KIT - Kalaignarkarunanidhi Institute of Technology

(An Autonomous Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai Accredited by NAAC with 'A' GRADE & NBA (AERO, BIO TECH, CSE, ECE, EEE, MECH & MBA)

An ISO 9001 : 2015 Certified Institution

Coimbatore - 641 402.

REGULATIONS, CURRICULUM & SYLLABUS - 2023

(For Students admitted from the Academic Year 2023-24 and onwards)

BACHELOR OF ENGINEERING DEGREE
IN
AERONAUTICAL ENGINEERING

DEPARTMENT OF AERONAUTICAL ENGINEERING

Vision and Mission of the Department

Vision

+	To promote high quality in technical education with relevant research in the field of Aeronautical engineering to bring out skilled and employable professionals for the upliftment of society.

Mission

+	To provide competent education in the domain of Aeronautical engineering.
+	To impart professional and ethical responsibilities, leadership and entrepreneurship qualities for the student's career development.
+	To cultivate the state of art research facilities to analyze and evaluate new fields of Aeronautical engineering and impart societal responsibilities among the students.
+	To collaborate with industries and professional bodies to mould the students as competent industry ready professionals.

Program Educational Objectives (PEO's)

PEO 1	Graduates will have the ability to apply knowledge across the disciplines and in emerging areas of Aeronautical engineering with sound technical expertise to solve competitive problems of real world challenges
PEO 2	Graduates will apply their analyzing, design and manufacturing skills in Aeronautical engineering and technology for the upliftment of social well being of the nation.
PEO 3	Graduates will be competitive professionals in aeronautical industries by adopting life-long learning and quality management practices for the betterment of society and individual.

Programme Outcomes (PO's)

Students graduating from Aeronautical Engineering should be able to

PO 1	**Engineering Knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis :** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design / Development of Solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4	**Conduct Investigations of Complex Problems :** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage :** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and Team Work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication :** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Lifelong Learning :** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO's)	
Graduates of Aeronautical Engineering Programme should be able to	
PSO 1	Apply the principles of Aeronautical engineering to solve engineering problems by utilizing advanced technology in the field of aerodynamics, structures, propulsion and maintenance.
PSO 2	Analyze and design the manufacturing and management practices for the betterment of society and individual to become a competitive professional in Aeronautical field.

Programme Coordinator

Curriculum

Conceptual Frame work

(For Students admitted from the Academic Year 2023-24 and onwards)

Semester	Level of Course	Hours / Week	No of Courses	Range of Credits / Courses	Total Credits
PART – I					
A - Foundation Courses					
I to VII	Humanities and Social Sciences (HS)	1- 4	6	1 - 4	10
I to IV	Basic Sciences (BS)	3 - 4	6	2 - 4	24
I to II	Engineering Sciences (ES)	4 - 5	5	2 - 4	18
B - Professional Core Courses					
III to VII	Professional Core (PC)	3 - 5	28	2 - 4	85
C - Elective Courses					
V to VIII	Professional Elective (PE)	3 - 5	4	3	12
V to VIII	Open Elective (OE)	3 - 5	2	3	6
D - Project Work					
VI, VII & VIII	Project Work (PW)	4 -16	3	2 - 8	12
E - Mandatory Courses Prescribed by AICTE/UGC (Not to be Included for CGPA)					
V & VI	**Mandatory Course (MC)**	3	3	NC	NC
Total Credit					**167**
PART – II					
F- Career Enhancement Courses (CEC)					
II	Soft Skills	2	1	-	NC
II	Application Design and Development	1	1	-	NC
IV	Professional Certificate course	-	1	1	1
V	Summer Internship	-	1	1	1
Total Credit					**02**
Total Credit to be Earned					**169**

Programme Coordinator

BoS Chairman

Programme Coordinator

BoS Chairman

Curriculum and Scheme of Assessment

(For Students admitted from the Academic Year 2023-24 and onwards)

Semester – I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23IPT101	Induction Programme	HS	-	-	-	-	0	-	-	-
Theory / Theory with Practical										
B23MAT101	Matrices and Differential Calculus	BS	4	3	1	0	4	40	60	100
B23MET101	Engineering Graphics	ES	4	2	2	0	4	40	60	100
B23HST101	தமிழர் மரபு / Heritage of Tamils	HS	1	1	0	0	1	40	60	100
B23ENI101	Professional Communication	HS	5	3	0	2	4	50	50	100
B23CHI101	Engineering Chemistry	BS	5	3	0	2	4	50	50	100
B23CSI102	Problem Solving and Python Programming	ES	5	3	0	2	4	50	50	100
Practical										
B23MEP101	Engineering Practices Laboratory	ES	4	0	0	4	2	60	40	100
Total credits to be earned							23			

Semester – II										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23ENT101	Professional English	HS	2	2	0	0	2	40	60	100
B23MAT201	Integral Calculus and Complex Analysis	BS	4	3	1	0	4	40	60	100
B23MET201	Engineering Mechanics	ES	4	3	1	0	4	40	60	100
B23HST201	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HS	1	1	0	0	1	40	60	100
B23PHI101	Engineering Physics	BS	5	3	0	2	4	50	50	100
B23EEI202	Basics Electrical and Electronics Engineering	ES	5	3	0	2	4	50	50	100
B23CEP201	Soft Skills	CEC	2	2	0	0	NC	100	-	100
B23CEP202	Application Design and Development	CEC	1	1	0	0	NC	100	-	100
Total credits to be earned							19			

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Semester – III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT301	Transforms and Partial Differential Equations	**BS**	4	3	1	0	**4**	40	60	100
B23AET301	Fundamentals of Aerospace Engineering	**PC**	3	3	0	0	**3**	40	60	100
B23AET302	Solid Mechanics	**PC**	3	3	0	0	**3**	40	60	100
B23AET303	Engineering Fluid Mechanics	**PC**	3	3	0	0	**3**	40	60	100
B23AEI301	Aero Engineering Thermodynamics	**PC**	5	3	0	2	**4**	50	50	100
Practical										
B23AEP301	Solid Mechanics Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23AEP302	Engineering Fluid Mechanics Laboratory	**PC**	4	0	0	4	**2**	60	40	100
Total credits to be earned							**21**			

Semester – IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT403	Numerical Methods	**BS**	4	3	1	0	**4**	40	60	100
B23AET401	Advanced Solid Mechanics	**PC**	4	3	1	0	**4**	40	60	100
B23AET402	Air Breathing Propulsion	**PC**	3	3	0	0	**3**	40	60	100
B23AET403	Aircraft Systems and Instruments	**PC**	3	3	0	0	**3**	40	60	100
B23AEI401	Low Speed Aerodynamics	**PC**	5	3	0	2	**4**	50	50	100
Practical										
B23AEP401	Aircraft Component Drawing Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23CEP301	Professional Certificate Course	**CEC**	2	0	0	2	**1**	100	-	100
Total credits to be earned							**21**			
Summer Internship – Three Weeks (Review will be conducted in first week of Semester V and its credit will be included in Semester V) / NPTEL / Product Development / Mini Project / Model Development										

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Semester – V										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23AET501	Aircraft Performance	**PC**	4	3	1	0	**4**	40	60	100
B23AET502	High Speed Aerodynamics	**PC**	4	3	1	0	**4**	40	60	100
B23AET503	Drone Technology with IoT	**PC**	3	3	0	0	**3**	40	60	100
B23AEI501	Aircraft Structures	**PC**	5	3	0	2	**4**	50	50	100
	Professional Elective - I	**PE**	3	3	0	0	**3**	40	60	100
	Open Elective - I	**OE**	3	3	0	0	**3**	40	60	100
B23MCT* **	Mandatory Course I	**MC**	3	3	0	0	**NC**	100	-	100
B23MCT505	Holistic insight into UN SDGs	**MC**	3	3	0	0	**NC**	100	-	100
Practical										
B23AEP501	Aero Engine and Airframe Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23AEP502	Aircraft Design Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23CEP501	Summer Internship	**CEC**	-	-	-	-	**1**	100	-	100
Total credits to be earned							**26**			

Semester – VI										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23AET601	Finite Element Methods	**PC**	4	3	1	0	**4**	40	60	100
B23AET602	Aircraft Stability and Control	**PC**	4	3	1	0	**4**	40	60	100
B23AET603	Rocket and Spacecraft Propulsion	**PC**	4	3	1	0	**4**	40	60	100
	Professional Elective II	**PE**	3	3	0	0	**3**	40	60	100
	Open Elective II	**OE**	3	3	0	0	**3**	40	60	100
B23MCT* **	Mandatory Course II	**MC**	3	3	0	0	**NC**	100	-	100
B23MCT605	Cyber Safety Concepts	**MC**	3	3	0	0	**NC**	100	-	100
Practical										
B23AEP601	Propulsion Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23AEP602	Aircraft Systems Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23AEP603	Innovative Design Practices	**PW**	4	0	0	4	**2**	40	60	100
Total credits to be earned							**24**			

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Semester – VII										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MGT701	Universal Human Values	**HS**	3	3	0	0	**2**	40	60	100
B23AET701	Composites Materials and Structures	**PC**	3	3	0	0	**3**	40	60	100
B23AET702	Computational Fluid Dynamics	**PC**	3	3	0	0	**3**	40	60	100
B23AEI701	Avionics	**PC**	5	3	0	2	**4**	50	50	100
	Professional Elective III	**PE**	3	3	0	0	**3**	40	60	100
	Professional Elective IV	**PE**	3	3	0	0	**3**	40	60	100
Practical										
B23AEP701	Computer Aided Simulation Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23AEP702	Project work Phase I	**PW**	8	0	0	8	**4**	40	60	100
Total credits to be earned							**24**			

Semester – VIII										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Practical										
B23AET801	Wind Tunnel Techniques	**PC**	3	3	0	0	**3**	40	60	100
B23AEP801	Project Work Phase II	**PW**	16	0	0	16	**8**	40	60	100
Total credits to be earned							**11**			

Programme Coordinator

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HUMANITIES AND SOCIAL SCIENCES (HS)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23IPT101	Induction Programme	HS	-	-	-	-	0	-	-	-
B23ENT101	Professional English	HS	2	2	0	0	2	40	60	100
B23HST101	தமிழர் மரபு / Heritage of Tamils	HS	1	1	0	0	1	40	60	100
B23ENI101	Professional Communication	HS	5	3	0	2	4	50	50	100
B23HST201	தமிழரும் தொழில் நுட்பமும் /Tamils and Technology	HS	1	1	0	0	1	40	60	100
B23MGT701	Universal Human Values	HS	3	3	0	0	2	40	60	100

BASIC SCIENCES (BS)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MAT101	Matrices and Differential Calculus	BS	4	3	1	0	4	40	60	100
B23CHI101	Engineering Chemistry	BS	5	3	0	2	4	50	50	100
B23PHI101	Engineering Physics	BS	5	3	0	2	4	50	50	100
B23MAT201	Integral Calculus and Complex Analysis	BS	4	3	1	0	4	40	60	100
B23MAT301	Transforms and Partial Differential Equations	BS	4	3	1	0	4	40	60	100
B23MAT403	Numerical Methods	BS	4	3	1	0	4	40	60	100

ENGINEERING SCIENCES (ES)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MET101	Engineering Graphics	ES	4	2	2	0	4	40	60	100
B23CSI102	Problem Solving and Python Programming	ES	5	3	0	2	4	50	50	100
B23MEP101	Engineering Practices Laboratory	ES	4	0	0	4	2	60	40	100
B23MET201	Engineering Mechanics	ES	4	3	1	0	4	40	60	100
B23EEI202	Basics Electrical and Electronics Engineering	ES	5	3	0	2	4	50	50	100

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PROFESSIONAL CORE (PC)

Course Code	Course Name	CT	Instructional Hours				Assessment			
			CP	L	T	P	C	CIA	ESE	Total
B23AET301	Fundamentals of Aerospace Engineering	PC	3	3	0	0	3	40	60	100
B23AET302	Solid Mechanics	PC	3	3	0	0	3	40	60	100
B23AET303	Engineering Fluid Mechanics	PC	3	3	0	0	3	40	60	100
B23AEI301	Aero Engineering Thermodynamics	PC	5	3	0	2	4	50	50	100
B23AEP301	Solid Mechanics Laboratory	PC	4	0	0	4	2	60	40	100
B23AEP302	Engineering Fluid Mechanics Laboratory	PC	4	0	0	4	2	60	40	100
B23AET401	Advanced Solid Mechanics	PC	4	3	1	0	4	40	60	100
B23AET402	Air Breathing Propulsion	PC	3	3	0	0	3	40	60	100
B23AET403	Aircraft Systems and Instruments	PC	3	3	0	0	3	40	60	100
B23AEI401	Low Speed Aerodynamics	PC	5	3	0	2	4	50	50	100
B23AEP401	Aircraft Component Drawing Laboratory	PC	4	0	0	4	2	60	40	100
B23AET501	Aircraft Performance	PC	4	3	1	0	4	40	60	100
B23AET502	High Speed Aerodynamics	PC	4	3	1	0	4	40	60	100
B23AET503	Drone Technology with IoT	PC	3	3	0	0	3	40	60	100
B23AEI501	Aircraft Structures	PC	4	3	0	2	4	50	50	100
B23AEP501	Aero Engine and Airframe Laboratory	PC	4	0	0	4	2	60	40	100
B23AEP502	Aircraft Design Laboratory	PC	4	0	0	4	2	60	40	100
B23AET601	Finite Element Methods	PC	4	3	1	0	4	40	60	100
B23AET602	Aircraft Stability and Control	PC	4	3	1	0	4	40	60	100
B23AET603	Rocket and Spacecraft Propulsion	PC	4	3	1	0	4	40	60	100
B23AEP601	Propulsion Laboratory	PC	4	0	0	4	2	60	40	100
B23AEP602	Aircraft Systems Laboratory	PC	4	0	0	4	2	60	40	100
B23AET701	Composites Materials and Structures	PC	3	3	0	0	3	40	60	100
B23AET702	Computational Fluid Dynamics	PC	3	3	0	0	3	40	60	100
B23AEI701	Avionics	PC	5	3	0	2	4	50	50	100
B23AEP701	Computer Aided Simulation Laboratory	PC	4	0	0	4	2	60	40	100
B23AET801	Wind Tunnel Techniques	PC	3	3	0	0	3	40	60	100

Programme Coordinator

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PROJECT WORK (PW)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23AEP603	Innovative Design Practices	PW	4	0	0	4	2	40	60	100
B23AEP702	Project work Phase I	PW	8	0	0	8	4	40	60	100
B23AEP801	Project Work Phase II	PW	16	0	0	16	8	40	60	100

MANDATORY COURSE (MC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
MANDATORY COURSE I										
B23MCT501	Environmental Sustainability	MC	3	3	0	0	NC	100	-	100
B23MCT502	Elements of Literature	MC	3	3	0	0	NC	100	-	100
B23MCT503	Foundations of Yoga	MC	3	3	0	0	NC	100	-	100
B23MCT504	Export Import Management	MC	3	3	0	0	NC	100	-	100
B23MCT505	Holistic insight into UN SDGs	MC	3	3	0	0	NC	100	-	100
MANDATORY COURSE II										
B23MCT601	Education Psychology	MC	3	3	0	0	NC	100	-	100
B23MCT602	Life Style Education	MC	3	3	0	0	NC	100	-	100
B23MCT603	Startup and Venture Funding	MC	3	3	0	0	NC	100	-	100
B23MCT604	Indian Knowledge System	MC	3	3	0	0	NC	100	-	100
B23MCT605	Cyber Safety Concepts	MC	3	3	0	0	NC	100	-	100

CAREER ENHANCEMENT COURSE (CEC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23CEP201	Soft Skills	CEC	2	2	0	0	NC	100	-	100
B23CEP202	Application Design and Development	CEC	1	1	0	0	NC	100	-	100
B23CEP301	Professional Certificate Course	CEC	2	0	0	2	1	100	-	100
B23CEP501	Summer Internship	CEC	-	-	-	-	1	100	-	100

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OPEN ELECTIVES (OE)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23AEO501	Principles of Flight	OE	3	3	0	0	3	40	60	100
B23AEO601	Unmanned Aircraft Systems Operation and MRO	OE	3	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6
Aerodynamics	**Propulsion**	**Structures**	**Computational Engineering**	**Aircraft Maintenance**	**Avionics and Drone Technology**
Experimental Aerodynamics	Heat Transfer for Aerospace Applications	Aero Elasticity	Numerical Methods in Fluid Dynamics	Aircraft General Engineering and Maintenance practices	Avionics System
Industrial Aerodynamics	Cryogenics Engineering	Advanced Aerospace Materials	Computational Heat Transfer	Aero Engine Maintenance and Repair	Aircraft Navigation System
Aircraft Design	Combustion Engineering	Experimental Stress Analysis	Computer Aided Design and Analysis	Airframe Maintenance and Repair	Aircraft System Modelling and Simulation
Helicopter Aerodynamics	Advanced Propulsion Systems	Fatigue and Fracture Mechanics	Grid Generation Techniques	Helicopter Maintenance	Aircraft Guidance and Control System
Hypersonic Aerodynamics	Rockets and Missiles	Non Destructive Testing and Evaluation	Computational Structural Mechanics	Aircraft Rules and Regulation CAR PART I	Air Traffic Control and Planning
Boundary Layer Theory	Electric Propulsion	Theory of Vibrations	Cyber Security in Aerospace Applications	Aircraft Rules and Regulation CAR PART II	UAV System Design
Launch Vehicle Design	Aircraft Engine Design	Structural Dynamics	Artificial Intelligence Systems for Unmanned Aerial Vehicles	Airline and Airport Management	Control Engineering
Missile Aerodynamics	Turbo Machines	Theory of Elasticity	Computer Integrated Manufacturing and Systems	Disaster Management	Aerodynamics of Drones

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: AERODYNAMICS

Course Code	Course Name	CT	Instructional Hours				Assessment			
			CP	L	T	P	C	CIA	ESE	Total
B23AEE901	Experimental Aerodynamics	PE	3	3	0	0	3	40	60	100
B23AEE902	Industrial Aerodynamics	PE	3	3	0	0	3	40	60	100
B23AEE903	Aircraft Design	PE	3	3	0	0	3	40	60	100
B23AEE904	Helicopter Aerodynamics	PE	3	3	0	0	3	40	60	100
B23AEE905	Hypersonic Aerodynamics	PE	3	3	0	0	3	40	60	100
B23AEE906	Boundary Layer Theory	PE	3	3	0	0	3	40	60	100
B23AEE907	Launch Vehicle Design	PE	3	3	0	0	3	40	60	100
B23AEE908	Missile Aerodynamics	PE	3	3	0	0	3	40	60	100

