Propulsion	PC	3	0	0	3	40	60	100
2.	21AE5202	Aircraft Structures - II	PC	3	0	0	3	40	60	100
3.	21AE5203	Flight Dynamics	PC	3	1	0	4	40	60	100
4.	21AE5204	High Speed Aerodynamics	PC	3	0	0	3	40	60	100
5.	21AE53XX	Professional Elective -I	PE	3	0	0	3	40	60	100
THEORY AND LAB COMPONENT										
6.	21AE5251	Aircraft Systems and General Maintenance Practices	PC	2	0	2	3	50	50	100
PRACTICALS										
7.	21AE5001	UAV design and Aeromodelling Laboratory	PC	0	0	3	1.5	50	50	100
8.	21AE5002	Aircraft Structures Laboratory -II	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9.	21HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10.	21HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
			TOTAL	**19**	**1**	**8**	**24**	**550**	**450**	**1000**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
THEORY										
1.	21AE6201	Finite Element Methods in Engineering	PC	3	0	0	3	40	60	100
2.	21AE6202	Composite Materials and Structures	PC	3	0	0	3	40	60	100
3.	21AE6203	Heat Transfer	PC	3	0	0	3	40	60	100
4.	21AE6181	Total Quality Management	HS	3	0	0	3	40	60	100
5.	21AE63XX	Professional Elective - II	PE	3	0	0	3	40	60	100
6.	21XX64XX	Open Elective– I	OE	3	0	0	3	40	60	100
PRACTICALS										

7.	21AE6001	Structural Simulation Laboratory	PC	0	0	3	1.5	50	50	100
8.	21AE6002	Aero Engine and Airframe Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9.	21AE6701	Internship / Industrial Training	EEC	0	0	0	1	100	0	100
10.	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
11.	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
			TOTAL	**20**	**0**	**6**	**24**	**640**	**460**	**1100**

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	21EI5331	Control Engineering	PE	3	0	0	3	40	60	100
2	21AE5301	Aircraft Materials and Process	PE	3	0	0	3	40	60	100
3	21AE5302	Wind tunnel techniques	PE	3	0	0	3	40	60	100
4	21AE5303	UAV and MAV design	PE	3	0	0	3	40	60	100
5	21AE5304	Non-Destructive Evaluation	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE II										
1	21AE6301	Theory of Elasticity	PE	3	0	0	3	40	60	100
2	21AE6302	Introduction to cryogenics	PE	3	0	0	3	40	60	100
3	21AE6303	Boundary Layer Theory	PE	3	0	0	3	40	60	100
4	21AE6304	AI & IoT for aviation	PE	3	0	0	3	40	60	100
5	21AE6305	Airframe Maintenance and Repair	PE	3	0	0	3	40	60	100

OPEN ELECTIVE

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	21AE6401	Introduction to Flight	OE	3	0	0	3	40	60	100

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
THEORY										
1.	21AE7201	Computational Fluid Dynamics	PC	3	0	0	3	40	60	100
2.	21AE7202	Vibrations and Elements of Aero Elasticity	PC	3	0	0	3	40	60	100
3.	21AE73XX	Professional Elective-III	PE	3	0	0	3	40	60	100
4.	21XX74XX	Open Elective – II	OE	3	0	0	3	40	60	100
THEORY AND LAB COMPONENT										
5.	21AE7251	Avionics	PC	2	0	2	3	50	50	100
PRACTICALS										
6.	21AE7001	Aircraft Design Project	PC	0	0	3	1.5	50	50	100

7.	**21AE7002**	Flow Simulation Laboratory	PC	0	0	3	1.5	50	50	100
PROJECT WORK										
8.	**21AE7901**	Project Phase I	EEC	0	0	4	2	50	50	100
			TOTAL	**14**	**0**	**12**	**20**	**360**	**440**	**800**

SEMESTER VIII

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	**21AE83XX**	Professional Elective –IV	PE	3	0	0	3	40	60	100
2.	**21AE83XX**	Professional Elective- V	PE	3	0	0	3	40	60	100
PRACTICAL										
3.	**21AE8901**	Project Work – Phase II	EEC	0	0	16	8	100	100	200
			TOTAL	**6**	**0**	**16**	**14**	**180**	**220**	**400**

PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	**21AE7301**	Smart Materials and Structures	PE	3	0	0	3	40	60	100
2.	**21AE7302**	Satellite Technology	PE	3	0	0	3	40	60	100
3.	**21AE7303**	Fatigue and Fracture Mechanics	PE	3	0	0	3	40	60	100
4.	**21AE7304**	Aero Engine Maintenance and Repair	PE	3	0	0	3	40	60	100
5.	**21AE7305**	Space Mechanics	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE IV										
1.	**21AE8301**	Experimental Stress analysis	PE	3	0	0	3	40	60	100
2.	**21AE8302**	Aviation management and Air safety Engineering	PE	3	0	0	3	40	60	100
3.	**21AE8303**	Helicopter Theory	PE	3	0	0	3	40	60	100
4.	**21AE8304**	Hypersonic Aerodynamics	PE	3	0	0	3	40	60	100
5.	**21AE8305**	Additive Manufacturing and Tooling	PE	3	0	0	3	40	60	100
6.	**21AE8311**	Aircraft Design	PE	3	0	0	3	40	60	100
PROFESSIONAL ELECTIVE V										
S.No.	**Course Code**	**Course Title**	**Type**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1.	**21AE8306**	Rockets and Missiles	PE	3	0	0	3	40	60	100
2.	**21AE8307**	Aircraft Rules and Regulations	PE	3	0	0	3	40	60	100
3.	**21AE8308**	Product Design and Development	PE	3	0	0	3	40	60	100
4.	**21AE8309**	Air traffic control and Airport planning	PE	3	0	0	3	40	60	100
5.	**21AE8310**	Industrial Aerodynamics	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVES – AERONAUTICAL ENGINEERING

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	21AE7401	Introduction to Drones	OE	3	0	0	3	40	60	100
	LIFE SKILL COURSES									
1.	21LSZ401	General Studies for Competitive Examinations	OE	3	0	0	3	40	60	100
2.	21LSZ402	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	40	60	100
3.	21LSZ403	Indian Ethos and Human Values	OE	3	0	0	3	40	60	100
4.	21LSZ404	Indian Constitution and Political System	OE	3	0	0	3	40	60	100
5.	21LSZ405	Yoga for Human Excellence	OE	3	0	0	3	40	60	100
NCC COURSES (Only for the students' who have opted NCC subjects in Semester I, II, III & IV are eligible)										
6.	21HEZ401	NCC course level 1	OE	3	0	0	3	40	60	100
7.	21HEZ402	NCC course level 2	OE	3	0	0	3	40	60	100

ADDITIONAL CREDIT COURSE FOR AERONAUTICAL ENGINEERING						
S.No	Course Code	Course Title	Category	Duration	Assessment	Credit
1.	21VAAE01	Design and drafting using solid works	VA	30 hrs	Internal	1
2.	21VAAE02	Catia with industrial approach	VA	30 hrs	Internal	1
3.	21VAAE03	LabVIEW	VA	30 hrs	Internal	1
4.	21VAAE04	Mesh tools for industrial approach	VA	30 hrs	Internal	1
5.	21VAAE05	Embedded systems design	VA	30 hrs	Internal	1

Enrollment for B.E. / B. TECH. (HONOURS) / Minor Degree (optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

Clause 4.10 of Regulation 2022 is applicable for the Enrolment of B.E. / B. TECH. (HONOURS) / Minor Degree (Optional).

VERTICALS FOR MINOR DEGREE

- Heads are requested to provide one vertical from their program to offer for other program students to register for additional courses (18 Credits) to become eligible for the B.E./B.Tech.