VERTICAL 2: PROPULSION

Course Code	Course Name	CT	Instructional Hours				Assessment			
			CP	L	T	P	C	CIA	ESE	Total
B23AEE909	Heat Transfer for Aerospace Applications	PE	3	3	0	0	3	40	60	100
B23AEE910	Cryogenics Engineering	PE	3	3	0	0	3	40	60	100
B23AEE911	Combustion Engineering	PE	3	3	0	0	3	40	60	100
B23AEE912	Advanced Propulsion Systems	PE	3	3	0	0	3	40	60	100
B23AEE913	Rockets and Missiles	PE	3	3	0	0	3	40	60	100
B23AEE914	Electric Propulsion	PE	3	3	0	0	3	40	60	100
B23AEE915	Aircraft Engine Design	PE	3	3	0	0	3	40	60	100
B23AEE916	Turbo Machines	PE	3	3	0	0	3	40	60	100

VERTICAL 3: STRUCTURES

Course Code	Course Name	CT	Instructional Hours				Assessment			
			CP	L	T	P	C	CIA	ESE	Total
B23AEE917	Structural Dynamics	PE	3	3	0	0	3	40	60	100
B23AEE918	Advanced Aerospace Materials	PE	3	3	0	0	3	40	60	100
B23AEE919	Experimental Stress Analysis	PE	3	3	0	0	3	40	60	100
B23AEE920	Fatigue and Fracture Mechanics	PE	3	3	0	0	3	40	60	100
B23AEE921	Theory of Vibrations	PE	3	3	0	0	3	40	60	100

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B23AEE922	Theory of Elasticity	**PE**	3	3	0	0	**3**	40	60	100
B23AEE923	Non Destructive Testing and Evaluation	**PE**	3	3	0	0	**3**	40	60	100
B23AEE924	Aero Elasticity	**PE**	3	3	0	0	**3**	40	60	100

VERTICAL 4: COMPUTATIONAL ENGINEERING										
Course Code	**Course Name**	**CT**	**Instructional Hours**				**Assessment**			
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
B23AEE925	Numerical Methods in Fluid Dynamics	**PE**	3	3	0	0	**3**	40	60	100
B23AEE926	Computational Heat Transfer	**PE**	3	3	0	0	**3**	40	60	100
B23AEE927	Computer Aided Design and Analysis	**PE**	3	3	0	0	**3**	40	60	100
B23AEE928	Grid Generation Techniques	**PE**	3	3	0	0	**3**	40	60	100
B23AEE929	Computational Structural Mechanics	**PE**	3	3	0	0	**3**	40	60	100
B23AEE930	Cyber Security in Aerospace Applications	**PE**	3	3	0	0	**3**	40	60	100
B23AEE931	Artificial Intelligence Systems for Unmanned Aerial Vehicles	**PE**	3	3	0	0	**3**	40	60	100
B23AEE932	Computer Integrated Manufacturing and Systems	**PE**	3	3	0	0	**3**	40	60	100

VERTICAL 5: AIRCRAFT MAINTENANCE										
Course Code	**Course Name**	**CT**	**Instructional Hours**				**Assessment**			
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
B23AEE933	Aircraft General Engineering and Maintenance practices	**PE**	3	3	0	0	**3**	40	60	100
B23AEE934	Aero Engine Maintenance and Repair	**PE**	3	3	0	0	**3**	40	60	100
B23AEE935	Airframe Maintenance and Repair	**PE**	3	3	0	0	**3**	40	60	100
B23AEE936	Helicopter Maintenance	**PE**	3	3	0	0	**3**	40	60	100
B23AEE937	Aircraft Rules and Regulation CAR PART I	**PE**	3	3	0	0	**3**	40	60	100
B23AEE938	Aircraft Rules and Regulation CAR PART II	**PE**	3	3	0	0	**3**	40	60	100
B23AEE939	Airline and Airport Management	**PE**	3	3	0	0	**3**	40	60	100
B23AEE940	Disaster Management	**PE**	3	3	0	0	**3**	40	60	100

VERTICAL 6: AVIONICS AND DRONE TECHNOLOGY										
Course Code	**Course Name**	**CT**	**Instructional Hours**				**Assessment**			
			CP	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**Total**
B23AEE941	Avionics System	**PE**	3	3	0	0	**3**	40	60	100
B23AEE942	Aircraft Navigation System	**PE**	3	3	0	0	**3**	40	60	100

Programme Coordinator

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B23AEE943	Aircraft System Modelling and Simulation	**PE**	3	3	0	0	**3**	40	60	100
B23AEE944	Aircraft Guidance and Control System	**PE**	3	3	0	0	**3**	40	60	100
B23AEE945	Air Traffic Control and Planning	**PE**	3	3	0	0	**3**	40	60	100
B23AEE946	UAV System Design	**PE**	3	3	0	0	**3**	40	60	100
B23AEE947	Control Engineering	**PE**	3	3	0	0	**3**	40	60	100
B23AEE948	Aerodynamics of Drones	**PE**	3	3	0	0	**3**	40	60	100

VERTICALS FOR MINOR DEGREE

AIRCRAFT MAINTENANCE

Course Code	Course Name	CT	Instructional Hours				Assessment			
			CP	L	T	P	C	CIA	ESE	Total
B23AEE933	Aircraft General Engineering and Maintenance practices	**PE**	3	3	0	0	**3**	40	60	100
B23AEE934	Aero Engine Maintenance and Repair	**PE**	3	3	0	0	**3**	40	60	100
B23AEE935	Airframe Maintenance and Repair	**PE**	3	3	0	0	**3**	40	60	100
B23AEE936	Helicopter Maintenance	**PE**	3	3	0	0	**3**	40	60	100
B23AEE937	Aircraft Rules and Regulation CAR PART I	**PE**	3	3	0	0	**3**	40	60	100
B23AEE938	Aircraft Rules and Regulation CAR PART II	**PE**	3	3	0	0	**3**	40	60	100
B23AEE939	Airline and Airport Management	**PE**	3	3	0	0	**3**	40	60	100
B23AEE940	Disaster Management	**PE**	3	3	0	0	**3**	40	60	100

Programme Coordinator

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Syllabus

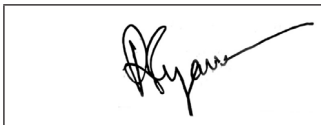
Semester – I

B.E. / B.Tech. (Except CSBS)	B23ENT101 – PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives	
1.	To develop the listening and reading skills of first year engineering and technology students.
2.	To help learners' develop vocabulary through reading skills.
3.	To enhance learners' grammatical knowledge.
4.	To enhance the learners' ability of writing different complex texts.
5.	To develop the competency of learners through LSRW skills.

UNIT – I		6
Listening	Listening to voicemail & messages; Listening and contextualizing.	
Speaking	Replying to polite requests and offers, understanding basic instructions.	
Reading	Short comprehension passages, practice in skimming & scanning.	
Writing	Writing Instructions.	
Language development	Parts of Speech, Wh - Questions, yes or no questions, Question tags.	
Vocabulary development	Prefixes - suffixes.	

UNIT – II		6
Listening	Listening commentaries and announcements.	
Speaking	Role Play exercises based on workplace contexts.	
Reading	Comprehension questions including dialogues and conversations.	
Writing	Writing different types of Paragraph.	
Language development	Regular & Irregular Verbs, Tenses.	
Vocabulary development	Understanding contextual meaning, Synonyms.	



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UNIT – III	6
Listening	Listening to a product launch-sensitizing leaners to the nuances of persuasive communication.
Speaking	Debate - discussion on current issues.
Reading	Short texts and longer passages - note making.
Writing	Understanding text structure, use of reference words and discourse markers, jumbled sentences.
Language development	Idioms and Phrases, Degrees of comparison.
Vocabulary development	One word substitutes.

UNIT – IV	6
Listening	Listening to short academic videos.
Speaking	Making short presentation through short films.
Reading	Intensive and Extensive reading-reading different types of magazines.
Writing	Letter writing- formal and informal.
Language development	Direct / indirect questions.
Vocabulary development	Phrasal verbs

UNIT – V	6
Listening	Listening to talks/lectures by specialists on specific topics.
Speaking	Discussion on general and current topics.
Reading	Longer texts - cloze reading.
Writing	Writing short essays, developing outline, identifying main and subordinate ideas, Dialogue writing.
Language development	Spelling and Punctuations, Modal verbs.
Vocabulary development	Collocations
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Develop listening and reading skills for effective communication
CO2	Develop vocabulary skills
CO3	Build grammatical understanding
CO4	Explain opinions efficiently in writing formal and informal contexts
CO5	Develop knowledge through LSRW skills

Text Books	
1.	Board of Editors Using English, “A Course book for Undergraduate Engineers and Technologists”, Orient Black Swan Limited, Hyderabad : 2015.
2.	Richards, C. Jack,“ Interchange Students Book - 2”, New Delhi, CUP, 2015.

Reference Books	
1.	Bailey, Stephen, “A practical guide for students”, New York Rutledge, 2011.
2.	Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice” Oxford University Press: New Delhi, 2014.
3.	Dutt P. Kiranmai and Rajeevan Geeta, “Basic Communication Skills”, Foundation Books, 2013.

Approved by BoS Chairman

B.E. / B.Tech.	B23MAT101 - MATRICES AND DIFFERENTIAL CALCULUS (Common to all Branches)	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To develop the use of matrices that is needed by engineers for practical applications.
2.	To understand the concept of functions of several variables.
3.	To recognize and classify ordinary differential equations.
4.	To apply the concept of ordinary differential equations in engineering disciplines.
5.	To learn the applications of Laplace transforms in engineering.

UNIT - I	MATRICES	12

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley Hamilton theorem – Quadratic form: Nature, Reduction to canonical form by orthogonal transformation

UNIT - II	FUNCTIONS OF SEVERAL VARIABLES	12

Partial differentiation –Total derivative – Jacobians – Taylor‘s series expansion for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers

UNIT - III	ORDINARY DIFFERENTIAL EQUATIONS	12

Higher order linear ordinary differential equations with constant coefficients - Method of variation of parameters - Simultaneous differential equations

UNIT - IV	APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS	12

Solution of specified differential equations connected with electric circuits - Law of Natural growth and decay - Simple harmonic motion (Differential equations and associated conditions need to be given)

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UNIT - V	LAPLACE TRANSFORM	12
Existence conditions - Properties (excluding proofs) - Transform of standard functions -Transforms of derivatives and integrals - Inverse Laplace transform - Applications to solution of linear second order ordinary differential equations with constant coefficients		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Make use of Eigen values and Eigen vectors to reduce the quadratic form into canonical form and to find the powers of a square matrix.
CO2	Construct maxima and minima problems.
CO3	Solve differential equations which existing in different engineering disciplines.
CO4	Develop the applications of differential equations in various engineering field.
CO5	Apply Laplace transform and inverse transform to solve differential equations with constant coefficients.

Text Books	
1.	Grewal B.S.,"Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2015.
2.	Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media - An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2015.
3.	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2015.
4.	George B. Thomas, Joel Hass, Christopher Heil, Maurice D. Weir, "Thomas' Calculus", Pearson, 14th Edition, 2018.

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Reference Books	
1.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2019.
2.	Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
3.	Ramana B V., “Higher Engineering Mathematics”, Tata Mc Graw Hill Publishing Company, New Delhi, 2017.
4.	Veerarajan T., “Engineering Mathematics for Semester I and II”, Tata Mc Graw Hill Publishing Company, New Delhi, 2019.
5.	Gean Duffy., “Advanced Engineering Mathematics with MATLAB”, A CRC Press Company, Boca Raton London, New York Washington, D.C, 2nd edition 2009. (Free e-book downloaded from www.EasyEngineering.net.pdf).

Approved by BoS Chairman

B.E / B.Tech	B23MET101 – ENGINEERING GRAPHICS (Common to All)	L	T	P	C
		2	2	0	4

Course Objectives	
1.	Understand the conventions and method of Engineering drawing.
2.	Construct and interpret the basic Engineering drawings.
3.	Improve their visualization skills so that they can apply these skills in new product development.
4.	Enhance their technical communication skill in the form of communicative drawings.
5.	Comprehend the theory of projection.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)	2
Importance of graphics in Engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning	

UNIT - I	PLANE CURVES AND FREE HANDSKETCHING	14
Basic Geometrical constructions, Curves used in Engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects		

UNIT - II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	14
Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method		

UNIT - III	PROJECTION OF SOLIDS	14
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method		

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UNIT - IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	14
Sectioning of solids in simple vertical position when the cutting plane is inclined to the 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 cylinders and cones		

UNIT - V	ISOMETRIC AND PERSPECTIVE PROJECTIONS	14
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-prisms, pyramids and cylinders by visual ray method		

COMPUTER AIDED DRAFTING	3
Introduction to drafting packages and demonstration of their use Basic Geometrical constructions using AUTOCAD	
Total Instructional hours : 75	

Course Outcomes : Students will be able to	
CO1	Construct the basic Engineering curves and freehand sketching of basic geometrical constructions and multiple views of objects.
CO2	Draw problems related to projections of points, straight lines, planes and solids.
CO3	Build the projection of simple solids.
CO4	Apply the knowledge acquired on practical applications of sectioning and development of solids.
CO5	Construct simple solids and its sections in isometric view and projections and to draw its perspective views.

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Text Books	
1.	K.V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhana Lakshmi Publishers, Chennai, 2015.
2.	N.D. Bhatt and V.M. Panchal, “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2014.

Reference Books	
1.	K. Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Publishers, 2017.
2.	K.R.Gopalakrishna., “Engineering Drawing” (Vol. I & II combined) Subhas Publications, Bangalore, 2018.
3.	N.S Parthasarathy and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.

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B.E. / B.Tech.	B23HST101 - தமிழர் மரபு	L	T	P	C
		1	0	0	1

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 - சிற்பக்கலை	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 - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி

அலகு - V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டில் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

மொத்தம் - 15 காலங்கள்

Approved by BoS Chairman

Text - Cum - Reference Books	
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 of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

Approved by BoS Chairman

B.E. / B.Tech.	B23HST101 - HERITAGE OF TAMILS (Common to all Branches)	L	T	P	C
		1	0	0	1

UNIT - I	LANGUAGE AND LITERATURE	3

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan

UNIT - II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART - SCULPTURE	3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils

UNIT - III	FOLK AND MARTIAL ARTS	3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils

UNIT - IV	THINAI CONCEPT OF TAMILS	3

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 - Export and Import during Sangam Age - Overseas Conquest of Cholas

UNIT - V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3

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

Total Instructional hours : 15

Approved by BoS Chairman

Text - Cum - Reference Books	
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 of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

Approved by BoS Chairman

B.E. / B.Tech.	B23CHI101 - ENGINEERING CHEMISTRY (Common to all Branches)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To make the students conversant with boiler feed water requirements, related problems, water treatment and inculcate practical skills in the water quality analysis.
2.	To make the students conversant with basics of polymer chemistry.
3.	To make the students conversant with basic of electrochemical reactions, corrosion and induce experimental skills in the electro-analytical techniques.
4.	To make the student acquire sound knowledge of energy devices.
5.	To develop an understanding of the basic concepts of nano materials.

UNIT - I	WATER TECHNOLOGY	17

Hardness of water : Types, expression of hardness and their units, hardness problems, boiler troubles - scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming

Treatment of Boiler feed water : Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning)

External treatment : Ion exchange process, Zeolite process

Desalination of brackish water : Reverse osmosis - municipal water treatment, break point chlorination

Determination of alkalinity in water sample, Determination of total, temporary & permanent hardness of water by EDTA method. Estimation of iron content of the water sample using spectrophotometer

UNIT - II	POLYMERS	9

Polymers : Definition, polymerization, types - addition and condensation polymerization, free radical mechanism - tacticity – biodegradable polymer (PHBV) and conducting polymer (poly-aniline)

Plastics : Classification, preparation, properties and uses of PVC, teflon, nylon-6, 6 and epoxy resin

Rubber : Vulcanization of rubber, synthetic rubbers -n-butyl rubber and SBR

Moulding : Ingredients - compression and Injection

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UNIT - III	ELECTROCHEMISTRY AND CORROSION	16

Electrochemistry : Redox reaction, electrode potential - oxidation potential, reduction potential, Nernst equation (derivation) - measurement and applications - electrochemical series and its significance

Corrosion : causes - types-chemical and electrochemical corrosion (galvanic and differential aeration), corrosion control - electrochemical protection (sacrificial anodic method and impressed current cathodic method)

Estimation of iron content of the given solution using potentiometer, Conductometric titration of strong acid vs strong base, Estimation of copper in brass

UNIT - IV	ENERGY DEVICES	9

Batteries : Types of batteries – primary (alkaline battery) and secondary battery (lead acid battery, lithium-ion-battery), Fuel Cells (H_2 - O_2 fuel cell)

Super Capacitors : Principle, construction, working and applications

Photo voltaic cell : Solar cells - principle, construction, working and applications

UNIT - V	NANOCHEMISTRY	9

Basics : Distinction between molecules, nanoparticles and bulk materials- surface area to volume ratio

Synthesis : Top-down process (ball milling) - Bottom-up process (chemical vapour deposition and sol-gel method)

Properties of nano materials - Optical, electrical, thermal and mechanical

Applications of nano materials - Medicine, Industries, electronics and biomaterials

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Determine the characterization of water and quantitative analysis of alkalinity, hardness and Iron. (K5)
CO2	Develop the basics of polymer chemistry. (K3)
CO3	Interpret the principles of electrochemical reactions, corrosion and estimation of copper in Alloy. (K5)
CO4	Apply the concepts of energy devices and its engineering applications. (K3)
CO5	Organize the basics of Nano chemistry and its applications. (K3)

Approved by BoS Chairman

Text Books	
1.	Dara, S S and Umare, S S, “A Textbook of Engineering Chemistry”, Chand S & Company Ltd., New Delhi, 2015.
2.	Jain, P C and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2015
3.	Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Reference Books	
1.	Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt. Ltd., New Delhi, 2014.
2.	Prasanta Rath, “Engineering Chemistry”, Cengage Learning India Pvt. Ltd., Delhi, 2015.
3.	Shikha Agarwal, “Engineering Chemistry - Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.
4.	Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", John Wiley Sons, New Jersey, 2003.

Equipment Needed for 30 Students

1. Conductivity Meter-10
2. Potentiometer-10
3. Spectrophotometer-02
4. Electronic Balance-01

Approved by BoS Chairman

B.E.	B23CSI102 - PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to AERO, AGRI, BT and MECH)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To develop python programs with conditional statements and loops.
2.	To learn how to use strings, functions and pass arguments in Python.
3.	To use python data structures such as lists, tuples, and dictionaries.
4.	To use file concepts and to build a package using Python modules for reusability.
5.	To learn the fundamentals of data manipulations with Python.

UNIT - I	INTRODUCTION TO PYTHON PROGRAMMING	9

Introduction : Python basics and its scripting modes – Variables, Operators - Control Structures : if, if - else, nested if, if – elif ladder statements - Iterative statements : while, for, Nested loops, else in loops, break, continue and pass statements

UNIT - II	STRINGS AND FUNCTIONS	9

Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions. Regular expression: Matching the patterns, Search and replace. Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments

UNIT - III	COLLECTIONS	9

List : Create, Access, Slicing, Negative Indices, List Methods, and comprehensions, Tuples : Create, Indexing and Slicing, Operations on tuples. Dictionary: Create, add, and replace values, operations on dictionaries

UNIT - IV	SETS AND FILE HANDLING	9

Sets : Create and operations on set, Files : Manipulating files and directories, text files : reading / writing text and numbers from / to a file; creating and reading a formatted file (csv or tab separated)

UNIT - V	MODULES AND PACKAGES	9

Modules: Importing module, standard modules, executing modules. Packages: Importing Packages, simple programs using built-in functions of packages like pandas, jumpy, matplotlib

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List of Experiments		
Expt. No.	**Description of the Experiments**	
1.	Programs Using Simple Statements	
	a.	Exchange the values of two variables,
	b.	Circulate the values of n variables,
	c.	Distance between two points.
2.	Programs Using Conditionals and Iterative Statements	
	a.	Number Series
	b.	Number Patterns
	c.	Pyramid Pattern
3.	Programs Using built-in and user defined Functions	
	a.	Factorial of a Number
	b.	Largest Number in a list
	c.	Area of Shape
4.	Programs using Strings	
	a.	Reversing a String
	b.	Checking Palindrome in a String
	c.	Counting Characters in a String
	d.	Replacing Characters in a String
5.	Operations of Lists	
	a.	Basic Operations (Insertion, Updating, deletion, accessing, List Comprehensions)
	b.	Implement linear search and binary search using list.
	c.	Matrix operations using Nested List.
	d.	Implement Merge, Bubble and Insertion sort

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6.	Create a tuple and perform its operations for the following:	
	a.	Basic Operations (Insertion, Updating, deletion, accessing)
	b.	Items present in a library
	c.	Components of a car
	d.	Materials required for construction of a laboratory
7.	Operations of Dictionaries	
	a.	Python program to create a dictionary with integer keys, and print the keys, values & key-value pairs
	b.	Python program to randomize (shuffle) values of dictionary
8.	Operations of Sets	
	a.	Basic operations of set (Membership, Operations and Modifications)
9.	Programs using File Handling	
	a.	Copy from one file to another.
	b.	Word count
	c.	Longest word
10.	Python programs using Time and Calendar related functions	
	a.	Print the current time using time module.
	b.	Display the calendar of given month of the year using calendar module.
11.	Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)	
Total Instructional hours: (45+15) = 60		

Course Outcomes : Students will be able to	
CO1	Construct Python programs using iterative and conditional statements.
CO2	Experiment with user-defined functions and Strings.

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CO3	Build python programs with list, tuples, dictionaries and set.
CO4	Develop Python application using file operations and modules.
CO5	Apply data manipulation concepts using libraries.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
Sl. No.	**Description of the Equipment**	**Quantity required (Nos.)**
1.	HP Make, Core i5, 11th Generation, 16GB RAM PCs, Operating systems: Windows* 10 or later, macOS, and Linux. Python* version: 3.10.X	30

Text Books	
1.	Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Updated for Python 3, Shroff / O ‘Reilly Publishers, 2016
2.	Reema Thereja, “Python Programming using Problem Solving Approach”, 4th Impression, Oxford University Press, 2019.
3.	Python Course Data Analysis with Python by Bernd Klein, 2021.

Reference Books	
1.	John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and expanded Edition, MIT Press, 2013.
2.	Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python : An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd, 2016.
3.	Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd, 2015.
4.	Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.

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B.E. / B.Tech	B23MEP101 – BASIC WORKSHOP PRACTICES LABORATORY (GROUP - A & B) (Common to all Branches)	L	T	P	C
		0	0	4	2

Course Objectives	
1.	Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work, sawing, planning, making joints in wood materials used in common household wood work.
2.	Welding various joints in steel plates using arc welding work; machining various simple processes like turning, drilling, tapping in parts; assembling simple mechanical assembly of common household equipments, making a tray out of metal sheet using sheet metal work.
3.	To provide exposure to the students with hands on experience on various basic Engineering practices in Electrical Engineering.
4.	To provide exposure to the students with hands on experience on various basic Engineering practices in Electronics Engineering.

GROUP – A (CIVIL & MECHANICAL)

I	Civil Engineering Practices	12

Plumbing Works

Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings

Carpentry

Preparation of wooden joints by sawing, planning and cutting

1.	Planning & Polishing operation
2.	Half lap joint
3.	Cross lap joint

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II	Mechanical Engineering Practices	18
Welding Workshop Study of welding tools and equipment's - Study of various welding methods - Instruction of BI standards and reading of welding drawings.		
Exercise in arc welding for making		
1.	Lap joint	
2.	Butt joint	
3.	Demonstration of gas welding and cutting.	
Machine Shop		
1.	Drilling and Tapping	
2.	Lathe Exercise – Facing operation	
3.	Lathe Exercise – Straight turning and Chamfering	
Sheet metal		
Making of small parts using sheet metal		
1.	Making of Square Tray	

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GROUP – B (ELECTRICAL & ELECTRONICS)	30

Expt. No.	Description of the Experiments
1.	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2.	Fluorescent lamp and Stair case wiring.
3.	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
4.	Measurement of energy using single phase energy meter.
5.	Measurement of resistance to earth of an electrical equipment.
6.	Study of Electronic components and equipment's – Resistor color coding
7.	Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
8.	Study of logic gates AND, OR, EX-OR and NOT.
9.	Soldering & desoldering practices.
10.	Study of Fan, Iron Box, Emergency Lamp, Telephone and FM Radio.
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the pipe connections and identify the various components used in plumbing.
CO2	Develop simple wooden joints using wood working tools and simple components using lathe and drilling machine.
CO3	Construct simple lap, butt and tee joints using arc welding equipment and simple parts using sheet metal.
CO4	Construct Residential house wiring, Fluorescent lamp wiring and Stair case wiring.
CO5	Measure electrical quantities such as voltage, current, power & power factor in RLC Circuit, resistance to earth, AC signal parameter (peak-peak, RMS period, frequency) and ripple factor.
CO6	Examine logic gates (AND, OR, EX-OR and NOT), Electronic components and equipment's.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS			
GROUP – A (CIVIL & MECHANICAL)			
Sl. No.	**Description of Equipment**		**Quantity required**
1.	Assorted components for plumbing, Consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.		15
2.	Carpentry vice (fitted to work bench)		15
3.	Standard woodworking tools		15
4.	Models of industrial trusses, door joints, furniture joints		5
5.	Power Tools:		
	(a)	Rotary Hammer	2
	(b)	Demolition Hammer	2
	(c)	Circular Saw	2
	(d)	Planer	2
	(e)	Hand Drilling Machine	2
	(f)	Jigsaw	2
6.	Arc welding transformer with cables and holders		5
7.	Welding booth with exhaust facility		5
8.	Welding accessories like welding shield, chipping hammer, wire brush, etc.		5
9.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.		2
10.	Centre lathe		2
11.	Hearth furnace, anvil and smithy tools		2
12.	Moulding table, foundry tools		2
13.	Power Tool: Angle Grinder		2
14.	Study-purpose items: Centrifugal pump, Airconditioner		1

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GROUP – B (ELECTRICAL & ELECTRONICS)		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Assorted Electrical Components for House Wiring	15 sets
2.	Electrical Measuring Instruments	10 sets
3.	Iron Box	1
4.	Fan and Regulator	1
5.	Emergency Lamp	1
6.	Megger	1
7.	Digital Live Wire Detector	2
8.	Soldering Guns	10
9.	Assorted Electronic Components for Making Circuits	50
10.	Multipurpose PCBs	10
11.	Multi Meters	10
12.	Telephone	2
13.	FM radio	2
14.	Regulated Power Supply	2
15.	CRO (30MHz)	2
16.	Bread board	10
17.	Digital IC types (IC 7432, IC 7408, IC 7400, IC 7404, IC 7402, IC 7486)	Each 10

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Semester – II

B.E. / B.Tech.	B23MAT201 - INTEGRAL CALCULUS AND COMPLEX ANALYSIS (Common to all Branches)	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To recognize various techniques of integration.
2.	To apply integration techniques in evaluating area and volume of solids.
3.	To develop the use of Vector calculus in two and three dimensional spaces.
4.	To demonstrate understanding of the basic concepts of complex differentiation.
5.	To understand Cauchy theorem and Cauchy integral formulae and apply these to evaluate complex contour integrals.

UNIT - I	INTEGRAL CALCULUS	12

Riemann sum – Definite and Indefinite integrals - Substitution rule (Exponential, logarithmic, Trigonometric functions) – Integration by parts – Integration of Rational functions by Partial fraction

UNIT - II	MULTIPLE INTEGRALS	12

Double integrals : Double integrals in Cartesian coordinates - Double integrals in Polar coordinates – Area enclosed by plane curves – Triple integrals: Evaluation of triple integrals - Volume as triple integral (Simple problems)

UNIT - III	VECTOR CALCULUS	12

Gradient and directional derivative - Divergence and curl - Solenoidal and Irrotational vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and applications (for cubes and rectangular parallellopipeds)

UNIT - IV	COMPLEX DIFFERENTIATION	12

Analytic functions - Cauchy - Riemann equations (excluding proof) – Properties of analytic function – Harmonic conjugate - Construction of analytic function by Milne Thomson method – Bilinear transformation

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UNIT - V	COMPLEX INTEGRATION	12
Cauchy‘s integral theorem – Cauchy‘s integral formula – residues - Cauchy‘s Residue theorem – Evaluation of real integrals – Stereographic projection – Use of circular contour and semicircular contour (excluding poles on real axis)		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop Fundamental Theorem of Calculus, techniques of Integration such as substitution, partial fractions and integration by parts.
CO2	Make use of integration to compute area and volume.
CO3	Apply the line, surface and volume integrals for verification of Green‘s, Gauss and Stokes theorems.
CO4	Develop an understanding of the standard techniques of complex variable theory in particular analytic function
CO5	Classify and compare the different types of Crystals, their structures and its defects.

Text Books	
1.	Grewal B.S.,”Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3.	George B. Thomas , Joel Hass , Christopher Heil , Maurice D. Weir, “Thomas' Calculus”, Pearson, 14th Edition, 2018.

Reference Books	
1.	Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media - An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2015.
2.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition 2019.

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3.	O'Neil, P.V.,"Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd, New Delhi, 7th Edition 2017.
4.	Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5.	Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics", (Tata McGraw Hill Education Pvt. Ltd), 6th Edition, New Delhi, 2012.
6.	Gean Duffy., "Advanced Engineering Mathematics with MATLAB", A CRC Press Company, Boca Raton London, New York Washington, D.C, 2nd edition 2009. (Free e-book downloaded from www.EasyEngineering.net.pdf)

Approved by BoS Chairman

B.E. / B.Tech.	B23HST201- தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

அலகு – I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு – II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை

அலகு – III	உற்பத்தித் தொழில் நுட்பம்	3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருவாக்குதல், எ.ஃ.கு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

அலகு – IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன் வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்

அலகு – V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்

மொத்தம் – 15 காலங்கள்

Approved by BoS Chairman

Text - Cum - Reference Books	
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
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 of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroy of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

Approved by BoS Chairman

B.E. / B.Tech.	B23HST201- TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT - I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries

UNIT - II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

UNIT - III	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel - Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram

UNIT - IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society

UNIT - V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

Total Instructional hours : 15

Approved by BoS Chairman

Text - Cum - Reference Books	
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 of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

Approved by BoS Chairman

B.E.	B23MET201 – ENGINEERING MECHANICS (Common to Mech, Aero, Agri)	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To make the students understand the vector and scalar representation of forces and the static equilibrium of particles.
2.	To understand the moment and the equilibrium of rigid bodies in two dimensions and three dimensions.
3.	To make the students understand the properties of surfaces and solids in relation to moment of inertia.
4.	To understand laws of motion, kinetics of particles and their interrelationship.
5.	To make the students understand effect of friction on equilibrium in rigid bodies.

UNIT - I	STATICS OF PARTICLES	12

Introduction – Units and Dimensions – Laws of Mechanics – Principle of transmissibility – Lami's theorem, Parallelogram and triangular Law of forces – Coplanar Forces – rectangular components – Equivalent systems of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space using vector representation

UNIT - II	EQUILIBRIUM OF RIGID BODIES	12

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Varignon's theorem - Moment of a force about a point and about an axis – Scalar components of a moment – Single equivalent force - Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force - Couple system – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT - III	PROPERTIES OF SURFACES AND SOLIDS	12

Centroids and centre of mass – Centroids of lines and areas – T section, I section, Angle section and Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – T section, I section, Angle section and Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Mass moment of inertia for cylindrical and spherical solids from first principle

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UNIT - IV	DYNAMICS OF PARTICLES	15
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics - Newton's Second Law of Motion - Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies		

UNIT - V	FRICTION	9
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the basics and state of particles and understand the vectorial and scalar representation of forces and moments.
CO2	Interpret static equilibrium of particles and rigid bodies in two and three dimensions.
CO3	Identify the properties of surfaces & solids in relation to moment of inertia.
CO4	Illustrate the laws of motion, kinematics and kinetics of particles and their interrelationship.
CO5	Determine the friction and the effects by the laws of friction

Text Books	
1.	Vela Murali, "Engineering Mechanics", Oxford University Press, 2018.
2.	Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12th Edition, 2019.

Reference Books	
1.	Hibbeller, R.C., Engineering Mechanics: Statics and Dynamics, 13th Edition, Prentice Hall, 2013.
2.	Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.
3.	Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.

Approved by BoS Chairman

B.E. / B.Tech.	B23CEP201 – SOFT SKILLS (Common to all Branches)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To identify personality using evaluation method.
2.	To encourage creative thinking by practice.
3.	To enrich interpersonal skills through integrated activities.
4.	To develop social and professional etiquette.
5.	To identify and apply employability skills for professional success.

UNIT - I	SELF EVALUATION	6
Introduction to soft skills, Familiarize oneself, Self-understanding, SWOT analysis, Goal Setting		

UNIT - II	INNOVATIVE THINKING	6
Divergent thinking, Encourage curiosity, Writing a story, Poster making		

UNIT - III	INTERPERSONAL SKILLS	6
Interpersonal skills - Need & Components – Understanding Intercultural Competence - Team Work-Problem Solving Skills - Conflict Management & Resolutions in Workplace, Leadership skills, Managerial skills		

UNIT - IV	BUSINESS ETIQUETTE	6
Define Etiquette -Types and Importance of Workplace Etiquette - Basic Corporate Etiquette - Telephone Etiquette - Meeting & E-mail Etiquette - Customer Service Etiquette		

UNIT - V	CORPORATE SKILLS	6
Work Ethics - Adaptability - Analytical Reasoning - Lateral Thinking - Stress & Time Management		
		Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Identify different personalities.
CO2	Show creative skill in different aspects.
CO3	Utilize leadership skills with ability to work in a team.
CO4	Analyze work place etiquette.
CO5	Develop adequate soft skills required for the workplace.

Reference Books	
1.	Butterfield, Jeff “Soft Skills for Everyone” Cengage Learning, New Delhi, 2015.
2.	S.Hariharanetal ”Soft Skills” MJP Publishers : Chennai, 2010.
3.	Peter, Francis “Soft Skills and Professional Communication” New Delhi : Tata McGraw Hill, 2012. Print.
4.	Meenakshi Raman, Shalini Upadhyay, ’Soft Skills’, Cengage Learning India Pvt. Ltd, Delhi, 2018.
5.	M.S. Rao, ‘Soft Skills Enhancing Employability’, I. K. International Publishing House Pvt. Ltd, New Delhi, 2010
6.	Sabina Pillai, Agna Fernandez, ‘Soft Skills and Employability Skills’, Cambridge University Press, 2018.
7.	John Peter.A, ‘Self – Development and Professional Excellence’, Cengage Learning India Pvt. Ltd, Delhi, 2019.

Approved by BoS Chairman

B.E. / B.Tech. (Except CSBS)	B23ENI101 – PROFESSIONAL COMMUNICATION	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To enhance listening and reading ability of learners to comprehend various forms of speech or conversations.
2.	To develop learners' verbal ability through complex texts and speak effectively in real life and workplace context.
3.	To make use of grammatical knowledge to enhance fluency.
4.	To foster learners' ability to write convincing job applications and effective reports.
5.	To develop learners language proficiency through LSRW skills.

UNIT – I	9
Listening	Listening for general information - specific details - conversation - Audio / video (formal & informal); Telephone conversation
Speaking	Self-Introduction; Introducing a friend; - politeness strategies - making polite requests & polite offers
Reading	Introduction to technical texts, scientific texts
Writing	Extended definitions, Writing checklists, Recommendation
Language development	Gerunds, Infinitives
Vocabulary development	Technical vocabulary, abbreviations, British & American spelling

UNIT – II	9
Listening	Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities
Speaking	Narrating personal experiences / Talking about events and situations
Reading	Reading longer technical texts, Summarizing

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Writing	Interpreting graphical representations, Writing dialogues about formal and informal contexts
Language development	Use of conjunctions and prepositions
Vocabulary development	Numerical adjectives, Transitional device

UNIT – III	**9**
Listening	Listen to a classroom lecture; listening to advertisements about products
Speaking	Picture description - describing locations in workplace, Presenting product, describing shape, size and weight - talking about quantities - talking about precautions, discussing advantages and disadvantages - making comparisons
Reading	Cause & effect texts, practice in speed reading
Writing	Process writing, Use of sequence words, Analytical and issue based essays
Language development	Subject verb agreement, Pronoun concord / pronoun antecedent
Vocabulary development	Sequence words, Misspelled words, Content v/s Function words

UNIT – IV	**9**
Listening	Listening to TED Talks, Educational videos and completing exercises based on them
Speaking	Short speech (Just A Minute) - Extempore and persuasive speech, discussing and making plans-talking about tasks-talking about progress
Reading	Reading for details in personal and professional emails
Writing	Drafting personal and professional emails, job application - cover letter, résumé preparation, Internship letter
Language development	Clauses, if conditionals
Vocabulary development	Finding suitable synonyms, Paraphrasing

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UNIT – V		9
Listening	Listening to debates/ discussions and panel discussions, listening to interviews	
Speaking	Making predictions - talking about a given topic, giving opinions & facts, describing a process, discussing safety issues (making recommendations)	
Reading	Reading and understanding technical articles	
Writing	Writing reports, Minutes of meeting, Writing feasibility, survey and industrial reports	
Language development	Reported speech, Active and Passive voice, Impersonal passive, Idioms	
Vocabulary development	Verbal analogies, Purpose statements	
		Total Theory Instructional hours : 45 **Total Lab Instructional hours : 30**

Course Outcomes : Students will be able to	
CO1	Develop listening skills to respond appropriately in general and academic purposes.
CO2	Develop strategies and skills to enhance their ability to read and comprehend.
CO3	Apply vocabulary skills to improve their language skills.
CO4	Build the writing skills with specific reference to technical writing.
CO5	Demonstrate language proficiency through LSRW skills.