Minor Degree.
Note: Each programme should provide verticals for minor degree

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	21AE5231	Sem 5: Fundamentals of Aeronautics	MDC	3	0	0	3	3
2.	21AE6231	Sem 6: Aircraft Systems and Instruments	MDC	3	0	0	3	3
3.	21AE6232	Sem6: Aircraft Materials and Processes	MDC	3	0	0	3	3
4.	21AE7231	Sem 7: Aircraft General Maintenance	MDC	3	0	0	3	3
5.	21AE7232	Sem 7: Introduction to Unmanned Aerial Vehicle Systems	MDC	3	0	0	3	3
6.	21AE8231	Sem 8: Introduction to Space Vehicles	MDC	3	0	0	3	3

*MDC – Minor Degree Course

In addition to the above the following additional courses for Minor Degree can also be given to the student's common to all the branches.

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Environment and Sustainability
Financial Management	Foundations of Entrepreneurship	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Green Technology
Introduction to Fintech	Financing New Business Ventures	Environmental Quality Monitoring and Analysis

B.E. (Hons) Aeronautical Engineering

S.No.	Course Code	Course Title	Category	Periods per Week				TCP	CIA	ESE	Total
				L	T	P	C				
1.	21AE5205	Sem 5: Space Flight Mechanics	PC	3	0	0	3	3	40	60	100
2.	21AE5206	Sem 5: Wind Engineering	PC	3	0	0	3	3	40	60	100
3.	21AE6204	Sem 6: Space Propulsion Systems	PC	3	0	0	3	3	40	60	100
4.	21AE6205	Sem 6: Heat Transfer in Aerospace Applications	PC	3	0	0	3	3	40	60	100
5.	21AE6206	Sem 6: Experimental methods in fluid	PC	3	0	0	3	3	40	60	100

		mechanics									
6.	**21AE6207**	Sem 6: Introduction to turbulence	PC	3	0	0	3	3	40	60	100
7.	**21AE7203**	Sem 7: Missiles Guidance and Control	PC	3	0	0	3	3	40	60	100
8.	**21AE7204**	Sem 7: Satellite attitude dynamics and control	PC	3	0	0	3	3	40	60	100
9.	**21AE7205**	Sem 7: Space Vehicle Aerodynamics	PC	3	0	0	3	3	40	60	100
10.	**21AE7206**	Sem 7: Computational Heat Transfer and fluid flow	PC	3	0	0	3	3	40	60	100
11.	**21AE8201**	Sem 8: Electrical Propulsion	PC	3	0	0	3	3	40	60	100
12.	**21AE8202**	Sem 8: Aviation innovation and biomimicry	PC	3	0	0	3	3	40	60	100

SEMESTER-WISE CREDIT DISTRIBUTION

B.E. / B.TECH. PROGRAMMES									
S.No.	**Course Area**	**Credits per Semester**							**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
1	HS	04	04	-	-	-	03	-	-	11
2	BS	10	10	04	04	-	-	-	-	28
3	ES	06	08	-	-	-	-	-	-	14
4	PC	-	-	16	17	19	12	12	-	76
5	PE	-	-	-	-	03	03	03	06	15
6	OE	-	-	-	-	-	03	03	-	06
7	EEC	-	-	-	-	02	03	02	08	15
Total		**20**	**22**	**20**	**21**	**24**	**24**	**20**	**14**	**165**

Credit Distribution R2019

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Credits	20	22	20	21	24	24	20	14	**165**

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SYLLABUS
VII SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7201	Computational Fluid Dynamics	3	0	0	3

Course Objective

1. To introduce Governing Equations of viscous fluid flows
2. To understand the flow behavior through finite difference and finite volume approach.
3. To understand the various discretization schemes.
4. To study the flow field with corrective measures.
5. To understand the basic concepts of turbulence models.

Unit	Description	Instructional Hours
I	**FUNDAMENTAL CONCEPTS** Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.	10
II	**FLOW WITH DIFFUSION** Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.	7
III	**CONVECTIVE DIFFUSIVE FLOW** Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.	8
IV	**FLOW FIELD ANALYSIS** Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.	6
V	**TURBULANCE MODELS AND GRID GENERATION** Turbulence models, mixing length model, Two equation models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.	14
	Total Instructional Hours	**45**

Course Outcome

Upon completion students will be able to,
CO1: derive the governing equations and boundary conditions for viscous flows.
CO2: analyze the flow properties of diffusive flow.
CO3: compute the discretization behavior for convective diffusive flow.
CO4: predict the corrections involved in flow field.
CO5: understand the significance of turbulence models and mesh generation.

TEXT BOOKS:

T1 - Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd, Second Edition, 2007.
T2 - Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.

REFERENCE BOOKS:

R1 - Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.
R2 - Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
R3 - John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer – Verlag, Berlin, 1992
R4 - Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
C04	2	2	2	2	2	-	-	-	-	-	-	-	2	2
C05	3	3	3	2	2	-	-	-	-	-	-	-	2	2
AVG	2.4	2.2	2.2	2	2	-	-	-	-	-	-	-	2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7202	Vibration and Elements of Aero Elasticity	3	0	0	3

Course Objective

1. To study the effect of time dependent forces on mechanical systems
2. To learn the Eigen value and vector problems
3. To understand about the natural characteristics of continuous system.
4. To Familiarize with the Approximate Methods
5. To study the Aero elastic effects of aircraft wing.

Unit	Description	Instructional Hours
I	**SINGLE DEGREE OF FREEDOM SYSTEMS** 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	10
II	**MULTI DEGREE OF FREEDOM SYSTEMS** 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.	10
III	**CONTINUOUS SYSTEMS** Vibration of elastic bodies - vibration of strings – longitudinal, lateral and torsional vibrations	8
IV	**APPROXIMATE METHODS** Approximate methods - Rayleigh's method - Dunkerley's method – Rayleigh-Ritz method	9
V	**ELEMENTS OF AERO-ELASTICITY** 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.	8
	Total Instructional Hours	**45**

Course Outcome

CO1. understand the single degree vibrating system
CO2. solve multi-degree vibrating systems
CO3. Differentiate types of vibrations according to dampness and particle motion.
CO4. use numerical techniques for vibration problems
CO5. Understand the formation of Aileron reversal, flutter and wing divergence

TEXT BOOKS:

T1 - William Weaver, Stephen P. Timoshenko, Donovan H. Yound, Donovan H. Young. 'Vibration Problems in Engineering' – John Wiley and Sons, New York, 2001
T2 - Grover. G.K., —Mechanical Vibrationsl, 7th Edition, Nem Chand Brothers, Roorkee, India, 2003

REFERENCE BOOKS:

R1 - Leonard Meirovitch, "Elements of Vibration Analysis". McGraw Hill International Edition,2007
R2 - Bisplinghoff R.L., Ashely H and Hogman R.L., "Aeroelasticity", Addision Wesley Publication, New York, 1983.
R3 - Den Hartog, "Mechanical Vibrations" Crastre Press, 2008.
R4- V. P. Singh, _Mechanical Vibrations', Fourth Edition, Dhanpat Rai and Co., 2014.

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	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	-	-	-	-	-	-	-	-	-	3	2
C05	2	2	2	-	-	-	-	-	-	-	-	-	2	2
AV G	2.8	2.8	2	-	-	-	-	-	-	-	-	-	2.8	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7251	**Avionics**	2	0	2	3

Course Objective

1. To introduce the basic of avionics and its need for civil and military aircraft
2. To impart knowledge about the avionic architecture, various avionics data buses
3. To gain more knowledge on flight decks and cockpits
4. To impart knowledge about the navigation systems
5. To gain more knowledge on air data systems and autopilot

Unit	Description	Instructional Hours
I	**INTRODUCTION TO AVIONICS** Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, Design, technologies.	5
II	**DIGITAL AVIONICS ARCHITECTURE** 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. **Sorting of Data in Ascending & Descending order for voting mechanism-Addition/Subtraction of 8 bit and 16 bit data for control surface deflection.**	6
III	**FLIGHT DECKS AND COCKPITS** Control and display technologies: CRT, LED, LCD, EL and plasma panel – Direct voice input (DVI) – ARINC 818- Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS. **Sum of a given series with and without carry for identifying flap data.**	6
IV	**INTRODUCTION TO NAVIGATION SYSTEMS AND 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. **Greatest in a given series & Multi-byte addition in BCD mode- Addition/Subtraction of binary numbers using adder and Subtractor circuits.**	8
V	**MAINTENANCE AND COST OF AVIONICS** 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.	5
	Total Instructional Hours	**45**

Course Outcome

CO1: Knowledge of avionics sub systems used in civil and military aircrafts.