Text Books	
1.	Board of Editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad : 2016
2.	Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

Approved by BoS Chairman

Reference Books	
1.	Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice” Oxford University Press: New Delhi, 2014.
2.	Kumar, Suresh. E. “Engineering English” Orient Blackswan: Hyderabad, 2015.
3.	Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4.	Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
5.	Communicative English for Engineers and Professionals- Nitin Bhatnagar & Mamta Bhatnagar.
6.	Skills for Success. Listening and Speaking. Level 4- Margret Brooks.
7.	Grammar F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press : Oxford, 2011.

Exercises for Batch of 30 Students

1. Listening Comprehension
2. Self- introduction
3. Short presentation
4. Group Discussion

Approved by BoS Chairman

B.E. / B.Tech.	B23PHI101 - ENGINEERING PHYSICS (Common to all Branches)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To gain knowledge on the basics of properties of matter, its applications and inculcate practical skills in the determination of elastic property of the materials.
2.	To acquire knowledge & experimental skills on the concepts of Photonics and their applications in fiber optics.
3.	To have adequate knowledge on the concepts of electrical, magnetic properties of materials and enhance the practical skills in determination of electrical properties of the materials.
4.	To get knowledge on advanced physics concepts of quantum theory and its applications in SEM, TEM and induce practical skills in microscope.
5.	To enhance the fundamental knowledge of students in Crystal Physics and its Applications relevant to various streams of Engineering and Technology.

UNIT - I	PROPERTIES OF MATTER	14

Elasticity - Modulus, types of modulii of elasticity, Stress - strain diagram and its uses - factors affecting elastic modulus and Twisting couple, torsion pendulum; theory and experiment

Bending of beams - Bending moment - uniform and non- uniform bending; theory and experiment - I - shaped girders and its applications

Determination of rigidity modulus - Torsion pendulum - Determination of Young's modulus by non-uniform bending method - Determination of Young's modulus by uniform bending method

UNIT - II	PHOTONICS AND FIBER OPTICS	12

Lasers ; properties of laser-spontaneous and stimulated emission-amplification of light by population inversion - Einstein's A and B coefficients - derivation – Types of laser; Nd. - YAG Laser, Semiconductor lasers; homojunction and heterojunction, Industrial and Medical Applications

Fiber Optics ; Principle, Numerical Aperture and Acceptance Angle - Types of optical fibres - Fiber optic communication System - Block diagram - Medical Applications - Endoscopy

Determination of wavelength of the Laser using grating- Determination of particle size using Laser - Determination of Numerical aperture and acceptance angle of an optical fiber

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UNIT - III	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	12

Classical free electron theory – Relaxation time and collision time - Expression for electrical conductivity – Thermal conductivity – Wiedemann - Franz law – Lorentz number - Drawbacks of classical theory - Quantum theory - Fermi - Dirac statistics – variation of Fermi level with temperature

Introduction to magnetic materials – Comparision of Dia, Para and Ferro magnetic materials – Domain theory of ferromagnetism - Hysteresis - Soft and Hard magnetic materials - Ferrites and its applications.

Determination of specific resistance of the wire using Carey Foster's Bridge

UNIT - IV	QUANTUM PHYSICS	12

Black body radiation; Planck's theory (derivation) - wave particle duality- debroglie's wavelength -concept of wave function and its physical significance

Wave equation; Schroedinger's time independent and time dependent equations, particle in a one-dimensional rigid box. **Applications;** Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM)

Determination of thickness of a thin wire by using travelling microscope

UNIT - V	CRYSTAL PHYSICS	10

Crystal Structures; Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattices - Miller indices- inter - planar distances – coordination number and packing factor for SC, BCC, FCC and HCP structures

Crystal imperfections; Point and Line defects - Burger vector

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Categorize the basics of properties of matter and its applications, classify the elastic properties of materials by using uniform, non-uniform bending method and torsional pendulum apparatus.
CO2	Explain the basics of Laser, Fiber Optics and their applications, determination of Particle size, Wavelength of laser and acceptance angle, numerical aperture of optical fiber.
CO3	Justify the concepts of electrical, magnetic properties of materials, determination of Specific resistance of the material.

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CO4	Interpret the basic knowledge of quantum theory that could be helpful in understanding the wave functions of the particle and determination of thickness of thin sheet by using travelling microscope.
CO5	Classify and compare the different types of Crystals, their structures and its defects.

Text Books	
1.	Bhattacharya, D.K. & Poonam, T, "Engineering Physics", Oxford University Press, 2015.
2.	Gaur, R.K. & Gupta, S.L. "Engineering Physics", Dhanpat Rai Publishers, 2012.
3.	Pandey, B.K. & Chaturvedi, S. "Engineering Physics", Cengage Learning India, 2012.
4.	Rajendran V, "Engineering Physics", Tata McGraw Hill, Publishing Company, New Delhi, 2011.
5.	Wahab, M.A. - Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, 2009.

Reference Books	
1.	Halliday, D., Resnick, R. & Walker, J. "Principles of Physics"", Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers", Cengage Learning, 2010.
3.	Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
4.	Avadhanulu M.N, "Engineering Physics - Volume 1", S.Chand & Company Ltd., New Delhi, 2010.
5.	Garcia, N. & Damask, A. - Physics for Computer Science Students. Springer - Verlag, 2012.
6.	Senthil Kumar, G. Physics Laboratory I & II, VRB publishers Pvt. Ltd., Chennai (2016).

Equipment Needed for 30 Students

1. Diode Laser (2 mS power) , He – Ne Laser source (2mW), Optical Fibre Kit - 06
2. Travelling Microscope ,Knife edge, Slotted weights - 19
3. Carey Foster Bridge - 06
4. Air Wedge Apparatus with Travelling Microscope - 06
5. Torsional Pendulum - 06

Approved by BoS Chairman

B.E.	B23EEI202 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common to AERO, AGRI and MECH)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To analyse the electric circuit laws and theorems.
2.	To analyse the single and three phase circuits with different types of load.
3.	To understand the working principles and characteristics of electrical machines.
4.	To understand the working principle of various electronic devices.
5.	To understand the concept of electrical wiring and safety.

UNIT - I	ELECTRICAL CIRCUITS	9

Basic circuit components - Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources. Steady state solution of DC circuits - Nodal analysis, Mesh analysis. Network Theorems -Thevenin's theorem, Norton's theorem, Maximum Power transfer theorem - Superposition theorem

UNIT - II	AC CIRCUITS	9

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three - phase balanced circuits – Three phase loads

UNIT - III	ELECTRICAL MACHINES	9

Construction, working and characteristics of DC machines, single phase transformers, single phase and three phase induction motors, Introduction to special electrical machines (BLDC, PMSM)

UNIT - IV	ELECTRONIC DEVICES AND CIRCUITS	9

Types of Materials – Silicon and Germanium- N type and P type materials – PN Junction - Forward and Reverse Bias – Semiconductor Diodes. Bipolar Junction Transistor - Characteristics – Field Effect Transistors – Transistor Biasing. Introduction to operational Amplifier – Inverting Amplifier – Non Inverting Amplifier

Approved by BoS Chairman

UNIT - V	ELECTRICAL WIRING AND SAFETY	9
Housing wiring, industrial wiring, materials of wiring – Hazards of electricity - Electrical safety equipment – safety procedures and methods – Grounding – safety requirements and standards - Human factors in electrical safety		
		Total Instructional hours : 45

Expt. No.	Description of the Experiments
1.	Verification of Circuit Laws.
2.	Verification of Circuit Theorems.
3.	Measurement of three phase power.
4.	Load test on DC shunt motor.
5.	Speed control of DC shunt motor.
6.	Load test on Single phase Transformer.
7.	Load test on single phase Induction motor.
8.	VI characteristics of Diode.
9.	Characteristics of Common Emitter Configuration in NPN transistor.
	Total Practical hours : 30
	Total Instructional hours : 45 + 30 = 75

Course Outcomes : Students will be able to	
CO1	Apply basic circuit laws and Theorems to analyze the electrical circuits.
CO2	Analyze the single and three phase circuit with different types of load.
CO3	Examine the performance of DC machines, transformers, induction motors and explain the construction and operation of special machines.
CO4	Analyze the characteristics of various semiconductor devices.
CO5	Outline the basic wiring materials, types of wiring and Safety practices

Approved by BoS Chairman

Text Books	
1.	Leonard S Bobrow, Foundations of Electrical Engineering, Oxford University Press, 2013.
2.	Kothari.D.P and Nagarath.I.J,Electrical Machines - Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
3.	S.Salivahanan , N.Suresh Kumar, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, 4th edition, 2017.
4.	E.G. Janardanan, “Special electrical machines”, PHI learning Private Limited, Delhi, 2014.
5.	John Cadick, P.E, “Electrical Safety Handbook”, 4th edition, McGraw Hill, 2012.

Reference Books	
1.	N K De, DipuSarkar, Basic Electrical Engineering, Universities Press (India) Pvt. Ltd, 2016.
2.	Vincent Del Toro, Electrical Engineering Fundamentals, Pearson Education, Second Edition New Delhi, 2015.
3.	John Bird, Electrical Circuit Theory and Technology, Elsevier, Fifth Edition, 2014.

Approved by BoS Chairman

B.E.	B23AET301 - FUNDAMENTALS OF AEROSPACE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the Historical evaluation of Airplanes.
2.	To study the different component systems and functions.
3.	To understand the basic properties and principles behind the flight.
4.	To study the various types of power plants used in aircrafts.
5.	To study the different structures & construction.

UNIT - I	HISTORY OF FLIGHT	9

Balloon flight – ornithopters - Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT - II	AIRCRAFT CONFIGURATIONS AND ITS CONTROLS	9

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.

UNIT - III	BASICS OF AERODYNAMICS	9

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.

UNIT - IV	BASICS OF PROPULSION	9

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.

UNIT - V	BASICS OF AIRCRAFT STRUCTURES	9
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 - Stresses and strains - Hooke's law - stress-strain diagrams - elastic constants - Factor of Safety.		
		Total Instructional hours : 45

Course Outcomes	
At the end of the course, the students will be able to	
CO1	Outline the history of Aircraft and developments over the years.
CO2	Identify the types and classification of components and control system.
CO3	Apply the various forces and properties in Aircraft.
CO4	Categorize the different types of engines and principles of rocket.
CO5	Identify different type of fuselage and constructions.

Text Books	
1.	Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition, 2015
2.	Richard S. Shevell, " Fundamentals of Flight", Pearson Education,2nd Edition – 2004.

Reference Books	
1.	Kermode, A.C. Flight without Formulae, Pearson Education; Eleven edition, 2011.
2.	Stephen. A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.
3.	Lalit Gupta and O P Sharma, "Fundamentals of Flight Vol-I to Vol-IV", Himalayan Books, 2006.

Programme Coordinator **BoS Chairman**

B.E.	B23AET302 – SOLID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of stress, strain, principal stresses and principal planes.
2.	To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
3.	To determine stresses and deformation in circular shafts and helical spring due to torsion.
4.	To compute slopes and deflections in determinate beams by various methods.
5.	To study the stresses and deformations induced in thin and thick shells.

UNIT - I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT - II	TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM	9

Beams – types transverse loading on beams – Shear force and bending moment in beams - Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Shear stress distribution.

UNIT - III	TORSION	9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT - IV	DEFLECTION OF BEAMS	9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

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UNIT - V	THIN CYLINDERS, SPHERES AND THICK CYLINDERS	9
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.		

Course Outcomes : Students will be able to	
CO1	Explain the concept of stress and strain in simple compound bars.
CO2	Illustrate the load transferring mechanism in beams and shear distribution due to shearing force and bending moment.
CO3	Apply basic equation of simple torsion in designing of shafts, helical spring and columns.
CO4	Identify the slope and deflection in beams using different methods.
CO5	Solve the thin and thick shells for the applied internal and external pressures.

Text Books	
1.	Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
2.	Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

Reference Books	
1.	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2.	Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
3.	Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013

Programme Coordinator

BoS Chairman

B.E.	B23AET303 – ENGINEERING FLUID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the properties of fluids and concept of control volume.
2.	To study applications of the conservation laws to flow through pipes.
3.	To understand the importance of dimensional analysis
4.	To study the importance of various types of flow in pumps.
5.	To understand the importance of various types of flow in turbines.

UNIT - I	FLUID PROPERTIES AND FLOW CHARACTERISTICS	9

Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, capillarity and surface tension. Flow characteristics – concept of control volume - application of control volume to continuity equation.

UNIT - II	FLOW THROUGH CIRCULAR CONDUITS	9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli - Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor - commercial pipes - minor losses – Flow through pipes in series and parallel.

UNIT - III	DIMENSIONAL ANALYSIS	8

Need for dimensional analysis – methods of dimensional analysis – Similitude – types of similitude - Dimensionless parameters - application of dimensionless parameters – Model analysis.

UNIT - IV	PUMPS	10

Euler's equation - Theory of Roto-dynamic machines – various efficiencies – velocity components at entry and exit of the rotor - velocity triangles - Centrifugal pumps – working principle - work done by the impeller - performance curves - Reciprocating pump - working principle.

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UNIT - V	TURBINES	9
Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines - working principles - work done by water on the runner – draft tube - performance curves for turbines – governing of turbines.		

Course Outcomes : Students will be able to	
CO1	Relate the mathematical knowledge to predict the properties and characteristics of fluid.
CO2	Identify the major and minor losses associated with pipe flow in piping networks.
CO3	Make use of mathematical prediction to select the nature of physical quantity.
CO4	Analyze critical performance of pumps.
CO5	Analyze critical performance of turbines.

Text Books	
1.	White, Frank M. Fluid Mechanics. 7th ed. McGraw-Hill, 2010. ISBN: 9780077422417
2.	S K Som, G Biswas,Suman Chakraborty, Introduction to Fluid Mechanics and Fluid machines, Tata McGraw Hill Edition, 2017.

Reference Books	
1.	Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
2.	Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd., New Delhi, 2016.
3.	Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.

Programme Coordinator

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B.E.	B23AEI301 - AERO ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To make the students understand the basic concepts of thermodynamics and the application of first law of thermodynamics to open and closed systems.
2.	To understand the concept of second law of thermodynamics and entropy
3.	To develop the relations of efficiency and mean effective pressure for various air standard cycles.
4.	To calculate the power developed from steam as the working medium.
5.	To understand the basics of jet engines and heat transfer methods.

UNIT - I	FUNDAMENTAL CONCEPT AND FIRST LAW	12

Concept of continuum, microscopic and macroscopic approach, thermodynamic systems – closed, open and isolated. Thermodynamic Properties, state, path and process, quasi-static process, internal energy, enthalpy, specific heat capacities, work and heat transfer. Zeroth law of thermodynamics, First law of thermodynamics,SFEE, application of SFEE to jet engine components-Numerical problems.

UNIT - II	SECOND LAW AND ENTROPY	12

Second law of thermodynamics – Kelvin Planck and Clausius statements of second law, Reversibility and Irreversibility, Carnot theorem, Carnot cycle, Reversed Carnot cycle, efficiency, COP, Thermodynamic temperature scale - Clausius inequality, Concept of entropy, Entropy change for various processes, Mixing of fluids-Numerical problems.

UNIT - III	AIR STANDARD CYCLES	12

Otto, Diesel, Dual, Ericsson, Atkinson, Stirling and Brayton cycles - air standard efficiency - mean effective pressure-Numerical problems.

UNIT - IV	FUNDAMENTALS OF VAPOUR POWER CYCLES	12

Properties of pure substances – solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surfaces, thermodynamic properties of steam - calculations of work done and heat transfer in non-flow and flow processes - standard Rankine cycle, Reheat and Regeneration cycle. Heatrate, Specific steam consumption, Tonne of refrigeration-Numerical problems.

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UNIT - V	BASICS OF PROPULSION AND HEAT TRANSFER	12
Classification of jet engines -working principles- thrust equation, specific thrust, SFC, TSFC, specific impulse - isentropic efficiencies of jet engine components, actual cycles. Heat transfer modes- conduction in parallel, radial, and composite wall- convective and radiation- numerical problems.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Apply first law of thermodynamics to solve problems related to open and closed systems
CO2	Estimate the heat engine efficiency and COP for both heat pump and refrigeration systems.
CO3	Identify efficient air cycles for specific applications.
CO4	calculate the power developed from steam as the working medium
CO5	Analyze the various jet engines parameters and modes of heat transfer.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Performance test on a 4-stroke engine
2.	Valve timing of a 4 – stroke engine
3.	Port timing of a 2-stroke engine
4.	Determination of thermal resistance of a composite wall.
5.	COP test on a vapour compression refrigeration test rig
6.	COP test on a vapour compression air-conditioning test rig
7.	Determination of specific heat of solid
8.	Determination of thermal conductivity of solid.
9.	Determination of effectiveness of a parallel flow heat exchanger
10.	Determination of effectiveness of a counter flow heat exchanger
Total Instructional hours : 60	

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Text Books	
1.	Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 2013.
2.	Yunus A. Cengel and Michael A. Boles, “Thermodynamics: An Engineering Approach” McGraw-Hill Science / Engineering / Math; 7th edition 2010.

Reference Books	
1.	Rathakrishnan E., “Fundamentals of Engineering Thermodynamics”, Prentice-Hall India, 2005.
2.	Holman J.P., “Thermodynamics”, 3rd Edition, McGraw-Hill, 2007.
3.	Rayner Joel, “Basic Engineering Thermodynamics”, 5th Edition, Addison Wesley, New York, 2016

Programme Coordinator

BoS Chairman

B.E.	B23AEP301 – SOLID MECHANICS LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To study the stress -strain curve and understand its behaviour.
2.	To study the linearly elastic behaviour of mild steel under different loading conditions.
3.	To evaluate the fracture behaviour of materials when subjected to impact loading.
4.	To study the mechanical properties of materials when subjected to different types of loading.
5.	To examine the mechanical properties of materials under compression.

List of Experiments	
Expt. No.	**Description of Equipment**
1.	Tensile test on a mild steel rod
2.	Double shear test on Mild steel
3.	Torsion test on mild steel rod
4.	Deflection test on beams
5.	Charpy Impact test on metal specimen
6.	Izod Impact test on metal specimen
7.	Hardness test on metals using Brinnell Hardness Number
8.	Hardness test on metals using Rockwell Hardness Number
9.	Compression test on helical springs
10.	Strain Measurement using Rosette strain gauge

Total Instructional hours : 30

Course Outcomes : Students will be able	
CO1	Identify the mechanical properties like tensile and compressive strength, shear strength of materials.

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CO2	Analyze the deformation behavior of materials for different loading conditions.
CO3	Identify the materials for best practices based on mechanical properties like toughness.
CO4	Analyze the different hardened samples using various hardness machines.
CO5	Utilize the strain gauges for measurement of loaded beams.

List of Equipment for Batch of 30 Students

Sl. No.	Name of the Equipment	Quantity
1.	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2.	Torsion Testing Machine (60 NM Capacity)	1
3.	Impact Testing Machine (300 J Capacity)	1
4.	Brinell Hardness Testing Machine	1
5.	Rockwell Hardness Testing Machine	1
6.	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7.	Strain Indicator	1

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B.E.	B23AEP302 – ENGINEERING FLUID MECHANICS LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To study the coefficient of discharge for various flow meters.
2.	To calculate rate of flow for the liquids.
3.	To determine friction factor for a pipes.
4.	To verify the performance of the pumps.
5.	To verify the performance of the turbines.

List of Experiments

Expt. No.	Description of the Experiments
1.	Determination of the Coefficient of discharge of given Orifice meter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Calculation of the rate of flow using Rota meter.
4.	Determination of friction factor for a given set of pipes.
5.	Conducting experiments and drawing the characteristic curves of centrifugal pump.
6.	Conducting experiments and drawing the characteristic curves of reciprocating pump.
7.	Conducting experiments and drawing the characteristic curves of Gear pump.
8.	Conducting experiments and drawing the characteristic curves of Pelton wheel.
9.	Conducting experiments and drawing the characteristics curves of Francis turbine.
10.	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Total Instructional hours : 30

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Course Outcomes : Students will be able	
CO1	Analyze the various flow meters for measuring coefficient of discharge.
CO2	Examine the operation of the variation in friction factor for the given set of pipes.
CO3	Analyze the discharge coefficients of flow meters for calibration of centrifugal and reciprocating pumps.
CO4	Examine the performance of Pelton wheel and gear pump.
CO5	Evaluate the characteristics curves of the operation of fluid machineries.

List of Equipment for a Batch of 30 Students

Sl. No.	Name of the Equipment	Quantity
1.	Orifice meter setup	1
2.	Venturi meter setup	1
3.	Rotameter setup	1
4.	Pipe Flow analysis setup	1
5.	Centrifugal pump	1
6.	Reciprocating pump setup	1
7.	Gear pump setup	1
8.	Pelton wheel setup	1
9.	Francis turbine setup	1
10.	Kaplan turbine setup	1

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BoS Chairman

B.E.	B23AET401 – ADVANCED SOLID MECHANICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide the students an understanding on the linear static analysis of determinate and indeterminate aircraft structural components.
2.	To calculate the deflection of beams, frames and trusses by different energy methods.
3.	To calculate the buckling load and stresses in beam columns.
4.	To provide the design process using different failure theories.
5.	To understand the impacts of induced stresses.

UNIT - I	STATICALLY DETERMINATE & INDETERMINATE STRUCTURES	10
Plane truss analysis – Method of joints – Method of sections – Method of shear – 3-D Trusses – principle of super position, Clapeyron's 3 Moment equation.		

UNIT - II	ENERGY METHODS	10
Strain Energy in axial, bending, Torsion and shear loadings. Castigliano's theorems and their applications. Energy theorems – Dummy load & unit load methods – Energy methods applied to Statically determinate and Indeterminate beams, Frames, Rings & Trusses.		

UNIT - III	COLUMNS	10
Euler's column curve – Inelastic buckling – Effect of initial curvature – South well plot – Columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – Stresses in beam columns.		

UNIT - IV	FAILURE THEORIES	8
Ductile and Brittle materials – Maximum principal stress theory - Maximum principal strain theory - Maximum shear stress theory - Distortion energy theory – Octahedral shear stress theory.		

UNIT - V	INDUCED STRESSES	7
Thermal stresses – Impact loading – Fatigue – Creep - Stress Relaxation, Introduction to elasticity approach.		
		Total Instructional hours : 45

Programme Coordinator

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Identify the determinate and indeterminate aircraft structural components based on linear static analysis.
CO2	Apply the reactions of structures using strain energy concept.
CO3	Identify the stresses in beam columns with different end conditions.
CO4	Examine the structural failures using different theories of failures.
CO5	Identify response of statically indeterminate structures under various loading conditions.

Text Books	
1.	James M. Gere & Barry J Goodno.,"Mechanics of Materials", cengage Learning Custom Publishing; 8th edition, 2012.
2.	Megson T M G.," Aircraft Structures for Engineering students", Butterworth-Heinemann publisher, 5th edition, 2012.

Reference Books	
1.	Bruhn E F., “Analysis and Design of Flight Vehicle Structures”, Tri-State Off-set Company, USA, 1985.
2.	Donaldson, B.K., “Analysis of Aircraft Structures”, - An Introduction’ Cambridge University Press publishers, 2nd edition, 2008.
3.	Peery, D.J., and Azar, J.J.," Aircraft Structures", 2nd edition, McGraw – Hill, N.Y., 1999.

Programme Coordinator

BoS Chairman

B.E.	B23AET402 – AIR BREATHING PROPULSION	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To establish fundamental approach and application of jet engine components and estimate the thrust developed by jet engine.
2.	To understand the working principle of inlets & its types, nozzle & its types.
3.	To gain knowledge about the different types of combustion chambers and its mechanism.
4.	To understand the working principle of axial compressor and centrifugal compressor.
5.	To gain knowledge about the working of turbines and its matching with other components.

UNIT - I	PRINCIPLES OF AIR BREATHING ENGINES	9

Operating principles of piston engines – Classification of piston engines - Illustration of working of gas turbine engines – Factors affecting thrust – Methods of thrust augmentation – Performance parameters of jet engines – Study on recent advancement in air breathing engine.

UNIT - II	JET ENGINE INTAKES AND EXHAUST NOZZLES	9

Ram effect, Internal flow and Stall in subsonic inlets - Modes of operation - Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – Real flow through nozzles and nozzle efficiency – losses in nozzles – Ejector and variable area nozzles - Interaction of nozzle flow with adjacent surfaces – Thrust reversal.

UNIT - III	JET ENGINE COMBUSTION CHAMBERS	9

Chemistry of combustion, Combustion equations, Combustion process, Classification of combustion chambers – Combustion chamber performance – Effect of operating variables on performance – Flame stabilization.

UNIT - IV	JET ENGINE COMPRESSORS	9

Euler's turbo machinery equation, Principle operation of centrifugal compressor, Principle operation of axial flow compressor– Work done and pressure rise – velocity diagrams – degree of reaction – Free vortex and constant reaction designs of axial flow compressor – Performance parameters axial flow compressors– Stage efficiency.

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UNIT - V	JET ENGINE TURBINES	9
Principle of operation of axial flow turbines – limitations of radial flow turbines - Work done and pressure rise – Velocity diagrams – Degree of reaction – Constant nozzle angle designs – Performance parameters of axial flow turbine– Turbine blade cooling methods – Stage efficiency calculations – Basic blade profile design considerations – Matching of compressor and turbine.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Interpret control volume and momentum equation to estimate the forces produced by aircraft propulsion systems.
CO2	Illustrate the principal design parameters and constraints that set the performance of gas turbine engines.
CO3	Analyze the gas turbine engine to relate thrust and fuel burn to component performance parameter.
CO4	Identify the working of multistage compressor to use velocity triangles for the performance of compressor.
CO5	Make use of velocity triangles and turbine blade cooling methods to choose the turbine performance parameters.

Text Books	
1.	Hill, P.G. & Peterson, C.R. “Mechanics & Thermodynamics of Propulsion” Pearson education (2009)
2.	Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Pearson Education Canada; 6th edition, 2008.

Reference Books	
1.	Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.
2.	Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3.	“Rolls Royce Jet Engine”, Rolls Royce; 4th revised edition, 1986.

Programme Coordinator

BoS Chairman

B.E.	B23AET403 – AIRCRAFT SYSTEMS AND INSTRUMENTS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge of the hydraulic and pneumatic systems components.
2.	To impart the modern control system and auto pilot system in aircraft
3.	To understand the different types of fuel system in jet engine and piston engine.
4.	To Apply the air cycle system, vapors cycle system and cabin pressurization system.
5.	To get the knowledge about the accelerometer, air speed indicator and gyroscopic

UNIT - I	AIRCRAFT SYSTEMS	9

Hydraulic systems – Study of typical systems – Components – Hydraulic systems controllers – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system – Brake system – Components, Landing Gear Systems – Classification – Shock absorbers – Retractive mechanism.

UNIT - II	AIRPLANE CONTROL SYSTEMS	10

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – Operating principles – Modern control systems – Digital fly by wire systems – Auto pilot system, Active Control Technology.

UNIT - III	ENGINE SYSTEMS	9

Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating systems – Starting and Ignition systems.

UNIT - IV	AIRCONDITIONING AND PRESSURIZING SYSTEM	8

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.

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UNIT - V	AIRCRAFT INSTRUMENTS	9
Flight Instruments and Navigation Instruments – Accelerometers, Air speed Indicators – Mach Meters – Altimeters – Gyroscopic Instruments– Principles and operation – Study of various types of engine instruments – Tachometers – Temperature and Pressure gauges.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the principles and working of different Aircraft systems.
CO2	Compare the features of various flight control system.
CO3	Identify the performance of various aircraft engine systems.
CO4	Experiment with the data from various aircraft system cycle.
CO5	Identify the principles and operation of various cockpit control systems.

Text Books	
1.	Mekinley, J.L. and R.D. Bent , " Aircraft Power Plants", McGraw Hill 1993.
2.	Pallet, E.H.J, "Aircraft Instruments & Principles, " Pitman & Co 1993.

Reference Books	
1.	Handbooks of "Airframe and Power plant Mechanics", US dept. of Transportation, Federal, Aviation Administration, the English Book Store, New Delhi, 1995.
2.	McKinley, J.L. and Bent R.D., " Aircraft Maintenance & Repair", McGraw Hill, 1993.
3.	Teager, S, "Aircraft Gas Turbine technology", McGraw Hill 1997.

Programme Coordinator

BoS Chairman

B.E.	B23AEI401 – LOW SPEED AERODYNAMICS	T	P	TU	C
		3	0	2	4

Course Objectives	
1.	To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
2.	To make the student understand the concept of vorticity, irrotationality and real flow over the 2D objects.
3.	To understand the Theory of Aero foil And Wing Sections
4.	To introduce the basics of viscous flow.
5.	To introduce the conceptual boundary layer thickness.

UNIT - I	INTRODUCTION TO LOW-SPEED FLOW	9

Euler equation, Incompressible Bernoulli's Equation. Circulation and Vorticity, Green's lemma and Stoke's Theorem, Barotropic flow, Kelvin's Theorem, Streamline, Stream function, Irrotational flow, Potential function, Equipotential lines, Elementary flows and their combinations.

UNIT - II	TWO-DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW	9

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus Effect, Kutta Joukowski's Theorem, Starting vortex, Kutta condition, Real flow over smooth and rough cylinder.

UNIT - III	AIRFOIL THEORY	9

Cauchy - Riemann relations, complex potential, Methodology of conformal Transformation, kutta - Joukowski's Transformation and its applications, Thin Airfoil Theory and its Applications.

UNIT - IV	SUBSONIC WING THEORY	9

Vortex filament, Biot and Savart law, bound vortex and Trailing vortex, horse shoe vortex, Lifting line Theory and its Limitations.

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UNIT - V	INTRODUCTION TO BOUNDARY LAYER THEORY	9
Boundary layer and Boundary layer Thickness, Displacement Thickness, Momentum Thickness, Energy Thickness, Shape Parameter, Boundary layer equations for a steady, two-dimensional incompressible flow, boundary layer growth over a flat plate, critical Reynolds number, Blasius solution, basics of turbulent flow.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the characteristics of low-speed flow.
CO2	Examine the characteristics of wing performance in in viscid compressible flow.
CO3	Apply the airfoil theory to predict airfoil performance.
CO4	Interpret the concept of subsonic wing theory and vortex formations.
CO5	Categorize the characteristics of boundary layer formation.

Text Books	
1.	Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 2010.
2.	Clancy, L J.," Aerodynamics", Pitman, 1986.

Reference Books	
1.	John J Bertin., "Aerodynamics for Engineers", Pearson Education Inc, 2002.
2.	Kuethe, A.M and Chow, C.Y, "Foundations of Aerodynamics", Fifth Edition, John Wiley & Sons, 2000.
3.	Milne Thomson, L.H., "Theoretical Aerodynamics", Macmillan, 1985.

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List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Calibration of a subsonic Wind tunnel.
2.	Determination of lift for the given airfoil section.
3.	Pressure distribution over a smooth circular cylinder.
4.	Pressure distribution over a rough circular cylinder.
5.	Pressure distribution over a symmetric aero foil.
6.	Pressure distribution over a cambered aero foil.
7.	Force measurement using wind tunnel balancing set up.
8.	Flow over a flat plate at different angles of incidence.
9.	Flow visualization studies in low speed flows over cylinders.
10.	Flow visualization studies in low speed flows over airfoil with different angle of incidence.
Total Instructional hours : 30	

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List of Equipment		
Sl. No.	**Name of the Equipment**	**Quantity**
1.	Subsonic Wind tunnel	1
2.	Models (aerofoil, rough and smooth cylinder, flat plate)	1
3.	Angle of incidence changing mechanism	1 No.
4.	Smoke Generator	1 No.
5.	Water flow channel	1 No.

Programme Coordinator

BoS Chairman

B.E.	B23AEP401 – AIRCRAFT COMPONENT DRAWING LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To make the students understand and interpret drawings of machine components
2.	To prepare assembly drawings both manually and using standard CAD packages
3.	To familiarize the students with Indian Standards on drawing practices and standard components
4.	To gain practical experience in handling 2D drafting and 3D modeling software systems.
5.	To understand the load impacts for various mechanical components

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Drawing standards fits & tolerances, study of codes of practice for engineering drawing
2.	Introduction to modelling software Solidworks
3.	3D Assembly of Flange Coupling
4.	3D Assembly of Universal Coupling
5.	3D Assembly of Oldham's Coupling
6.	3D Assembly of Knuckle Joints
7.	3D Assembly of Gib and cotter joints
8.	3D Assembly of sleeve and cotter joints

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9.	Design and drafting control components bell crank
10.	3D Modelling of Swept Wing from Airfoil Coordinates
11.	3D Modelling of Aircraft fuselage
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Identify the drawing standard used in design.
CO2	Plan the fits and tolerances limits used in design.
CO3	Design the part drawings as per standard.
CO4	Design the sectional view of drawings as per standard.
CO5	Design the assembly drawings as per standard.

List of Equipment

Sl. No.	Name of the Equipment	Quantity
1.	Internal server (or) Work station	1
2.	Computers	30
3.	Standard Modelling and analysis packages	30
4.	UPS	1
5.	Printer	1

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B.E.	B23AET501 – AIRCRAFT PERFORMANCE	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To study the performance of airplanes under various operating conditions
2.	To introduce the various engine parameters affecting the performance
3.	To understand the climbing, gliding performance and load factor of airplanes
4.	To understand the turning performance of airplanes
5.	To introduce the takeoff, landing performance and also the distance estimation of these performance.

UNIT - I	CRUISING FLIGHT PERFORMANCE	12

Forces and moments acting on a flight vehicle – Flight stability and response system - 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.

UNIT - II	INFLUENCES OF ENGINE FEATURES IN PERFORMANCE	12

Introduction - Performance - Variation of thrust, power with velocity and altitudes for air breathing engines. Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required.

UNIT - III	MANEUVERING FLIGHT PERFORMANCE	12

Range and endurance - Climbing and gliding flight - Maximum rate of climb - steepest angle of climb, Minimum rate of sink - shallowest angle of glide – Hodograph – Absolute Ceiling and Service Ceiling.

UNIT - IV	TURNING PERFORMANCE	12

Introduction - Turning performance (Turning rate turn radius) - Level Turn - Minimum Turn Radius Maximum Turn Rate - Instantaneous turn - Pull up and Pull down manoeuvers - Cobra Maneuver - Bank angle and load factor - V-n diagram and load factor.

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UNIT - V	TAKEOFF AND LANDING PERFORMANCE	12
Introduction to Take-off, Estimation of take-off distance - ground roll, obstacle clearing distance and height, Take off assist devices – Spoilers andlanding distance – approach distance and flare distance.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Classify the forces and moments acting on an aircraft and flight performance in stady level flight.
CO2	Analyze the performance characteristics of jet and propeller engines.
CO3	Identify the maneuvering flight performance in steady level flight.
CO4	Examine the performance during turning manoeuvers of aircraft.
CO5	Make use of landing and taking characteristics to recognize the ground effects of the aircraft.

Text Books	
1.	Anderson, John David. “Aircraft performance and design”. Vol. 1221. New York: McGraw-Hill, 1999.
2.	Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2004.
3.	Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley & Son, Inc, NY, 1988.
4.	Mc Cornick B. W, “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1995

Reference Books	
1.	Babister, A.W., “Aircraft Dynamic Stability and Response”, Pergamon Press, Oxford, 1980.
2.	Dommasch, D.O., Sherby, S.S., and Connolly, T.F., “Aeroplane Aero dynamics”, Third Edition, Issac Pitman, London, 1981.
3.	Etkin, B., “Dynamics of Flight Stability and Control”,Edn. 2, John Wiley, NY, 1982.

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B.E.	B23AET502 – HIGH SPEED AERODYNAMICS	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To introduce the concepts of compressibility and performance of the pressure
2.	To make the student understand the theory behind the formation of shocks and strength of the shock
3.	To make the student understand the theory behind the formation expansion fans in Supersonic flows and shock behavior of interaction
4.	To introduce the methodology of measurements in Supersonic flows
5.	To understand characteristics of Aircraft wing structure to transonic flow over the wing and conceptual understanding of the hypersonic aerodynamics

UNIT - I	ONE DIMENSIONAL COMPRESSIBLE FLOW	12
Energy, Momentum, and Continuity equations, Velocity of sound, Adiabatic steady state flow equations, Flow through convergent - divergent passage, Performance under various back pressures.		

UNIT - II	NORMAL AND OBLIQUE SHOCKS	12
Prandtl equation and Rankine – Hugoniot relation, Pitot static tube, Oblique shocks and corresponding equations, Pressure turning angle, Shock polar, Flow past wedges and concave corners, Strong, Weak and Detached shocks.		

UNIT - III	EXPANSION WAVES AND METHOD OF CHARACTERISTICS	12
Flow past convex corners, Expansion hodograph, Reflection and interaction of shocks and expansion, waves. Two-dimensional supersonic nozzle contours. Rayleigh and Fanno Flows.		

UNIT - IV	DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS	12
Small perturbation potential theory, Solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert rule - Affine transformation relations for subsonic flows, Linearized two-dimensional supersonic flow theory - Lift, Drag, Pitching moment and center of pressure of supersonic profiles.		