CO2: Ability to build Digital avionics architecture

CO3: Ability to design flight decks and cockpits

CO4: Ability to design Navigation system

CO5: Ability to design and perform analysis on air system

TEXT BOOKS:

T1 - Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004

T2 - Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.

REFERENCE BOOKS:

R1 - Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.

R2 - Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.

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R3 - Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Longman Scientific, 2011.

R4 - Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000

List of Equipment (for a batch of 30 students)

S.No.	Details of Equipments	Quantity	Experiment Nos.
1.	Microprocessor 8085 Kit	10	1,2,3,4,5
2.	Adder/Subtractor Binary bits Kit	10	1,2,3,4,5
3.	Regulated power supply*	10	1,2,3,4,5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	2	2	-	-	-	1	3	3	2
CO2	3	1	3	3	3	1	-	-	-	-	-	-	3	2
CO3	3	2	3	3	3	1	-	-	-	-	-	3	3	3
C04	3	3	3	-	3	3	2	-	-	-	-	2	3	2
C05	3	3	1	2	3	-	-	-	-	-	-	3	3	2
AVG	3.0	2.2	2.4	2.7	3.0	1.8	2.0	-	-	-	1.0	2.8	3.0	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7001	Aircraft Design Project	0	0	3	1.5

Course Objective

1. To enable to understand the behavior of aircraft structural components under different loading condit
2. To provide the Principle involved in photo elasticity and its applications in stress analysis.
3. To study about non-destructive testing methods.

Expt. No.	Description of the Experiments
1.	Comparative studies of different types of airplanes, specifications and performance details with reference to the design work under taken.
2.	Comparative graphs preparation and selection of main parameters for the design.
3.	Preliminary weight estimation.
4.	Preliminary design of Wing –airfoil selection, fixing the geometry of wing
5.	Fixing the Geometry of tail and control surfaces
6.	Preparation of fuselage layout.
7.	Wetted surface area calculation
8.	Drag Estimation – Drag polar curve at different flight speed.
9.	Power plant selection
10.	Rate of Climb determination
11.	V-n diagram.
12.	Landing gear selection &design
13.	Fixing structural members such as ribs, longerons, spars, bulkheads etc.
14.	Preparation of a detailed design report with CAD drawings

Total Practical Hours 45

Course Outcome

CO1: Ability design aircraft and demonstrate the performance of the design
CO2: Capacity to design g aircraft wings, fuselage, loading gears.
CO3: Ability to draw the V-n diagram.
CO4: Apply the knowledge of aircraft structure to choose suitable materials to different components of airc
CO5: Ability to visualize and draw three view diagrams of the aircraft.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	2	3	2	2	2	3	3
CO2	3	3	3	3	2	-	1	1	3	2	2	2	3	3
CO3	3	3	3	3	1	1	-	1	3	2	2	2	3	3
C04	3	3	3	3	2	-	2	1	3	2	2	2	3	3
C05	3	2	3	3	3	2	-	-	3	2	2	2	3	3
AVG	3.0	2.8	3.0	3.0	2.2	1.3	1.3	1.3	3.0	2.0	2.0	2.0	3.0	3.0

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Programme	Course Code	Name of the Course	L	T	P
BE	21AE7002	Flow Simulation Laboratory	0	0	3

Course Objective

1. To make the students familiarize with computational fluid dynamics.
2. To provide knowledge on the advantages of Flow Simulation instead of Real-time Experiments
3. To simulate and analyze fluid flow problems in aerospace engineering.

Expt. No.	Description of the Experiments
1.	Design, mesh and perform analysis of Laminar flow and turbulent flow in a duct and its interaction.
2.	Grid independence study and convergence test on airfoil
3.	Simulation of Karman vortex trail (vortex shedding) using circular cylinder.
4.	External flow simulation of subsonic and supersonic aero foils.
5.	Internal flow simulation of subsonic, sonic and supersonic flow through a CD nozzle.
6.	Simulation of flow through an axial flow compressor and turbine blade passage
7.	Design, mesh and perform analysis of Steady flow past a cylinder.
8.	Design, mesh and perform analysis of Supersonic flow over a wedge and cone
9.	Design, mesh and perform analysis of a supersonic inlet.
10.	Design, mesh and perform analysis of flow in a combustion chamber.

Total Practical Hours 45

Course Outcome

CO1: Discrete the strategies to be employed for different problems
CO2: Evaluate the internal flow parameters.
CO3: Analyse the external flow phenomenon.

List of Equipment (for a batch of 30 students)

Sl. No.	Equipment	Qty.
1	Internal server (or) Work station	1
2	Computers	30
3	Modelling packages (i) CATIA (ii) ANSYS (iii) Pro E (iv) NASTRAN (v) MATLAB	30 licenses
4	UPS	1
5	Printer	1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	1	2	3	3
CO2	3	3	2	2	1	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	1	-	-	-	-	-	-	2	3	3
AVG	3.0	3.0	2.3	2.7	1.3	-	-	-	-	-	1.0	2.0	2.7	2.7

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PROFESSIONAL ELECTIVE-III

Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7301	Nano Science and Technology	3	0	0	3

Course Objective

1. **To introduce the concepts of Nano science and technology**
2. **To understand the general preparation methods of Nano materials**
3. **To identify the different types of Nano materials.**
4. **To characterize the Nano materials for various applications**
5. **To understand the applications of Nano materials.**

Unit	Description	Instructional Hours
I	**INTRODUCTION** Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).	8
II	**GENERAL METHODS OF PREPARATION** Bottom -up Synthesis-Top-down Approach: Co-Precipitation, Ultra sonication, Mechanical Milling ,Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.	9
III	**NANO MATERIALS** Nano forms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nano metal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nano alumina, CaO, AgTiO2, Ferrites, Nano clays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.	12
IV	**CHARACTERIZATON TECHNIQUES** X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation.	9
V	**APPLICATIONS** Nano InfoTech: Information storage- Nano computer, molecular switch, super chip, nanocrystal, Nano bio technology: Nano probes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bio imaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nano sensors, Nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery. Applications and Functionalization of Carbon Nano tubes, upcoming functional Nano systems, Nano bots	7
	Total Instructional Hours	**45**

Course Outcome

CO1: understand the basics of Nano science
CO2: understand the preparation methods of Nano materials
CO3: identify different types of Nano materials
CO4: apply the methods of testing to characterize the Nano materials
CO5: acquire knowledge on applications of Nano materials

TEXT BOOKS:

T1- A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
T2 - N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.
T3-Pradeep T, —Nano: The Essentials Understanding Nanoscience and Nanotechnology|, Tata Mc-Graw Hill, New Delhi, 2012.

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REFERENCE BOOKS:

R1 - Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

R2 - G Timp, "Nanotechnology", AIP press/Springer, 1999.

R3- Brenner D W, Lyshevski S E, and Goddard W A, —Handbook of Nanoscience Engineering and Technology‖, CRC Press, 2009.

R4-Ramachandra Rao M S and Shubra Singh, —Nanoscience and Nanotechnology: Fundamentals to Frontiers‖, Wiley, Delhi, 2014.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	1	1	-	-	-	-	-	-	-	-	-	3	2
C04	3	1	1	1	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	1	1	-	-	-	-	-	-	-	3	2
AVG	3	1.6	1.4	1.3	1	-	-	-	-	-	-	-	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7302	Satellite Technology	3	0	0	3

Course Objective

1. To know types of satellite propulsion with respect to Indian & international scenario
2. To understand the orbital transfer of satellites
3. To analyze the various thrusters for satellites
4. To enrich their knowledge in the control of spacecraft.
5. To select suitable materials

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SATELLITE PROPULSION** Introduction – Classification of space propulsion– Mission requirements –Mission analysis- Current status of Indian rocket programme with respect to international scenario.	8
II	**BASICS OF SATELLITE PROPULSION** Approximate ΔV for Low-Thrust Spiral Climb- Re-positioning in Orbits-Brophy's Theory- Thrust Calculation -Numerical Problems.	10
III	**THRUSTERS FOR SPACE PROPULSION** Chemical Thrusters for In-Space Propulsion-Bipropellant Chemical Thrusters and Chemical Propulsion Systems Consideration (Valving, Tanks, etc.)- Small Solid Propellant Rockets for In-space Propulsion-Electrostatic Thrusters-Hall Thruster-Electrostatic versus Electromagnetic Thrusters-Colloidal Engines- solar- Hall Thruster Efficiency- Electric Propulsion	12
IV	**CONTROL OF SATELLITES** Satellite Vector Control – Methods, Thrust determination, - Orbit Optimization - Orbit Separation Dynamics - Separation Techniques, Types of aerodynamics control in satellite	8
V	**MATERIALS FOR SATELLITES** Selection of Materials - Special Requirements of Materials to Perform under Adverse Conditions.	7
	Total Instructional Hours	**45**

Course Outcome

CO1: understand evolution of satellite propulsion
CO2: understand separation techniques of satellite
CO3: identify suitable thrusters for satellites
CO4: acquire knowledge on control of satellites
CO5: identify suitable materials for satellites

TEXT BOOKS:

T1 - Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.
T2 - Charles D. Brown., "Spacecraft Propulsion", AIAA, 1996

REFERENCE BOOKS:

R1 - Parket, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.
R2 - Vincent L. Pisacane., "Fundamentals of Space Systems", Oxford University Press, 2005
R3 - Martin J. L. Turner., "Rocket and Spacecraft Propulsion", Springer Science & Business Media, 2008.
R4 – David.A.Vallado., "Fundamentals of astrodynamics and application",4th edition,ST library,2013.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	-	-	-	-	-	-	-	3	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	3	1
CO3	3	2	2	1	-	-	-	-	-	-	-	-	3	1
C04	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	-	-	-	-	-	-	-	-	-	3	1
AVG	3	1	1	1	1	-	-	-	-	-	-	-	3	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21AE7303	Fatigue and Fracture Mechanics	3	0	0	3

Course Objective

1. To understand the basic concepts involved in fatigue structures.
2. To know the various behavior of fatigue.
3. To learn about the various aspects of fatigue.
4. To understand the mechanics of fracture.
5. To study the importance of fracture mechanics in aerospace applications.

Unit	Description	Instructional Hours
I	**FATIGUE OF STRUCTURES** S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.	7
II	**STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR** Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner's theory - Other theories.	10
III	**PHYSICAL ASPECTS OF FATIGUE** Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.	10
IV	**FRACTURE MECHANICS** Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - stress analysis of cracked bodies - Effect of thickness on fracture toughness.	10
V	**FATIGUE DESIGN AND TESTING** Safe life and Fail-safe design philosophies – Fatigue testing methods - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.	8
	Total Instructional Hours	**45**

Course Outcome

CO1. Understand how fatigue occurs in structures.
CO2. Analyze the type of various aspects of fatigue behavior.
CO3. Access the different types of cracks on components.
CO4. Ability to analyze the fracture due to fatigue.
CO5. Skill to perform on fatigue design.

TEXT BOOKS:

T1 - Prasanth Kumar, "Elements of fracture mechanics", Wheeter publication, 1999.
T2 - Barrois W, Ripely, E.L., "Fatigue of aircraft structure," Pergamon press. Oxford, 1983.

REFERENCE BOOKS:

R1 - Knott, J.F., "Fundamentals of Fracture Mechanics," - Buterworth & Co., Ltd., London, 1983.
R2 - Kare Hellan ,'Introduction to Fracture Mechanics', McGraw Hill, Singapore,1985.
R3 - Sih C.G., "Mechanics of fracture." Vol - I, Sijthoff and w Noordhoff International Publishing Co.,Netherlands, 1989.
R4 – T.L.Anderson.,"Fracture Mechanics",4th edition, CRC Press,2017.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.00	2.00	2.00	3.00	-	-	-	-	-	-	-	2.00	3.00	1.00
CO2	3.00	2.00	3.00	2.00	-	-	-	-	-	-	-	2.00	3.00	2.00
CO3	3.00	2.00	3.00	3.00	2.00	-	-	-	-	-	-	2.00	2.00	3.00
C04	3.00	2.00	3.00	3.00	3.00	-	-	-	-	-	-	2.00	3.00	2.00
C05	3.00	2.00	3.00	3.00	2.00	-	-	-	-	-	-	2.00	3.00	2.00
AVG	3.00	2.00	2.80	2.80	2.33	-	-	-	-	-	-	2.0	2.80	2.00

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7304	Aero Engine Maintenance And Repair	3	0	0	3

Course Objective

1. To make the students to familiarize with the Aircraft engine maintenance procedure and practice.
2. To impart knowledge of basics of Aeronautics and engine components.
3. To understand the maintenance trouble shooting, testing procedure of Aircraft engines.
4. To familiarize the aircraft engines health monitoring and correctives methods.
5. To know the inspection, maintenance and overhaul procedures of aircraft engines.

Unit	Description	Instructional Hours
I	**PISTON ENGINES** Carburation and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out. Inspection and maintenance and troubleshooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.	9
II	**PROPELLERS** Propeller theory - operation, construction assembly and installation - Pitch change mechanism- Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.	9
III	**JET ENGINES** Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors- turbines- exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance- permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage.	9
IV	**TESTING AND INSPECTION** Symptoms of failure - Fault diagnostics - Case studies of different engine systems - Rectification during testing equipment for overhaul: Tools and equipment requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection - Methods and instruments for non-destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance.	9
V	**OVERHAULING** Engine Overhaul - Overhaul procedures - Inspections and cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: describe the function of each components of piston engines maintenance.
CO2: describe the working of propeller and its inspection procedures.
CO3: understand maintenance procedure to jet Engines.
CO4: interpret testing and inspection procedures to identify the defects.
CO5: enumerate overhauling procedure to new engines.

TEXT BOOKS:

T1 - Kroes & Wild, "Aircraft Power plants ", 7th Edition - McGraw Hill, New York, 1994.
T2 - "Aviation Maintenance Technician Handbook - Powerplant", Vol.2, ", U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012..

REFERENCE BOOKS:

R1 - Turbomeca, "Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.

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R2 - United Technologies' Pratt & Whitney, "The Aircraft Gas turbine Engine and its Operation", The English Book Store, New Delhi.2001.
R3 – "Aircraft Engine log book" Graphyco publishing,Volume.3., 2019
R4 – Varsha Arora., "Planner 2020-AME" Wiley publisher..Germany.2019.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C04	2	3	2	-	-	-	-	-	-	-	-	-	3	2
C05	2	3	2	-	-	-	-	-	-	-	-	-	3	2
AVG	2.6	2.4	1.6	-	-	-	-	-	-	-	-	-	3	2.2

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21AE7305	Space Mechanics	3	0	0	3

Course Objective

1. To introduce concepts of orbital mechanics.
2. Categorize the bodies with respect to position and time.
3. To know the concept of satellite injection.
4. To identify the trajectory computation for interplanetary travel.
5. To know the fundamental flight of ballistic missiles.