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UNIT - V	HIGH SPEED FLOW OVER WING	12
Lower and upper critical Mach numbers, Drag divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule. Introduction to Hypersonic Aerodynamics.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the characteristics fluid flows.
CO2	Identify the properties across normal and oblique shocks.
CO3	Make use of two-dimensional theory to analyze compressible flow problems
CO4	Analyze fluid flow characteristics over wing airfoils and airplanes.
CO5	Distinguish the characteristics of wing and examine flow behaviors over the wing.

Text Books	
1.	Anderson Jr., D, “Modern compressible flows”, 3rd Edition, McGraw-Hill Book Co., New York, 2017.
2.	L.J. Clancy, “Aerodynamics” Sterling Book House, 2006.

Reference Books	
1.	Rathakrishnan, E., “Gas Dynamics”, 6th Edition, Prentice Hall of India, 2017.
2.	Shapiro, A.H., “Dynamics and Thermodynamics of Compressible Fluid Flow”, Ronald Press, 1982.
3.	Zucrow, M.J. and Anderson, J.D., “Elements of gas dynamics”, McGraw-Hill Book Co., New York, 1989.

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B.E.	B23AET503 – DRONE TECHNOLOGY WITH IoT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of drone concepts.
2.	To learn and understand the fundaments of design, fabrication and programming of drone
3.	To impart the knowledge of an flying and operation of drone
4.	To know about the various applications of drone
5.	To understand the current trends in IoT and their implications.

UNIT - I	INTRODUCTION TO DRONE TECHNOLOGY	9

Drone Concept – Vocabulary Terminology – History of drone – Types of current generation of drones based on their method of propulsion – Drone technology impact on the businesses – Drone business through entrepreneurship – Opportunities/applications for entrepreneurship and employability.

UNIT - II	DRONE DESIGN, FABRICATION AND PROGRAMMING	9

Classifications of the UAV – Overview of the main drone parts – Technical characteristics of the parts – Function of the component parts – Assembling a drone – The energy sources – Level of autonomy – Drones configurations – the methods of programming drone – Download program – Install program on computer – Running programs – Multi rotor stabilization – Flight modes – Wi-Fi connection.

UNIT - III	DRONE FLYING AND OPERATION	9

Concept of operation for drone – Flight modes – Operate a small drone in a controlled environment – Drone controls flight operations – Management tool – Sensors – Onboard storage capacity – Removable storage devices – Linked mobile devices and applications.

UNIT - IV	DRONE COMMERCIAL APPLICATIONS	9

Choosing a drone based on the application – Drones in agriculture – Drones in the insurance sector – Drones in delivering mail, parcels and other cargo – Drones in agriculture – Drone in inspection of transmission lines and power distribution – Drones in filming and panoramic picturing.

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UNIT - V	INTRODUCTION TO IOT AND ITS ARCHITECTURE	9
Elements of an IoT ecosystem - Technology drivers, Business drivers, Trends and implications - Overview of Governance, Privacy and Security Issues - IoT Architecture - IoT Open source architecture (OIC)- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.		
		Total Instructional hours : 45

Course Outcomes: At the end of the course, the students will be able to	
CO1	Know about a various type of drone technology and its impact on the businesses.
CO2	Execute the suitable operating procedures for functioning a drone.
CO3	Select appropriate sensors and actuators for drones.
CO4	Develop a drone mechanism for specific applications
CO5	Evaluate current trends in IoT and apply design principles to IoT architecture.

Text Books	
1.	Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.
2.	Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones”, Maker Media, Inc, 2016.
3.	Honbo Zhou, “ IoT in the cloud: A Middle wave perspective”, CRC Press, 2012

Reference Books	
1.	John Baichtal, “Building Your Own Drones: A Beginners’ Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
2.	Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance:, Springer, 2018.
3.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”,1st Edition, VPT, 2014.

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B.E.	B23AEI501 – AIRCRAFT STRUCTURES	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To provide the behavior of loads experience of aircraft indigenous components.
2.	To understand the shear flow of symmetrical, unsymmetrical and thin-walled structures.
3.	To provide conception design of major aircraft structural components.
4.	To provide the better understate the low weight structures.
5.	To provide the students adopt with various methods for analysis of aircraft wings and fuselage

UNIT - I	UNSYMMETRICAL BENDING	9

Bending of symmetric beams subject to skew loads - Bending stresses in beams of unsymmetrical sections – Generalized k-method, Neutral axis method, Principal axis method, Advantages and Disadvantages of three methods.

UNIT - II	SHEAR FLOW IN OPEN SECTIONS	9

Thin-walled beams – Concept of shear flow – The shear center and its determination – Shear flow distribution in symmetrical and unsymmetrical thin-Walled sections – Structural idealization – Shear flow variation in idealized sections - Applications of shear flow calculations.

UNIT - III	SHEAR FLOW IN CLOSED SECTIONS	9

Bredt - Batho theory – Single-cell and multi-cell tubes subject to torsion – Shear flow distribution in thin- walled single & Multi-cell structures subject to combined bending and torsion – With walls effective and ineffective in bending - Importance of shear flow & shear center determination.

UNIT - IV	BUCKLING OF PLATES	9

Bending of thin plates - local buckling stress of thin walled sections – Crippling strength estimation - Thin skin stringer panel - Effective skin width – Inter rivet buckling - Skin stringer panel - Integrally stiffened panels - cutouts - Lightly loaded beams.

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UNIT - V	STRESS ANALYSIS OF WING AND FUSELAGE	9
Aircraft loads - classification – The V-n diagram – Shear force and bending moment distribution over the aircraft wing and fuselage – Shear flow in thin-webbed beams with parallel and non-parallel flanges – Complete tension field beams – Semi-tension field beam theory.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Analyze the loads acting on aircraft.
CO2	Identify and resolve the structural design & the limitations.
CO3	Identify the distribution of loads on aircraft member.
CO4	Categorize the design of low weight to high strength panel member.
CO5	Analyze the aircraft real structures components such as wings and fuselages.

Text Books	
1.	Bruhn E.H., “Analysis and Design of Flight Vehicles Structures”, Tri-state off-set Company, USA, 1985.
2.	Megson T M G, “Aircraft Structures for Engineering Students”, Elsevier Ltd, 2012
3.	Michael Chun-Yung Niu, “Airframe structural Design”, Conmilit Press Ltd, 1998

Reference Books	
1.	Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997.
2.	Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw Hill, 1993.
3.	Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw Hill, N.Y., 1999.

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List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Deflection of Beams
2.	Verification of superposition theorem and Maxwell's reciprocal theorem
3.	Combined bending and Torsion of a Hollow Circular Tube
4.	Buckling load estimation of slender eccentric columns
5.	Unsymmetrical Bending of a Cantilever Beam
6.	Shear Centre of a Channel Section
7.	Shear Center of Closed Sections
8.	Material Fringe Constant of a Photo elastic Models
9.	Fabrication of a Composite Laminate.
10.	Tension field beam
	Total Instructional hours : 30

Course Outcomes : Students will be able to	
CO1	Identify the different types of beams.
CO2	Examine the super position and Maxwell's reciprocal theorem for different types of beams
CO3	Estimate the buckling load for different end conditions of columns.
CO4	Analyze the shear center of open channel and closed thin-walled sections.
CO5	Examine the fringe patterns in photo elastic technique and there by analysis the stress formation due to flaws in the specimen.

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List of Equipment		
Sl. No.	**Name of the Equipment**	**Quantity**
1.	100 kN Universal Testing Machine	1
2.	Beams with weight hangers and dial gauges	2
3.	Column set up with dial gauges	1
4.	Photo elasticity set up	1
5.	Wagner beam	1
6.	Unsymmetrical bending set up	1
7.	Set up for combined bending and torsion	1

Programme Coordinator

BoS Chairman

B.E / B.Tech	B23MCT505- Holistic Insight into UN SDGs (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand the origin, purpose, and significance of the UN Sustainable Development Goals (SDGs).
2.	To explore the 17 SDGs, their interconnections, and challenges in achieving them.
3.	To analyze global and local case studies of SDG implementation.
4.	To evaluate the role of governments, businesses, and individuals in sustainable development.
5.	To develop practical solutions and action plans for achieving SDGs at community and policy levels

SYLLABUS:

UNIT - I	INTRODUCTION TO SUSTAINABLE DEVELOPMENT & SDGS	6

Concept of **sustainability** and its evolution.

UN Millennium Development Goals (MDGs) vs. Sustainable Development Goals (SDGs). Overview of the **17 SDGs**, their targets, and indicators.

Importance of **global collaboration** for sustainable development.

UNIT - II	PEOPLE-CENTERED SDGS (SDG 1–6)	6

SDG 1: No Poverty – Causes, measures & policies.

SDG 2: Zero Hunger – Food security & sustainable agriculture.

SDG 3: Good Health & Well-being – Universal healthcare & disease prevention.

SDG 4: Quality Education – Inclusive and equitable education.

SDG 5: Gender Equality – Women's empowerment & equal opportunities.

SDG 6: Clean Water & Sanitation – Water conservation & access to sanitation.

Approved by BoS Chairman

UNIT - III	ECONOMIC & INFRASTRUCTURE SDGS (SDG 7–12)	6

SDG 7: Affordable & Clean Energy – Renewable energy solutions.

SDG 8: Decent Work & Economic Growth – Inclusive economic policies.

SDG 9: Industry, Innovation & Infrastructure – Sustainable development & digital transformation.

SDG 10: Reduced Inequalities – Social inclusion & global justice.

SDG 11: Sustainable Cities & Communities – Smart urban planning & resilience.

SDG 12: Responsible Consumption & Production – Circular economy & waste management.

UNIT - IV	ENVIRONMENTAL SDGS (SDG 13–15)	6

SDG 13: Climate Action – Climate change impacts & mitigation strategies.

SDG 14: Life Below Water – Ocean conservation & marine biodiversity.

SDG 15: Life on Land – Forest preservation & biodiversity protection.

UNIT - V	Governance & Global Partnerships (SDG 16–17)	6

SDG 16: Peace, Justice & Strong Institutions – Human rights & good governance.

SDG 17: Partnerships for the Goals – Role of international cooperation, businesses & individuals.

Course Outcomes: Students will be able to	
CO1	Explain the origin, purpose, and significance of the UN Sustainable Development Goals.
CO2	Summarize the 17 SDGs, their interconnections, and challenges in achieving them.
CO3	Interpret global and local case studies of SDG implementation.
CO4	Describe the roles of governments, businesses, and individuals in sustainable development.
CO5	Illustrate practical solutions and action plans for achieving SDGs at community and policy levels.

Approved by BoS Chairman

Text Books	
1.	Sachs, J. D. (2015). The Age of Sustainable Development. Columbia University Press.
2.	United Nations (2015). Transforming Our World: The 2030 Agenda for Sustainable Development.
3.	Griggs, D., Stafford-Smith, M., Gaffney, O., & Rockström, J. (2017). Sustainable Development Goals: Harnessing Business to Achieve the SDGs Through Finance, Technology and Innovation. Routledge.
4.	Mebratu, D., & Swilling, M**. (2019).** Transformational Infrastructure for Development of a Wellbeing Economy. Springer.

Reference Books	
1.	Leal Filho, W. (Ed.). (2020). Encyclopedia of the UN Sustainable Development Goals. Springer.
2.	Sachs, J. D. (2021). The Decade of Action: Mobilizing the World to Achieve the SDGs. Columbia University Press.

Approved by BoS Chairman

B.E.	B23AEP501 - AERO ENGINE AND AIRFRAME STRUCTURAL LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To impart knowledge on assembling and reassembling of an aircraft piston engine and its operating principle.
2.	To attain knowledge lubrication and auxiliary system in aircraft.
3.	To understand various joining methods in airframe.
4.	To expose patch repairing procedure and tube bending methods.
5.	To attain hands on experience on glass epoxy laminate and sheet metal forming.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Dismantling and reassembling of an aircraft piston engine.
2.	Study of Camshaft operation, firing order and magneto, valve timing
3.	Study of lubrication and cooling system
4.	Study of auxiliary systems, pumps and carburetor
5.	Aircraft wood gluing-single & double scarf joints
6.	Welded single & double V-joints.
7.	Fabric & Riveted Patch repairs
8.	Tube bending and flaring
9.	Sheet metal forming
10.	Preparation of glass epoxy of composite laminates and specimens.
	Total Practical Hours : 60

Programme Coordinator

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Course Outcomes : Students will be able to	
CO1	Experiment with the Aircraft to perform the Dismantling and Reassembling of an Aircraft piston Engine, there by the cam shaft operation and valve timings are studied.
CO2	Identify the Lubrication and Auxiliary systems incorporated with the Aircraft.
CO3	Examine the wood gluing and welding techniques that is used to join the given work pieces.
CO4	Inspect the structural damage to perform repair works by means of Fabric Patch work and Flaring methods.
CO5	Construct the channel section by sheet metal forming and Glass epoxy composite Laminates

List of Equipment for a Batch of 30 Students		
Sl. No.	**Description of the Equipment**	**Quantity**
1.	Aircraft Piston engines	1
2.	Set of basic tools for dismantling and assembly	1 set
3.	NDT equipment	1 set
4.	Micrometers, depth gauges, vernier calipers	1 set
5.	Shear cutter pedestal type	1
6.	Drilling Machine	1
7.	Bench Vices	1
8.	Radius Bend bars	1
9.	Pipe Flaring Tools	1
10.	Welding machine	1
11.	Glass fibre, epoxy resin	1

Programme Coordinator

BoS Chairman

B.E.	B23AEP502 - AIRCRAFT DESIGN LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To study the different types of airplanes and their specifications.
2.	To know the performance details, associate with their own aircraft.
3.	To understand the preliminary design concept of aircraft.
4.	To acquire knowledge on performance calculations and estimation of drag.
5.	To gain exposure on V-n diagram through stability analysis.

To make the student work in groups and understand the Concepts involved in aircraft structure, aerodynamics and power plant selection. The following are the assignments are to be carried out.	
1.	The preliminary weight estimation, Selection of design parameters, power plant selection, aero foil selection, control surfaces, landing gear selection and stability aspects of different types of airplanes.
2.	Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment
3.	Detailed design of an aircraft wing – Design of spars and stringers.
4.	Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
5.	Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations.
6.	Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads
	Total Practical Hours : 60

Course Outcomes : Students will be able to	
At the end of this course, the student will be able to:	
CO1	Develop the structural design of an aircraft wing. (K3)
CO2	Build the spars and stringer for the aircraft wing with bending stress and shear flow analysis. (K3)
CO3	Analyze the load, buckling and bending stress distribution on an aircraft fuselage. (K4)
CO4	Explain the maneuvering loads acts on the control surfaces. (K5)
CO5	Design the landing gear, wing root attachment. (K6)

Programme Coordinator

BoS Chairman

B.E.	B23AET601 – FINITE ELEMENT METHODS	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To understand various approximate methods and weighted residual approach to solve the structural problems
2.	To impart local and natural coordinates for bar, truss, beam and frame elements for various loading and boundary conditions.
3.	To give exposure on various plane stress, strain and axis symmetry problems
4.	To know about shape function and stiffness matrix by using numerical integration method.
5.	To realize the steady flow and heat transfer problem solving methods and to know about the software packages.

UNIT - I	INTRODUCTION	12
Review of various approximate methods – variational approach and weighted residual approach - application to structural mechanics' problems. Finite difference methods - governing equation and convergence criteria of finite element method.		

UNIT - II	DISCRETE ELEMENTS	12
Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.		

UNIT - III	CONTINUUM ELEMENTS	12
Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.		

UNIT - IV	ISOPARAMETRIC ELEMENTS	12
Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.		

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UNIT - V	FIELD PROBLEM AND METHODS OF SOLUTIONS	12
Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. bandwidth - elimination method and method of factorization for solving simultaneous algebraic equations – Features and application of software packages.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Apply different mathematical techniques to find deflection and bending moment.
CO2	Solve stiffness matrix for bar, beam and frame problems with different loading conditions.
CO3	Identify plane stress and plane strain for triangular and axisymmetric elements.
CO4	Evaluate the shape function and stiffness matrix using numerical integration for isoparametric elements.
CO5	Apply the concepts of finite element methods to solve fluid flow and heat transfer problems.

Text Books	
1.	Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill Education; 4th edition 2018.
2.	Tirupathi.R. Chandrapatha and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India, Fourth edition, 2012.

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

Programme Coordinator

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B.E.	B23AET602 – AIRCRAFT STABILITY AND CONTROL	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To know about the static longitudinal stability, power and Influence of CG location
2.	To introduce the concept of stick controls of Aircraft and Aerodynamic balancing.
3.	To acquire knowledge about lateral and directional stability of airplanes during different maneuvering conditions
4.	To impart knowledge about various Aerobatics Manoeuvres
5.	To understand the dynamic modes of stability in longitudinal, lateral and directional stability conditions.

UNIT - I	STATIC LONGITUDINAL STABILITY	12
Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes. Wing and tail contribution - Effects of Fuselage and nacelles - Power effects - Jet driven airplane and Propeller driven airplane - Influence of CG location.		

UNIT - II	STICK FIXED AND FREE LONGITUDINAL STABILITY	12
Basic equations of motion Elevator hinge moment, Estimation of hinge moment parameters - Stick fixed neutral point - Stick free neutral points - Symmetric maneuvers - Stick force gradients - Stick force per ‘g’ - Aerodynamic balancing.		

UNIT - III	LATERAL AND DIRECTIONAL STABILITY	12
Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.		

UNIT - IV	BASIC AEROBATICS MANOEUVRES	12
Introduction – Wing over (chandelle / lazy eight) – Loop – Aileron roll – Stall Turn- Barrel Roll – Slow roll – Roll of the top – Half reverse – Cuban – Loss of controls in the verticals- Wing drop stalls.		

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UNIT - V	DYNAMIC STABILITY	12
Introduction to dynamic longitudinal stability : Modes of stability, Characteristics modes of oscillation in stick fixed and stick free longitudinal dynamics - Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin – Introduction to flight simulation software.		
Total Instructional hours : 60		

Course Outcomes : Students will be able to	
CO1	Summarize the degree of freedom, static stability and the requirement of control force and power effect of aircraft system
CO2	Utilize the knowledge about degrees of stability, stick fixed, stick free stability and aerodynamic balancing.
CO3	Identify the different maneuvers performed by the aircraft.
CO4	Categorize the lateral control, rolling and yawing moments, rudder and aileron control requirements & rudder lock.
CO5	Classify the dynamic longitudinal stability and stability derivatives.