Unit	Description	Instructional Hours
I	**SPACE ENVIRONMENT** Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time	8
II	**BASIC CONCEPTS AND THE GENERAL N-BODY PROBLEM** The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws – Newton's universal law of gravitation - the many body problem - Lagrange-Jacobi identity – the circular restricted three body problem – libration points – the general N-body problem – two body problem – relations between position and time.	10
III	**SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS** General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.	10
IV	**INTERPLANETARY TRAJECTORIES** Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert's theorem	8
V	**BALLISTIC MISSILE TRAJECTORIES AND MATERIALS** Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: perform satellite injection, satellite perturbations and trajectory control
CO2: apply orbital mechanics to control ballistic missile
CO3: estimate the trajectory/orbit of a space vehicle or a satellite in a suitable coordinate system.
CO4: calculate the delta-v required for transferring a spacecraft from one orbit to another.
CO5: perform orbit perturbation analysis for satellite orbits.

TEXT BOOKS:

T1 - Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 1984.

T2 - Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

REFERENCE BOOKS:

R1 - Thomas A Ward, "Aerospace Propulsion systems", John Wiley, 2010.

R2 - Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.

R3 - Van de Kamp, P., "Elements of Astromechanics", Pitman, 1979.

R4 – Tom Logdson "Orbital Mechanics-Theory and Application", John Wiley and Sons, New York,1998.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C05	3	3	2	1	-	-	-	-	-	-	-	-	3	2
AVG	3	3	2	1	-	-	-	-	-	-	-	-	3	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7401	*Introduction to Drones*	3	0	0	3

Course Objective

1. To impart the knowledge on UAVs, UAS and Drone.
2. To understand about the components of Unmanned Aerial System.
3. To impart the knowledge on drone anatomy and assembly process.
4. To give exposure to drone applications and Innovations.
5. To know about operational concerns and future scope

Unit	Description	Instructional Hours
I	**INTRODUCTION** History of UAV – Classifications– UAV System composition – UAS – Drones- Evolution of drones – Concepts of flight : aerodynamics – flight performance – stability and control.	9
II	**UNMANNED AERIAL SYSTEM COMPONENTS** UAS - Platforms – Payload, installation and utilization - propulsion - on-board flight control - communications -Telemetry-tracking - launch / recovery systems - ground control stations – Trouble shooting.	9
III	**DRONE ANATOMY AND ASSEMBLY** Multi rotor introduction - Drone Anatomy: Motor – Propeller - ESC – Flight controller – Transmitter – Receiver Sensors – Assembly – Autonomous system - Emergency identification and handling. Hands on Training in Assembly.	10
IV	**APPLICATIONS AND INNOVATIONS OF DRONES** Military – Civil : Health care – Public safety – Disaster Management - Wild life monitoring – Railways - Data collection – Environmental Science – Product delivery - Surveying – Traffic Management – Agriculture – Construction –Entertainment – Innovations.	9
V	**OPERATIONAL CONSIDERATIONS AND FUTURE SCOPE** DGCA regulations –CAR -NPNT – fly zones - Digital sky platform - Federal Aircraft Regulations - Future Prospects and Challenges-Case Studies – Mini and Micro UAVs. Sensors – actuators, AI and IoT in drones Hands on training in Flying.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the fundamentals of UAVs and UAS.
CO2: Understand various components of Unmanned aerial systems.
CO3: Understand Drone anatomy and get an insight on Drone assembly.
CO4: Understand about areas of Drone applications and Innovations.
CO5: Understand the operational considerations of Drones in airspace.

TEXT BOOKS:

T1 - Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998
T2 - Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley,2010.

REFERENCE BOOKS:

R1- Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
R2- Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
R3 - Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	1	2	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
C04	3	3	2	2	2	-	-	-	-	-	-	3	2	2
C05	2	2	1	2	-	-	-	-	-	-	-	3	1	2
AVG	2.8	2.2	1.8	2	1.3	-	-	-	-	-	-	1.8	1.8	2

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Department of Aeronautical Engineering

R-2019 WITH AMENDMENT

NEW COURSES INTRODUCED

S. No	Course code	Name of the Course
1.	21AE7231	Aircraft General Maintenance
2.	21AE7232	Introduction to Unmanned Aerial Vehicle Systems
3.	21AE7203	Missiles Guidance and Control
4.	21AE7204	Satellite attitude dynamics and control
5.	21AE7205	Space Vehicle Aerodynamics
6.	21AE7206	Computational Heat Transfer and fluid flow

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SYLLABUS

MINOR

SEMESTER VII

Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7231	AIRCRAFT GENERAL MAINTENANCE	3	0	0	3

Course Objective

1. To carryout aircraft ground handling procedure.
2. To understand about the ground servicing of the various aircraft subsystem
3. To understand the procedure of aircraft system maintenance and safety.
4. To know the importance of periodic inspection of aircraft.
5. To understand the specification of aircraft hardware components and its materials.

Unit	Description	Instructional Hours
UNIT I	**AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT** Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions – Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Ground power unit.	9
UNIT II	**GROUND SERVICING OF VARIOUS SUB SYSTEMS** Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems – Oxygen systems – Fire extinguishing system and smoke detection system, Deicing and anti-icing system.	9
UNIT III	**MAINTENANCE OF SAFETY AND AIRCRAFT SYSTEM PROCESSES** Shop safety – Environmental cleanliness – Precautions- Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology.	9
UNIT IV	**INSPECTION** Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications.	9
UNIT V	**AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES** Specification and use of various aircraft hardware – American and British systems of specifications – Threads, gears, bearings, – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.	9
	Total Instructional Hours	**45**

Students who successfully complete this course will be able to:

CO1: Explain the various ground support system for aircraft operations.
CO2: Illustrate the ground servicing of critical aircraft systems.
CO3: Inspect the aircraft by considering the FAA airworthiness regulations and the checklist.
CO4: Apply the maintenance procedures to the aircraft subsystem and equipment.
CO5: Explain the specifications standards of aircraft hardware systems and materials.

TEXT BOOK:

1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993

REFERENCES:

1. A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996
2. A&P Mechanics," General Hand Book", F A A Himalayan Bok House, New Delhi, 1996

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2												2	
CO 2	2		1				1		1				2	
CO 3	3	1					1		1	1	2	1	3	2
CO 4	3	1							1				2	1
CO 5	2												2	2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7232	Introduction to Unmanned Aerial Vehicle Systems	3	0	0	3

Course Objective

1. To introduce the basics of UAV.
2. To impart knowledge about the design of UAV systems.
3. To gain more knowledge on avionics hardware.
4. To impart knowledge about the communication payloads and controls.
5. To study the development of UAV systems

Unit	Description	Instructional Hours
UNIT I	**INTRODUCTION** History of UAV – Classifications – Concepts of flight: Bernoulli's principle - four forces of an aircraft - aerodynamics – flight performance – stability and control.	9
UNIT II	**UNMANNED AERIAL SYSTEM COMPONENTS** UAS - Platforms – Air Vehicle, Payloads - Propulsion - onboard flight control - Communications - Telemetry-tracking – Launch and Recovery systems - Ground Control Station – Ground Support Equipment.	9
UNIT III	**UAV ANATOMY AND ASSEMBLY** Overview of the main drone parts - Technical characteristics of the parts - Function of the parts - Motor – Propeller - ESC – Servos - Flight controller – Transmitter – Receiver, Sensors - Assembling a drone.	9
UNIT IV	**APPLICATIONS OF UAV** Choosing a drone based on the application -Drones in the insurance sector- Drones in delivery –Drones in Survey and Mapping - Drones in agriculture- Drones in Health care - Drones in Asset Inspection- Drones in filming and panoramic picturing	9
UNIT V	**OPERATIONAL CONSIDERATIONS AND FUTURE SCOPE** Specific aviation regulation and standardization-Airspace - DGCA regulations – Remote Pilot Certificate - Digital sky platform - Future Prospects and Challenges – Miniaturization of drones- Increasing autonomy of drones - Use of drones in swarms - Mini and Micro UAVs - Weather and Meteorology.	9
	Total Instructional Hours	45

Upon successful completion of this course, the student will be able to:

CO1 Understand the fundamentals of UAVs and UAS.
CO2 Understand various components of Unmanned aerial systems.
CO3 Understand Drone anatomy and get an insight into Drone assembly.
CO4 Understand areas of Drone applications and Innovations.
CO5 Understand the operational considerations of Drones in airspace.

TEXTBOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, Mohammad H. Sadraey "Introduction to UAV Systems", UAV Systems, 5th Edition Inc, April 2022
2. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.

REFERENCES:

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1. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001
2. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	1	2	-	-	-	-	-	-	-	1	1	-
2	2	-	-	-	-	1	-	-	-	-	-	-	2	-
3	2	3	1	-	-	1	-	-	-	-	-	1	1	1
4	3	2	-	-	-	1	1	-	-	-	-	-	1	1
5	2	-	1	1	3	-	-	-	1	-	-	1	-	-
Avg	2.4	2	1	1.5	3	0.6	1	-	1	-	-	1	1.2	1

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SYLLABUS

Honors

SEMESTER VII

Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7203	Missiles Guidance and Control	3	0	0	3

Course Objective

1. To know the category of missiles and its components
2. To learn about fundamentals of guidance
3. To familiarize with the laws of guidance
4. To understand the strategy and performance of proportional navigation
5. To learn about applications of guidance.

Unit	Description	Hours
	Introduction to guided Missiles	
I	History of guided missiles; Category of guided missiles for air defence, Major components of guided missiles.	6
	Fundamentals of guidance	
II	Guidance Phases During Missile Flight – Standard terminologies in missile guidance - Basic results in interception and avoidance - Capturability in relative velocity space. Taxonomy of guidance laws. Command and homing guidance.	10
	Laws of Guidance	
III	Classical guidance laws - Pursuit, Line-of-Sight, Command to Line-of-Sight, Beam Rider, Constant Bearing guidance laws. Modern Guidance laws - Optimal control based guidance laws, Linear formulations. Non-linear formulations; Two point boundary value problems.	11
	Introduction to Proportional Navigation	
IV	Proportional Navigation (PN) and its variants like T (True) PN, P (Pure) PN, B (Biased) PN, G (Generalized) PN, and I (Ideal) PN.	9
	Applications of Guidance	
V	Approximations and closed-form solutions; Equivalence with PN guidance laws. Numerical solutions for guidance problems.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the components and categories of missiles.
CO2: Apply the knowledge to study the fundamentals of guidance.
CO3: Ability to indicate appropriate laws of guidance.
CO4: Ability to understand the strategy and performance of proportional navigation
CO5: Evaluate the numerical solutions for guidance problems.

TEXT BOOKS:

T1 - N.A. Shneydor: Missile Guidance and Pursuit: Kinematics, Dynamics and Control, Ellis Horwood Publishers, 2014.
T2 - R. Yanushevsky: Modern Missile Guidance, CRC Press, 2018.

REFERENCE BOOKS:

R1 - P. Zarchan: Tactical and Strategic Missile Guidance, AIAA, 2012.
R2 - G.M. Siouris: Missile Guidance and Control Systems, Springer Verlag, 2004.
R3 - Pierre T. Kabamba, Anouck R. Girard. 'Fundamentals of Aerospace Navigation and Guidance', Cambridge university press, 2014.

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COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	2	-	-	-	-	-	-	-	-	1	1	-
2	3	1	1	-	-	-	-	-	-	-	-	1	1	-
3	3	1	-	1	-	-	-	-	-	-	-	1	1	-
4	3	1	1		1	-	-	-	-	-	-	1	1	-
5	3	1	2	1	1	-	-	-	-	-	-	1	1	-
Avg.	3	1	1.5	1	1	-	-	-	-	-	-	1	1	-

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7204	Satellite attitude dynamics and control	3	0	0	3

Course Objective

1. To Understand the principles of satellite attitude kinematics and dynamics
2. To Analyze the stability of satellite attitude
3. To Design and implement attitude control systems
4. To Evaluate advanced attitude control methods
5. To Apply theoretical knowledge to practical satellite missions.

Unit	Description	Hours
	Fundamentals of Satellite Attitude Kinematics	
I	Introduction to satellite attitude and its significance - Attitude representation: Euler angles, quaternion, direction cosine matrix - Transformation between different attitude representations - Angular velocity and its representation - Kinematics equations governing satellite attitude motion. Attitude determination - attitude measuring sensors used in satellites.	9
	Attitude Dynamics and Stability	
II	Overview of attitude dynamics: Euler's equations of motion - Torque-free motion and its stability analysis - Stability analysis of torque-free rotation - Techniques for attitude stabilization in torque-free regimes	9
	Spin-Stabilized Satellites	
III	Concept and design principles of spin-stabilized satellites - Kinematics and dynamics of spin-stabilized satellites - Attitude control methods for spin-stabilized satellites - Challenges and limitations of spin stabilization	9
	Satellite Attitude Control Using Reaction Wheels and Control Moment Gyros	
IV	Principles of reaction wheels and control moment gyros (CMGs) - Control laws for attitude control using reaction wheels and CMGs - Implementation and performance considerations - Case studies and practical examples	9
	Advanced Attitude Control Techniques	
V	Attitude control using magnetic torquers and Lorentz force - Overview of thruster-based attitude control systems - Solar sails for attitude control and propulsion - Comparative analysis of different attitude control methods- Integration and management of attitude control systems in satellite missions	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the principles of satellite attitude kinematics and dynamics.
CO2: Apply the analyze the stability of satellite attitude.
CO3: Ability to design and implement attitude control systems.
CO4: Ability to evaluate advanced attitude control methods
CO5: Apply theoretical knowledge to practical satellite missions.

TEXT BOOKS:

T1 - Fundamental Spacecraft Dynamics and Control, by Weiduo Ho, Wiely, Singapore, 2015.
T2 - Spacecraft Dynamics and Control, by Marcel J. Sidi, Cambridge University Press, U.K, 2014.

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REFERENCE BOOKS:

R1 - "Fundamentals of Spacecraft Attitude Determination and Control" by Markley, F. Landis, and R. Berry, Springer, 2022.

R2 - Modern Spacecraft Dynamics and Control, by M. H. Kaplan, John Wiely & Sons, 1977.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	-	-	-	-	-	-	-	-	1	1	-
2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
3	3	2	1	1	-	-	-	-	-	-	-	1	1	-
4	3	2	2	-	1	-	-	-	-	-	-	1	1	-
5	3	2	2	1	1	-	-	-	-	-	-	1	1	-
Avg.	3	2	2	1	1	-	-	-	-	-	-	1	1	-

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE7205	Space Vehicle Aerodynamics	3	0	0	3

Course Objective

1. Understand the fundamental principles of aerodynamics and their application to space vehicles
2. Analyze the aerodynamic forces acting on spacecraft during atmospheric entry and exit.
3. Evaluate methods for achieving stability and control during various phases of spaceflight.
4. Investigate the characteristics and challenges of hypersonic flight and re-entry.
5. Explore advanced concepts in space vehicle aerodynamics, including aerodynamic heating mitigation and drag reduction techniques.