Text Books	
1.	Nelson, R.C. “Flight Stability and Automatic Control”, McGraw-Hill Book Co., 2004.
2.	Perkins, C.D., and Hage, R.E., “Airplane Performance stability and Control”, John Wiley & Son: Inc, NY, 1988.
3.	Aerobatics Manual- C152 A Master – 7th Edition

Reference Books	
1.	Babister, A.W., “Aircraft Dynamic Stability and Response”, Pergamon Press, Oxford, 1980.
2.	Dommasch, D.O., Sherby, S.S., and Connolly, T.F., “Aeroplane Aero dynamics”, Third Edition, Issac Pitman, London, 1981.
3.	Etkin, B., “Dynamics of Flight Stability and Control”, Edn. 2, John Wiley, NY, 1982.
4.	Mc Cornick B.W, “Aerodynamics, Aeronautics and Flight Mechanics”, John Wiley, NY, 1995

Programme Coordinator

BoS Chairman

B.E.	B23AET603 - ROCKET AND SPACECRAFT PROPULSION	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To impart make students understand theory in non-air-breathing and hypersonic propulsion methods.
2.	To gain knowledge about the basic principle of chemical rocket propulsion.
3.	To understand about the working principle of solid propellant rocket motors and its features.
4.	To understand the working principle of liquid propellant rocket engine and hybrid propulsion.
5.	To gain knowledge about the advance propulsion systems.

UNIT - I	RAMJET AND SCRAMJET PROPULSION	12

Operating principle of Ramjet engine – Combustion in Ramjet engine- Ramjet performance and sample ramjet design calculations - Introduction to hypersonic air breathing propulsion - Need for supersonic combustion for hypersonic propulsion – Salient features of scramjet engine and its applications for hypersonic vehicles – Problems associated with supersonic combustion – Engine/airframe integration aspects of hypersonic vehicles – Fuel injection schemes in scramjet combustors – Recent revolutionary advancement in rocket and spacecraft propulsion.

UNIT - II	CHEMICAL ROCKET PROPULSION	12

Operating principle – Specific impulse of a rocket – Internal ballistics – performance Characteristics of rockets – Simple rocket design problems – Types of igniters - Rocket nozzle classification - preliminary concepts in nozzle-less propulsion – Air augmented rockets – Pulse rocket motors – Static testing of rockets & instrumentation – Safety considerations.

UNIT - III	SOLID ROCKET PROPULSION	12

Salient features of solid propellant rockets – Selection criteria of solid propellants – Estimation of solid propellant adiabatic flame temperature - Propellant grain design considerations – Erosive burning in solid propellant rockets – Combustion instability – Strand burner and T-burner – Applications and advantages of solid propellant rockets.

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UNIT - IV	LIQUID AND HYBRID ROCKET PROPULSION	12

Salient features of liquid propellant rockets – Selection of liquid propellants – Various feed systems and injectors for liquid propellant rockets -Thrust control and cooling in liquid propellant rockets and the associated heat transfer problems – Combustion instability in liquid propellant rockets – Cryogenic liquids in Rocket launching - Zero gravity problems associated with cryogenic propellants - Introduction to hybrid rocket propulsion – Standard and reverse hybrid systems - combustion mechanism in hybrid propellant rockets – Applications and limitations.

UNIT - V	ADVANCED PROPULSION SYSTEMS	12

Electric rocket propulsion – Types of electric propulsion techniques - Ion propulsion – Nuclear rocket – Comparison of performance of these propulsion systems with chemical rocket propulsion systems – Future applications of electric propulsion systems - Solar sail – Current scenario of advanced propulsion projects worldwide.

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the hypersonic air breathing propulsion system.
CO2	Identify the chemical rocket propulsion systems.
CO3	Organize the solid rocket propulsion rocket system.
CO4	Distinguish the principles of liquid and hybrid propulsion system.
CO5	Compare the different types of advanced propulsion systems.

Text Books	
1.	Mathur, M.L., and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 2014.
2.	Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 8th Edition, 2010.

Reference Books	
1.	Robert G. Jahn, “Physics of Electric Propulsion”, Dover Publications, 2006.
2.	Segal, Corin. The scramjet engine: processes and characteristics. Vol. 25. Cambridge University Press, 2009.

Programme Coordinator

BoS Chairman

B.Tech CSBS	B23MCT605 CYBER SAFETY CONCEPTS	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand various types of cyber-attacks and cyber-crimes
2.	To learn threats and risks within context of the cyber security
3.	To have an overview of the cyber laws & concepts of cyber forensics
4.	To study the defensive techniques against these attacks
5.	To understand various cyber security privacy issues

UNIT- I	Introduction to Cyber Security	9

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT- II	Cyberspace and the Law & Cyber Forensics	9

Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT- III	Cybercrime: Mobile and Wireless Devices	9

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in
Mobile Computing Era, Laptops.

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UNIT- IV	Cyber Security	9
Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations		

UNIT- V	Privacy Issues	9
Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains medical, financial, etc.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Analyze and evaluate the cyber security needs of an organization.
CO2	Understand Cyber Security Regulations and Roles of International Law.
CO3	Design and develop a security architecture for an organization.
CO4	Understand fundamental concepts of data privacy attacks.
CO5	Explain fundamental concepts of data privacy and analyze the role of privacy policies and privacy- preserving techniques.

Text Books	
1.	Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2.	B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.
Reference Books	
1.	Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2.	Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

Approved by BoS Chairman

B.E.	B23AEP601 – PROPULSION LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To explore practically components of aircraft piston and gas turbine engines and their working principles.
2.	To impart practical knowledge of flow phenomenon of subsonic and supersonic jets.
3.	To perform testing on compressor blades and basic knowledge on cold flow studies
4.	To calculate wall pressure measurement high speed jets and supersonic nozzle.
5.	To understand the flow visualization by using schileren and shadowgraph techniques.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Study of aircraft piston engines and its components
2.	Study of gas turbine engines and its components
3.	Velocity profiles of free jets.
4.	Velocity profiles of wall jets.
5.	Velocity profiles of coaxial jets
6.	Cascade testing of compressor blades
7.	Wall pressure measurements of a subsonic diffusers.
8.	Wall Pressure measurements of supersonic nozzle.
9.	Measurement of potential core length in subsonic and supersonic jets
10.	Flow visualization of supersonic flow.
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Identify the components and information of piston and gas turbine engine.
CO2	Examine the flow phenomenon of subsonic and supersonic internal flows.
CO3	Evaluate the performance parameters involving external flows over cascades in turbomachines.
CO4	Analyze the behavior of flow through ducts and jet engine components.
CO5	Analyze flow visualization techniques pertaining to supersonic flows.

List of Equipment

Sl. No.	Name of the Equipment	Quantity
1.	Jet Engine	1
2.	Piston engine	1
3.	Free Jet	1
4.	Wall Jet	1
5.	Jet facility with compressor and storage tank	1
6.	Wind tunnel	1
7.	0-5 bar pressure transducer with pressure indicator OR DSA pressure scanner 8 channel	1
8	Compressor blade set	1
9.	Schlieren or Shadowgraph set up	1
10.	Convergent nozzle	1
11.	Convergent divergent nozzle	1

Programme Coordinator

BoS Chairman

B.E.	B23AEP602 – AIRCRAFT SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To train the students “ON HAND” experience in jacking and leveling of an aircraft.
2.	To recognize the concepts of aircraft control system check procedures.
3.	To realize the different types of tests to assess leakage and clogging.
4.	To enrich the knowledge on functional and pressure test on fuel system.
5.	To study about the wheel break units and maintenances in hydraulic and fuel systems.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Aircraft “Jacking Up” procedure
2.	Aircraft “Levelling” procedure
3.	Control System “Rigging check” procedure
4.	Aircraft “Symmetry Check” procedure
5.	“Flow test” to assess of filter element clogging
6.	“Pressure Test” To assess hydraulic External/Internal Leakage
7.	“Functional Test” to adjust operating pressure
8.	“Pressure Test” procedure on fuel system components
9.	“Brake Torque Load Test” on wheel brake units
10.	Maintenance and rectification of snags in hydraulic and fuel systems.
Total Practical Hours : 60	

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Course Outcomes : Students will be able to	
CO1	Experiment with the Aircraft to perform the Jacking UP and Levelling Procedure.
CO2	Experiment with the Aircraft to perform Rigging and symmetry check procedure.
CO3	Examine the Filter Clogging and hydraulic Leakage by Flow and Pressure test.
CO4	Inspect the operating Pressure and Fuel system components.
CO5	Evaluate the Brake units and Rectification of Snags of various Airframes system.

List of Equipment		
Sl. No.	**Name of the Equipment**	**Quantity**
1.	Serviceable aircraft with all above systems	1
2.	Hydraulic Jacks	3
3.	Trestle adjustable	5
4.	Spirit Level	2
5.	Levelling Boards	1
6.	Cable Tensiometer	1
7.	Adjustable Spirit Level	1
8.	Plumb Bob	1

Programme Coordinator

BoS Chairman

B.E.	B23AEE901– EXPERIMENTAL AERODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on measurement techniques in aerodynamic flow.
2.	To acquire basics concepts of wind tunnel measurement systems.
3.	To understand the specific instruments for flow parameter measurement like pressure, velocity.
4.	To expose the several measurement techniques involved in aerodynamic testing.
5.	To study the model measurements, lift and drag measurements through various techniques and testing of different models.

UNIT - I	BASIC MEASUREMENTS IN FLUID MECHANICS	9

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization – Components of measuring systems – Importance of model studies.

UNIT - II	WIND TUNNEL MEASUREMENTS	9

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence - Wind tunnel balance – Wire balance – Strut-type – Platform-type – Yoke-type – Pyramid type – Strain gauge balance – Balance calibration.

UNIT - III	FLOW VISUALIZATION AND ANALOGUE METHODS	9

Visualization techniques – Smoke tunnel – Hele - Shaw apparatus - Interferometer – Fringe - Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

UNIT - IV	INTRUSIVE AND NON-INTRUSIVE TECHNIQUES	9

Intrusive techniques – Pitot - static tube characteristics – Directional probes – Hot wire turbulence measurements - Non-intrusive techniques – Particle image velocimetry – Laser Doppler techniques – molecular tagging velocimetry – infrared thermography - image processing and data deduction.

Programme Coordinator	BoS Chairman

UNIT - V	SPECIAL FLOWS AND UNCERTAINTY ANALYSIS	9
Experiments on Taylor - Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation - Uses of uncertainty analysis.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify components and its performance terms associated with the measuring system.
CO2	Analyze the performance of wind tunnel to calibrate power loss.
CO3	Analyze the principles of flow visualization by the various analogue methods.
CO4	Measure pressure, velocity and temperature in low & high-speed flows.
CO5	Estimate the internal and external measurement errors in the special flows.

Text Books	
1.	Rathakrishnan, E., “Instrumentation, Measurements, and Experiments in Fluids,” CRC Press – Taylor & Francis, 2007.
2.	Robert B Northrop, “Introduction to Instrumentation and Measurements”, Second Edition, CRC Press, Taylor & Francis, 2006.

Reference Books	
1.	Bradsaw "Experimental Fluid Mechanics", Elsevier, 2nd edition, 1970.
2.	Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985.

Programme Coordinator

BoS Chairman

B.E.	B23AEE902 – INDUSTRIAL AERODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn the concepts of Non-aeronautical usages of aerodynamics
2.	To introduce the topic of wind energy collectors
3.	To impart concepts of analysing vibrations during flow
4.	To the learn the concepts of Atmospheric boundary layer
5.	To introduce the basics of Flow induced vibrations

UNIT - I	ATMOSPHERE	9
Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.		

UNIT - II	WIND ENERGY COLLECTORS	9
Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.		

UNIT - III	VEHICLE AERODYNAMICS	9
Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.		

UNIT - IV	BUILDING AERODYNAMICS	9
Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, building codes, Building ventilation and architectural aerodynamics.		

UNIT - V	FLOW INDUCED VIBRATIONS	9
Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.		
Total Instructional hours : 45		

Programme Coordinator	BoS Chairman

Course Outcomes : Students will be able to	
CO1	Use of aerodynamics for non- aerodynamics such as vehicle, building
CO2	Solve the problems and able to analyze vibrations during flow
CO3	Identify the Atmospheric boundary layer and applications of wind energy collectors
CO4	Analyse the aerodynamics of road vehicles and problems of flow induced vibrations
CO5	Analyse the aerodynamics of buildings and problems of flow induced vibrations.

Text Books	
1.	M.Sovran (Ed), “Aerodynamics and drag mechanisms of bluff bodies and Road vehicles”, Plenum press, New York, 1978.
2.	Sachs. P., “Winds forces in Engineering”, Pergamon Press, 1978.

Reference Books	
1.	Blevins. R.D., “Flow Induced Vibrations”, Van Nostrand, 1990.
2.	Calvent. N.G., “Wind Power Principles”, Charles Griffin & Co., London, 1979.

Programme Coordinator

BoS Chairman

B.E.	B23AEE903 – AIRCRAFT DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To familiarize with various configuration of aircraft.
2.	To gain a comprehensive understanding on power plant selection for a given mission.
3.	To gain knowledge in various performance parameters of aircraft.
4.	To expose the students with optimization of wing loading.
5.	To impart knowledge on structural design of airplanes.

UNIT - I	INITIAL SIZING OF AIRCRAFT	9
Categories and types of aircrafts – various configurations – Layouts and their relative merits – Mission requirement analysis - Selection of aerodynamic parameters - airfoil and geometry Selection - Thrust-to-Weight ratio and wing loading – Landing Gear Arrangements - Multidisciplinary Optimization.		

UNIT - II	POWER PLANT TYPES AND CHARACTERISTICS	9
Selection of power plants, Characteristics of different types of power plants – Propeller characteristics and selection – Relative merits of location of power plant - Electric propulsion for future aviation. Case studies on Tail-mounted Engines versus wing Mounted Engines and their impact on Aircraft stability and handling qualities.		

UNIT - III	PRELIMINARY DESIGN	9
Weight estimation - Iterative Refinement - balance diagram – Drag estimation of complete aircraft – Level flight, climb, takeoff and landing calculations – range and endurance – static and dynamic stability estimates – control requirements. Case studies on Preliminary Design of Airship, VTOL aircraft and Electric Aircraft.		

UNIT - IV	DESIGN OF UNIQUE CONFIGURATIONS	9
Layout peculiarities of subsonic and supersonic aircraft – optimization of wing loading to achieve desired performance – loads on undercarriages - Design of Flying Wing, Tailless, Lifting Fuselage, and Blended Wing-Body configurations. Case studies on Tiltrotor, Double-Decker Configurations and Amphibious capabilities.		

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UNIT - V	STRUCTURAL DESIGN	9
Estimation of loads on complete aircraft and components – Structural design of fuselage, wings and undercarriages, controls, connections and joints. Advanced materials for modern aircraft – Lightweight Structures - Fatigue and Damage Tolerance – Evaluation of life-cycle - Environmental impacts.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Appreciate the advantages of different configuration and types of aircraft.
CO2	Select proper airplane configuration and suitable power plant to satisfy given mission requirements.
CO3	Carry out weight estimation by iterative procedure and draw the balance diagram.
CO4	Design aerodynamically efficient wing and fuselage for the design Mach number of the aircraft.
CO5	Estimate different types of loads acting on complete aircraft and choose suitable materials for different components of the airframe.

Text Books	
1.	D.P. Raymer, “Aircraft conceptual design”, 5th Edition, 2012, AIAA Series.
2.	Mohammad H. Sadraey, “Aircraft Design: a Systems Engineering Approach”, 1st edition, 2013, John Wiley & Sons, Ltd., Publication.

Reference Books	
1.	G. Corning, “Supersonic & Subsonic Airplane Design”, 2nd Edition, 1953, Edwards Brothers Inc., Michigan.
2.	E.F. Bruhn, “Analysis and Design of Flight Vehicle Structures”, 1980, Tristate Offset Co., U.S.A.
3.	E.Torenbeek, “Synthesis of Subsonic Airplane Design”, 1976, Delft University Press, London.

Programme Coordinator

BoS Chairman

B.E.	B23AEE904 – HELICOPTER AERODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce fundamental aspects on helicopter rotor aerodynamics, generation of lift and rotor control & efficiency to students
2.	To make students familiarize with the concepts like hovering and vortex ring state and calculation of induced power
3.	To make students knowledgeable on helicopter flight performance calculations and on criteria for selection of power plants
4.	To acquaint students with lateral and longitudinal stability characteristics of helicopter and the differences between stability and control
5.	To elucidate students on the structural problems peculiar to helicopter rotor like rotor vibration

UNIT - I	INTRODUCTION	9
Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotors, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.		

UNIT - II	AERODYNAMICS OF ROTOR BLADE	9
Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.		

UNIT - III	STABILITY AND CONTROL	9
Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.		

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UNIT - IV	AERODYNAMIC DESIGN	9
Introduction, Blade section design, blade tip shapes, parasite drag, rear fuselage unsweep, Aerodynamics Design process.		

UNIT - V	ROTOR VIBRATIONS	9
Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Perform the Aerodynamic calculation of Rotor blades
CO2	Perform stability and control analysis of Helicopter
CO3	Develop methods to control Rotor vibration
CO4	Calculate power requirement of helicopter during hover and climb
CO5	Design rotor blades for a given helicopter.

Text Books	
1.	John Fay, "The Helicopter and How It Flies", Himalayan Books 1995
2.	Lalit Gupta, "Helicopter Engineering", Himalayan Books New Delhi 1996.
3.	Rathakrishnan E,Helicopter Aerodynamics,PHI Learning Pvt Ltd,NewDelhi,2019.

Reference Books	
1.	Joseph Schafer, "Basic Helicopter Maintenance", Jeppesen 1980
2.	R W Prouty, Helicopter Aerodynamics, Phillips Pub Co, 1993.

Programme Coordinator

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B.E.	B23AEE905 – HYPERSONIC AERODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce fundamental concepts and features peculiar to hypersonic flow to students to familiarize them with the aerodynamical aspects of hypersonic vehicles.
2.	To gain knowledge on basics of hypersonic and supersonic aerodynamics.
3.	To distinguish the general hypersonic flow theory.
4.	To gain knowledge on various interaction of boundary layers in hypersonic flow.
5.	To realize the role of chemical and temperature effects in hypersonic flows.

UNIT - I	FUNDAMENTALS OF HYPERSONIC AERODYNAMICS	9
Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics – concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.		

UNIT - II	SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS	9
Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.		

UNIT - III	VISCOUS HYPERSONIC FLOW THEORY	9
Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non-self- similar boundary layers – solution methods for non-self-similar boundary layers – aerodynamic heating and its adverse effects on airframe.		

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UNIT - IV	VISCOUS INTERACTIONS IN HYPERSONIC FLOWS	9
Introduction to the concept of viscous interaction in hypersonic flows – Strong and weak viscous interactions – hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.		

UNIT - V	HIGH TEMPERATURE EFFECTS IN HYPERSONIC FLOWS	9
Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb's free energy and entropy – chemically reacting boundary layers – recombination and dissociation.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Compare the hypersonic and supersonic aerodynamics concept.
CO2	Apply thin shock layer theory and shock expansion method for hypersonic inviscid flow.
CO3	Identify the aerodynamic heating due to viscous boundary layers of hypersonic flow.
CO4	Illustrate the strong and weak viscous interactions in hypersonic flow.
CO5	Analyze the chemical effects in the hypersonic boundary layer.

Text Books	
1.	John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", Mc.Graw hillSeries, New York, 1996.