Unit	Description	Instructional Hours
	FUNDAMENTALS OF AERODYNAMICS	
I	Introduction to aerodynamics-Fluid mechanics fundamentals-Airfoil theory and lift generation-Drag forces and drag reduction techniques-Stability and control principles-Application of aerodynamics to space vehicles	9
	ATMOSPHERIC ENTRY AND RE-ENTRY DYNAMICS	
II	Atmospheric entry overview-Entry trajectories and guidance-Aerodynamic heating and thermal protection systems-Hypersonic flow regimes-Entry vehicle design considerations-Case studies of atmospheric entry missions	9
	STABILITY AND CONTROL IN SPACEFLIGHT	
III	Spacecraft dynamics and equations of motion- Aerodynamic stability derivatives- Control surface design and effectiveness- Attitude determination and control systems- Orbital maneuvering and attitude control- Simulation and analysis of spacecraft stability and control	9
	HYPERSONIC AERODYNAMICS AND RE-ENTRY	
IV	Characteristics of hypersonic flow- Shock waves and boundary layers- Aerodynamic heating mechanisms- Thermal protection materials and systems- Re-entry vehicle aerodynamics- Challenges and solutions in hypersonic flight	9
	ADVANCED TOPICS IN SPACE VEHICLE AERODYNAMICS	
V	Aerodynamic drag reduction techniques-High-fidelity aerodynamic modeling- Aerodynamic interaction with spacecraft systems- Aerothermodynamics and heat transfer analysis- Future trends in space vehicle aerodynamics- Research and development in advanced aerodynamic concepts	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply aerodynamic principles to analyze and predict the behavior of space vehicles in different flight regimes.
CO2: Design and optimize trajectories for spacecraft during atmospheric entry and re-entry.
CO3: Assess the stability and control of space vehicles and propose strategies for improving performance.
CO4: Evaluate the thermal management techniques used to mitigate aerodynamic heating during high-speed flight.
CO5: Develop innovative solutions to address challenges in space vehicle aerodynamics, such as drag reduction and hypersonic vehicle design.

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TEXT BOOKS:

T1 -. Mark R. Jones and Steven A. Walker, "Fundamentals of Space Vehicle Aerodynamics" Mark R. Jones and Steven A. Walker Cambridge University Press ISBN: 978-1107029396
T2 - William Tyrrell Thomson and Frank E. Heppenheimer "Introduction to Space Dynamics" Dover Publications 2015

REFERENCE BOOKS:

R1 - John J. Bertin and Russell M. Cummings "Space Vehicle Aerodynamics" Wiley 1998
R2 - Leland M. Nicolai "Spacecraft Aerodynamic Heating" AIAA 1994

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	1	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	1	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C05	3	3	3	3	-	-	-	-	-	-	-	1	3	2
AVG	3.0	3.0	2.6	1.6	-	-	-	-	-	-	-	1.0	3.0	2.0

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	21AE7206	Computational Heat Transfer and Fluid Flow	3	0	0	3

Course Objective

1. To learn about different types of Discretization techniques.
2. To study about the one-dimensional modeling of heat transfer
3. To understand the modelling of diffusion problems using finite volume method.
4. To analyze the numerical grid and flow modeling.
5. To impart the knowledge about importance of turbulence and multiphase modeling.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Basics of heat transfer, fluid flow. Mathematical description of fluid flow and heat transfer: conservation equations for mass, momentum and energy, classification of partial differential equations, coordinate systems. Discretization techniques using finite difference methods: Taylor-Series and control volume formulations. Finite element discretization techniques.	10
II	**ONE-DIMENSIONAL MODELING OF HEAT TRANSFER** Introduction to one-dimensional modeling of heat transfer, Conduction heat transfer in fins and other geometries, Modeling of electrical circuits with heat transfer, Applications of one-dimensional heat transfer modeling in aerospace engineering.	8
III	**MODELLING OF DIFFUSION PROBLEMS USING FINITE VOLUME METHOD** Basic relations for heat transport in fluids and solids. Heat transport across material boundaries. Modelling techniques. One dimensional steady state diffusion problems; discretization technique. Numerical computational methods in heat transfer especially Two and three dimensional discretization. Discretization of both steady-state and unsteady diffusion problems: Explicit, Implicit methods.	10
IV	**NUMERICAL GRID GENERATION** Definition of Grid, need for grid, Geometric modelling and surface grid, Algebraic grid generation, Structured and Unstructured grid, Multi Block grid, Types of grid element, factors affecting the grid. Discretization of incompressible flow equations. Introduction to FVM with unstructured grids.	8
V	**TURBULENCE AND MULTIPHASE MODELING** Turbulent flows with heat transfer, Turbulent multiphase flows, Applications of turbulence modeling in industry. Introduction to Reynolds Averaged Navier Stokes Modeling, DNS and LES. Modeling of multiphase and phase change problems: enthalpy method, volume of fluid (VOF) and Level Set Methods.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Ability to use the different Finite element discretization techniques
CO2. Acquire the knowledge on one-dimensional modeling of heat transfer.
CO3. Ability to solve the diffusion problems using finite volume method
CO4. Ability to Analyze the numerical grid and flow modeling.
CO5. Ability to solve the turbulence and multiphase modeling.

TEXT BOOKS:

T1 - S. V. Patankar, "Numerical Heat Transfer and Fluid Flow," Hemisphere Publishing Corporation, 1980.
T2 – Anderson, D.A., Tannehill, J.C. and Pletcher, R.H "Computational Fluid Mechanics and Heat Transfer", . Taylor & Francis.1997.

REFERENCE BOOKS:

R1 - Ferziger, J. H. and Peric, M, "Computational Methods for Fluid Dynamics", Springer Verlag, Berlin., 2003.
R2 – Versteeg, H.K. and Malalasekara., "Introduction to Computational Fluid Dynamics: The Finite Volume Method", Pearson Education.2008.
R3 – T. J. Chung "Computational Fluid Dynamics", Cambridge University Press, 2012

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PO&PSO ⟶	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	1	2
CO2	3	3	1	2	-	-	-	-	-	-	-	1	1	2
CO3	3	2	1	2	1	-	-	-	-	-	-	1	1	2
CO4	3	1	1	1	1	-	-	-	-	-	-	1	1	2
CO5	3	1	-	2	1	-	-	-	-	-	-	1	1	2

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Course Code	Name of the Course	Course Duration
21VAAE01	Design and drafting using solid works	42

Course Objective

- The course aims to give students and professionals the essentials that is needed to become a known SOLIDWORKS associate.
- It will help individuals use the software with confidence and design/draft the next innovative thing.
- Skill to Build, control, and analyze assemblies for fit and function.
- Able to compete the industrial standards with known subject knowledge.

Sl. No.	Module	Details of Module	No. of Hours
1.	Introduction to Solid Works	➢ SolidWorks Graphical User Interface ➢ Feature manager design tree, Callouts, Handles ➢ Confirmation corner, mouse buttons, keyboard shortcuts, Command Manager, ➢ Hardware and Software requirements, ➢ SolidWorks Task Scheduler	5
2.	SKETCHER	➢ Sketch Entities, Sketch Tools ➢ Blocks – Make block, Edit block, Insert block, Add/Remove Entities, Rebuild, Save, Explode ➢ Relations - Adding Sketch Relation, Automatic relations, ➢ Dimensioning - Smart, Horizontal, Vertical, Ordinate, Horizontal ordinate, Vertical ordinate, Align ordinate, fully define sketch. ➢ Sketch Diagnosis, Sketch Expert , 3D Sketching, Rapid Sketch	6
3.	PART MODELING	➢ Part Modeling Tools ➢ Creating reference planes ➢ Creating Extrude features, Revolve features ➢ Creating Swept features, Loft features ➢ Creating curves, Fillet features, Hole types ➢ Creating Chamfer, Shell, Rib, Pattern ➢ Advanced Modeling Tools ➢ Inserting Fastening features	6
4.	ASSEMBLY	➢ Assembly Modeling Tools ➢ Introduction to Assembly, Modeling & Approaches ➢ Applying Standard Mates, Applying Smart mates ➢ Applying Mate reference ➢ Manipulating Components ➢ Creating Pattern, Explode Views	6

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Sl. No.	Module	Details of Module	No. of Hours
		➢ Top Down Design	
5.	SURFACE MODELING	➢ Creating Extrude, Revolve, Swept, loft, Boundary surface. ➢ Inserting Planar Surface, Offset Surface, Radiate Surface.	2
6.	DRAFTING	➢ Generating Drawing Views ➢ Introduction To Angle Of Projection ➢ Generating Views ➢ Creating Dimensions ➢ Inserting Annotations	3
7.	SHEET METAL	➢ Sheet Metal Design ➢ Working with import data	2
8.	WELDMENT DESIGN & MOLD DESIGN	➢ Introduction to Weldment, 3D sketch ➢ Introduction of Mold, type of mold design, how to used draft analysis ➢ Introduction to CAE/CDM	3
9.	GD & T	➢ Features and Rules of GD&T ➢ Datum's Control ➢ Adding GD&T to a Drawing/Design ➢ Form Tolerances, Orientation Tolerances, Profile Tolerances ➢ Location Tolerances, Runout Tolerances	4
10.	PRODUCT DATA MANAGEMENT	➢ Introduction to PDM, LAN, WAN, Server, client, user, administrator ➢ Creating new project, Check In/Check Out of a new document, viewing the configurations. ➢ Archive/Restore a document, Delete/Rollback a document	3
11.	DATA MIGRATION	➢ Build and analyze for fit and function Discussion ➢ Detailing	2

TOTAL: 42 HRS

Course Outcome: The student will be able to

1. Demonstrate competency with multiple drawing and modification commands in SolidWorks.
2. Create three-dimensional assemblies incorporating multiple solid models.
3. Apply industry standards in the preparation of technical mechanical drawings.
4. SolidWorks has advanced skills and the students can chose carrier in many sectors dealing with product design, validation, manufacturing, etc.

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Course Code	Name of the Course	Course Duration
21VAAE02	Catia with industrial approach	40

Course Objective

- Make the students to learn, plan and layout of the diagrams
- Make the students to understand tools and methods in converting sketches into 3d modelling
- Enable the students to execute simple design and complex design
- Equip the students to learn drafting using draft workbench.

Module I **Introduction to CATIA v5**

CATIA V5 Basic Modeling Process, Workbenches, Specification tree, Reference Planes, Compass,View Toolbar, Understanding the Functions of the Mouse Buttons, Hotkeys **5**

Module II **Sketcher Workbench**

Starting a New File, Invoking the Sketcher Workbench, Setting the Sketcher Workbench - Sketch tools Toolbar, Create Sketch Geometry - Basic sketching - Profile Toolbar, Advanced Sketching - Operation Toolbar, Advanced sketching - Knowledge Toolbar, Constraining the sketch - Constrain toolbar - Geometric and dimensional constraint, Saving and exporting the sketch **8**

Module III **Part design Workbench**

Invoking Part Design Workbench, converting 2d Sketch into 3d Part - Sketch-Based Features Toolbar, Advanced editing of 3d Part - Dress-up Features Toolbar, Advanced Part Designing - Transformation Features Toolbar, Additional References - Reference Elements Toolbar, Using Macros to import geometrical set, Annotations - Apply Material - Dynamic Sectioning Toolbar, Measure - Boolean operations - Graphic Properties - User Selection Filter Toolbar **17**

Module IV **Drafting Workbench**

Invoking Drafting Workbench - New Drawing Creation, Visualization - Tools - Views - Dimensioning Toolbar, Geometry Creation - Geometry Modification - Dress up Toolbar, Annotations Toolbar **10**

40 hours

Course Outcome: The student will be able to

1. Understand the plan and layout of drawings by the fundamentals in CATIA
2. Understand will be able to design the elements using computer aided techniques.
3. Transform technical data into electronic drawings.
4. Convert sketches to engineering drawing will improve
5. Do part designing of complex parts

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References

1. Richard Cozzens *"CATIA V5 Workbook Release 19"*, Schroff Development Corporation (August 31, 2009).
2. "CATIA Core Tools: Computer Aided Three-Dimensional Interactive Application" 1st Edition, McGraw-Hill Education
3. Sham Tickoo, "CATIA for Designers V5R13",
4. "CATIA V5-6R2015 Basics: Sketcher Workbench, Part Modeling, Assembly Design, Drafting, Sheet Metal", by Tutorial Books

Web Resources: http://www.coe.org/

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Course Code	Name of the Course	Course Duration
21VAAE04	Mesh tools for industrial approach	40

Course Objective

- Understand the basics of Finite Element Analysis
- Understand the Hypermesh tool
- Apply the Basics of FEA using Hypermesh in Industry applications

UNIT	CONTENT	HOURS
1	**UNIT 1 - Basics of FEA** The fundamentals of Finite Element Analysis (FEA) - FEA is a generic technique used to solve boundary value problems - FEA finds a lot of applications in structural analysis - Math behind FEA	7
2	**UNIT 2 - INTRODUCTION TO HYPER MESH** Introduction about Hyper mesh - Introduction to CAD & CAE - Application of CAE Software - Advantages and Theory of FEM and Basic engineering and Shortcuts. Geometry - Create node - Node edit -Temp nodes - Distance - Dimensioning - Lines - Line edit - Length - Creation of surfaces and surface edit - Normal Translate and Rotate – Auto – mid surface Extraction - Surface edges - Visualization tool bar - Display tool bar - Clean up using quick edit	7
3	**UNIT 3 – 2D Meshing** Introduction to meshing -Auto meshing - Size & Biasing - Density and mesh style - Mesh connectivity - Replace and remeshing - Current and surface components - Reviews of all options and doubt clarification - Quality criteria - Warpage - Aspect ratio - Jacobian - Skew - Reducing the Trias percentage	8
4	**UNIT 4 – 3D Meshing** Introduction to 3D meshing - Types of 3D elements - Drag, spin, line drag & Element offset - Solid and solid edit - Solid map commands - Linear mesh - Solid mesh - Tetra mesh - Tetra parameters - Tet collapse – Remeshing	8
5	**UNIT 5 – Analysis** Introduction to analysis - Create collectors - Material properties - Load constraints - Load steps - Deck preparation - Material and properties assignment - Assign of loads and constraints - Saving the file formats – Industry model application	10
	TOTAL HOURS	**40**

Course Outcome: The students will be able to

- Understand the basics of Finite Element Analysis
- Understand the Hypermesh tool
- Apply the Basics of FEA using Hypermesh in Industry applications

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Course Code	Name of the Course	Course Duration
21VAAE05	Embedded systems design	42

Course Objectives:

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

MODULE -I : Introduction to Embedded Systems 9

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

MODULE -II: Typical Embedded System 9

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

MODULE -III: Embedded Firmware 8

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

MODULE -IV: RTOS Based Embedded System Design 8

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

MODULE -V: Task Communication 8

Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TOTAL DURATION : 42 HRS

COURSE OUTCOMES:THE STUDENTS ABLE TO

1. Understand the selection procedure of Processors in the Embedded domain.
2. Design Procedure for Embedded Firmware.
3. Visualize the role of Real time Operating Systems in Embedded Systems
4. Evaluate the Correlation between task synchronization and latency issues

Preferable Development Kit:

1. STM32 MCU Discovery Kits
2. TI Launch Pad development kits
3. Single board computers (Raspberry Pi, Beaglebone Block, etc)
4. Required interface boards

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REFERENCE BOOKS:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.
5. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

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Department of Aeronautical Engineering

R-2022

OVERALL REVISION PERCENTAGE

Over all Percentage of the curriculum revised as per XIII Board of Studies: 35 %

New courses introduced as per XIII Board of Studies: 32

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