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

Programme Coordinator

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B.E.	B23AEE906 – BOUNDARY LAYER THEORY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To acquaint students with the fundamental concepts in boundary layer flow and with the governing equations of viscous flow
2.	To make students familiarize with obtaining analytical solutions for low speed viscous flow problems commonly found in engineering applications
3.	To introduce the basic concepts in laminar boundary layer theory and its applications in engineering to students
4.	To elucidate students on the complex phenomenon in turbulent boundary layer theory and turbulence modelling
5.	To make students knowledgeable on the techniques used for boundary layer control.

UNIT - I	FUNDAMENTAL EQUATIONS OF VISCOUS FLOW	9
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 - dimensionlisation the basic equations and boundary conditions, vorticity considerations, creeping flow and boundary layer flow.		

UNIT - II	SOLUTIONS OF VISCOUS FLOW EQUATIONS	9
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.		

UNIT - III	LAMINAR BOUNDARY LAYER	9
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, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy – Pohlhausen method.		

Programme Coordinator	BoS Chairman

UNIT - IV	TURBULENT BOUNDARY LAYER	9
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, Eddy Viscosity and mixing length.		

UNIT - V	BOUNDARY LAYER CONTROL	9
Boundary layer control in laminar flow-Methods of Boundary layer control: Acceleration of the boundary layer-Suction- Injection of a different gas-Prevention of transition - Cooling of the wall- Boundary layer suction- Practical examples of Boundary Layer Control.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply fundamental equations of the viscous flow for practical examples.
CO2	Analyze the viscous flow problems for solutions.
CO3	Explain the importance of viscosity and shear flow adjacent to the airframe of the aerospace vehicles
CO4	Build an understanding about the laminar boundary layer concepts and solution methods
CO5	Illustration about the importance of turbulence boundary layer in an aerospace engineering problem

Text Books	
1.	White, F. M., Viscous Fluid Flow, McGraw-Hill Education; 3rd edition, 2005.

Reference Books	
1.	A.J. Reynolds, “Turbulent flows in Engineering”, John Wiley & Sons, 1980.
2.	Frank White – Viscous Fluid flow – McGraw Hill, 1998
3.	H. Schlichting, “Boundary Layer Theory”, McGraw-Hill, New York, 1979.
4.	Ronald L., Panton, “Incompressible fluid flow”, John Wiley & Sons, 1984.
5.	Tuncer Cebeci and Peter Bradshaw, “Momentum transfer in boundary layers”, Hemisphere Publishing Corporation, 1977.

Programme Coordinator

BoS Chairman

B.E.	B23AEE907 – LAUNCH VEHICLE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To give exposure to students on different configurations of launch vehicles and the type of missions for the launch vehicles.
2.	To introduce the fundamental aerodynamic design aspects of launch vehicle airframes.
3.	To make students familiarize with the basic principles of design of the important components of propulsion systems of launch vehicles
4.	To give exposure to students on various types of aerodynamic control methods for launch vehicles
5.	To introduce jet control methods for long range launch vehicles

UNIT - I	LAUNCH VEHICLE CONFIGURATIONS AND MISSIONS	9

Classes of launch vehicles – air launched, sea launched, submarine launched and land based rocket vehicles – civil and military rocket vehicles – requirements of launch site and launch platforms – peculiarities of air launched and submarine launched missiles with respect to launching requirements – a brief introduction to launch vehicle airframe components and their functions.

UNIT - II	AERODYNAMIC DESIGN ASPECTS OF AIRFRAME	9

Aerodynamic design considerations of airframe components – Different forebody configurations and their applications to different classes of launch vehicles – Planforms and cross sections of wings and fins – Minimization of overall drag of the airframe of the launch vehicle – Interference effects of flow over different airframe components and its effect on normal force distribution – a brief introduction to aeroelasticity aspects of airframe design

UNIT - III	DESIGN ASPECTS OF PROPULSION SYSTEM COMPONENTS	9

Basic design considerations of propulsion system components such as igniter and nozzle – injector and combustion chamber design for liquid propulsion systems – chamber cooling – solid propellant grain design types and the requirements of these grain types – determination of thrust requirements and sizing of propulsion system – performance loss estimation of solid and liquid propulsion systems – matching the propulsion system design to mission requirements

Programme Coordinator	BoS Chairman

UNIT - IV	AERODYNAMIC CONTROL METHODS	9
Advantages and limitations of aerodynamic control methods – basic principle involved in aerodynamic control – Aerodynamic characteristics of wing control, canard control, tail control, tail-less control and other control methods using surface projections – Mission areas of applications of different aerodynamic control methods – Influence of centre of gravity travel on these methods – A comparison of aerodynamic control methods – Use of required hardware and electronics for achieving aerodynamic control.		

UNIT - V	JET CONTROL METHODS	9
Principle behind the jet control methods for thrust vectoring – different types of jet control methods and their advantages & limitations – Nozzle guide vanes method, nozzle rings method, jetevator method, swivel nozzle method and engine gimballing method – limitations of single nozzle jet control methods – Principle involved in fluidic thrust vector control methods and types – shifting nozzle throat method, counter flow method and secondary injection through diverging wall of the nozzle – a brief introduction to multiple nozzle based jet control methods.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	understand the requirements for different classes of launch vehicles for different missions
CO2	Understand the fundamental steps involved in the FEM analysis process.
CO3	Assemble stiffness matrices, formulate element equations, and perform numerical integration using FEM.
CO4	Be proficient in implementing FEM codes and the general methodology for solving engineering problems using FEM.
CO5	Utilize commercial finite element software to analyze and solve complex engineering problems.

Text Books	
1.	Weaver, W., and Gere, J.M., “Matrix Analysis of Framed Structures”, CBS Publishers and distributors pvt. Ltd., 2004.
2.	Rajasekaran, S., and Sankarasubramanian, G., “Computational Structural Mechanics”, PHI, New Dehi, 2001.
3.	Martin, H, C., “Introduction to Matrix Methods of Structural Analysis”, McGraw-Hill, New York, 1966.

Programme Coordinator

BoS Chairman

Reference Books	
1.	Rubinstein, M.F., “Matrix Computer Analysis of Structures”, Prentice-Hall, Englewood Cliffs, New Jersey, 1966.
2.	Beaufait, F.W., Rowan, W. H., Jr., Hoadely, P. G., and Hackett, R. M., Computer Methods of Structural Analysis, Prentice-Hall, Englewood Cliffs, New Jersey, 1970.
3.	Kardestuncer, H.,” Elementary Matrix Analysis of Structures”, McGrawHill, New York, 1974.

Programme Coordinator

BoS Chairman

B.E.	B23AEE908 – MISSILE AERODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce aerodynamic characteristics of different classes of missiles and rockets to students.
2.	To impart adequate knowledge on various airframe components of missiles and their functions to students.
3.	To give exposure to the students on the various forms and origins of drag and its estimation.
4.	To make the students familiarize with the concepts on missile integration and with validation of CFD methods with wind tunnel testing for aerodynamic characteristics.
5.	To make students learn the stability aspects and control methods for missiles.

UNIT - I	BASIC AERODYNAMIC CHARACTERISTICS OF MISSILES	9

Classification of missiles - Aerodynamics characteristics and requirements of air to air missiles, air to surface missiles and surface to air missiles - Missile trajectories and the relationship of the trajectory geometry with mission requirements-fundamental aspects of hypersonic aerodynamics.

UNIT - II	MISSILE DRAG ESTIMATION	9

Various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation - Various shapes of missile forebodies and the role of missile forebody on the overall drag of a missile - various types of drag and their origin–methods to minimize the drag types.

UNIT - III	THEORY OF SLENDER BODY AERODYNAMICS	9

Aerodynamics of slender and blunt bodies- comparison of aerodynamic design philosophies of missile and airplane airframes - wing-body interference effects - Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles-determination of aero elastic effects

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UNIT - IV	AERODYNAMIC ASPECTS OF LAUNCHING PHASE	9
Booster separation-cross wind effects-specific considerations in missile launching - Risk factors involved in launching air to air and air to surface missiles from mother aircraft -missile integration and separation-methods of evaluation and determination- Wind tunnel tests – Comparison with CFD Analysis.		

UNIT - V	STABILITY AND CONTROL ASPECTS OF MISSILES	9
Forces and moments acting on missiles in atmosphere - Lateral, rolling and longitudinal moments-missile dispersion-stability aspects of missile configuration- trim conditions - Aerodynamic control methods - Jet control methods - Stability derivatives		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Distinguish between different classes of missiles and their aerodynamic characteristics
CO2	Analyse the requirements of missile trajectories for different missions of the missiles
CO3	Understand the basic principles of slender body aerodynamics and apply them for the aerodynamic design of missile airframes
CO4	Evaluate aerodynamic characteristics of different classes of missiles that are air launched
CO5	Apply missile aerodynamics principles for achieving the required stability and control characteristics of missiles

Text Books	
1.	Chin SS, “Missile Configuration Design”, McGraw Hill, New York, 1961.
2.	Nielsen, Jack N, Stever, Gutford, “Missile Aerodynamics”, McGraw Hill, New York, 1988.

Reference Books	
1.	John D. Anderson. Jr., “Hypersonic and High Temperature Gas Dynamics”, AIAA; 3rd edition, 2019.
2.	John D. Anderson. Jr., “Modern Compressible flow with historical Perspective”, McGraw Hill Publishing Company, 4th edition, 2021.

Programme Coordinator

BoS Chairman

B.E.	B23AEE909– HEAT TRANSFER FOR AEROSPACE APPLICATIONS	L	T	P	C
		2	0	1	3

Course Objectives	
1.	To introduce the governing equations of the with and without governing equations.
2.	To understand the convection mode of heat transfer and overall heat transfer coefficient
3.	To get the knowledge about the radiation heat transfer of white body, gray body and block body.
4.	To learn the knowledge about the different types of fin and pin.
5.	To understand the gas turbine engine heat transfer.

UNIT - I	CONDUCTION	8
Governing Equation in Cartesian, Cylindrical and Spherical coordinates. 1-D steady state heat conduction with and without heat generation. Composite wall - Electrical analogy – Critical thickness of insulation – Heat transfer from extended surface – Effect of temperature on conductivity - 1-D Transient analysis.		

UNIT - II	CONVECTION	12
Review of basic Equations of fluid flow – Dimensional analysis - Forced convection – Laminar flow over flat plate and flow through pipes - Flow across tube banks. Turbulent flow over flat plate and flow through pipes – Free convection – Heat transfer from vertical plate using integral method – Empirical relations - Types of heat exchangers – Overall heat transfer coefficient – LMTD and NTU methods of analysis.		

UNIT - III	RADIATION	9
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.		

UNIT - IV	NUMERICAL METHODS IN HEAT TRANSFER	9
1-D and 2-D Steady and unsteady state heat conduction – Composite walls - heat generation - Variable thermal conductivity - Extended surfaces analysis using finite difference method - Convective heat transfer - Stream function - Vorticity method - Creeping flow analysis - Convection - diffusion 1-D, 2-D Analysis using finite difference approximation. Numerical methods applicable to radiation heat transfer.		

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UNIT - V	HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING	4
Heat transfer problems in gas turbines, Rocket thrust chambers- Aerodynamic heating – Ablative heat transfer.		
		Total Instructional Hours : 45

Course Outcomes : Students will be able to	
CO1	Classify the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction.
CO2	Make use of the basic methods in Conduction and understand the concept of Lump Parameter analysis and when it is applicable and earn the concepts of boundary layer.
CO3	Apply various correlation used in Convective Heat Transfer and Understand the concepts of Black Body, Grey Body, View factor, Radiation shielding.
CO4	Construct the design/size Heat Exchanger and understand the concept of Mass transfer, its types & laws associated with it.
CO5	Apply various technique used for high-speed flow heat transfer.

Text Books	
1.	Holman, J.P., "Heat Transfer", McGraw Hill Book Co., Inc., New York, Sixth Edition, 1991.
2.	Sachdeva, S.C., "Fundamentals of Engineering Heat and Mass Transfer", Wiley Eastern Ltd., New Delhi,1981.
3.	Yunus,A.Cengel, "Heat Transfet-A Practical Approach", Tata McGraw Hill, Second edition, 2003.

Reference Books	
1.	Lienhard, J.H , "A Heat Transfer Text Book", Prentice Hall Inc., 1981.
2.	Mathur, M. and Sharma, R.P, "Gas Turbine and Jet and Rocket Propulsion", Standard Publishers, New Delhi, 1988.
3.	Sutton, G.P, "Rocket Propulsion Elements", John Wiley and Sons, Fifth Edition, 1986

Programme Coordinator

BoS Chairman

B.E.	B23AEE910 – CRYOGENIC ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the fundamentals of cryogenic and refrigeration system.
2.	To understand the importance of cryostat design and their jointing techniques.
3.	To make the students understand the composition of Natural Gas, LNG and its safety aspects in storing procedure.
4.	To understand the application of cryogenic in various fields like electronic, food and nuclear industry.
5.	To familiarize about cryogenic insulation and regulation regarding the explosive hazards.

UNIT - I	CRYOGENIC ENGINEERING	9
Introduction to Cryogenic Systems - liquefaction systems - Lnde Hampton, precooled Linde Hampson, linde dual pressure, cascade, Claude, Kapitza-liquefaction systems for neon, hydrogen & helium - Refrigerators - Magnetic cooling, magnetic refrigeration systems, nuclear demagnetization, valves.		

UNIT - II	CRYOGENIC PLANTS	9
Design of cryostat - Various types of cryostats - construction - their salient features - Fabrications and jointing techniques - flanged and bolted joints - joining of dissimilar metals - welding of stainless steel and alloy steels.		

UNIT - III	CRYOFUEL SYSTEMS	9
Natural Gas - composition, source and pretreatment. Liquefaction of natural gas – simple cascade, mixed refrigerant and turbine expansion cycles. Storage of LNG - Application of NG and LNG and safety aspects.		

UNIT - IV	CRYOGENIC APPLICATIONS	9
Electronic Applications - MASER, LASER, infrared detectors, photomultipliers. Superconductive devices: Superconducting bearings, magnets, motors gyroscope and switches, cryotrons, MRI. Nuclear Application - Bubble chambers, radioactive waste disposal. Metal fabrication applications - cold stretching, cryo forming, metal stress reliving. Food handling applications: food freezing, food shipment and handling.		

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UNIT - V	INSULATION AND HAZARDS	9
Cryogenic Insulation - various types such as gas filled & fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multi-layer insulation. Hazards - Physical hazards, Chemical hazards, Physiological hazards, combustion hazards, oxygen hazards. Safety in handling of cryogens, care for storage of gaseous cylinders, familiarization with regulations of department of explosives.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the Various Cryogenic Systems.
CO2	Explain the Construction Techniques of Various Cryostats.
CO3	Illustrate the Pretreatment, Storage and Safety aspects of NG and LNG.
CO4	Determine the Electronic and Nuclear Applications of Cryogenics.
CO5	Explain the Various Hazards, Its Safety and Insulating Methods Handling of Cryogenics.

Text Books	
1.	Mamata Mukhopadhyay, "Fundamentals of Cryogenic Engineering", PHI Learning Pvt limited, 2013

Reference Books	
1.	Barron, R. F., "Cryogenic Systems", Oxford University, 2006.
2.	Timmerhaus, Flynn, "Cryogenics Process Engineering", Plenum Press, New York, 2007.
3.	G.M Walker. "Cryocooler Part - 1 Fundamental", Plenum Press, New York and London, 2001.
4.	G.M Walker. "Cryocooler Part - 2", Plenum Press, New York and London, 2005.

Programme Coordinator

BoS Chairman

B.E.	B23AEE911 – COMBUSTION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the principles of adiabatic flame temperature calculation and equilibrium products and apply fundamental laws of transport phenomena to analyze combustion processes using MATLAB.
2.	To explore the characteristics of one-dimensional combustion waves, analyze factors influencing laminar flame speeds, and investigate ignition and stabilization mechanisms of premixed and diffusion flames, utilizing MATLAB for simulation.
3.	To Evaluate combustion processes in gas turbine and ramjet engines, including the role of combustion zones, flame stability, and efficiency considerations, comparing and contrasting the combustion characteristics in both engine types.
4.	To Examine the complexities of supersonic combustion in scramjet engines, analyze the impact of combustor configurations, isolators, and combustion control mechanisms, and assess the role of struts and cavities in enhancing combustion efficiency.
5.	To Investigate combustion dynamics in liquid, solid, and hybrid propellant rockets, apply laminar flame theory to predict burning characteristics, analyze combustion instability issues, and determine specific impulse using MATLAB simulations for various rocket propulsion systems.

UNIT - I	BASIC PHENOMENA IN COMBUSTION	9
Calculation of adiabatic flame temperature and equilibrium products of combustion, Fundamental laws of transport phenomena, Conservations Equations, Transport in Turbulent Flow, Basic Reaction Kinetics, Elementary reactions, Chain reactions and Multistep reactions, simplification of reaction mechanism, Global Reactions, Determination of adiabatic flame temperature and Heat of reaction using MATLAB.		

UNIT - II	FUNDAMENTALS OF PREMIXED AND DIFFUSION FLAMES	9
One dimensional combustion wave, Laminar premixed flame, Burning velocity measurement methods, Effects of chemical and physical variables on Burning velocity, Flame extinction, Ignition and Flame stabilization mechanism, Turbulent Premixed flame. Diffusion flames, fundamentals of droplet combustion, Laminar flame speed measurement using MATLAB.		

UNIT - III	GAS TURBINE AND RAMJET COMBUSTION	9
Combustion in gas turbine combustion chambers - recirculation, premixed and secondary zones - factors affecting combustion efficiency - need for flame holders and types - flame stability limits - combustion in ramjet engine - pressure losses in ramjet combustion chambers and its effect on net thrust - combustion stability in ramjet combustors - a comparison between gas turbine and ramjet combustor.		

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UNIT - IV	PRINCIPLES OF SUPERSONIC COMBUSTION	9
Supersonic combustion in scramjet - Dual mode scramjet combustors - Role of isolator on combustion in scramjet engine - Different configurations of scramjet combustors - use of struts and cavities in scramjet combustors - supersonic combustion controlled by diffusion mixing and heat convection.		

UNIT - V	COMBUSTION IN CHEMICAL ROCKETS	9
Combustion in liquid propellant rockets - Combustion of solid propellants - application of laminar flame theory to the burning of homogeneous propellants, Combustion in hybrid rockets - combustion instability in rockets. Determination of specific impulse of solid and hybrid propellants using MATLAB.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Calculate adiabatic flame temperatures, predict equilibrium products, and apply conservation equations to model combustion processes in MATLAB.
CO2	Be measure and analyze laminar flame speeds, understand the effects of various factors on burning velocity, and simulate premixed and diffusion flame behavior using MATLAB.
CO3	Assess combustion efficiency, flame stability, and pressure losses in gas turbine and ramjet engines, and compare their combustion characteristics.
CO4	Analyze supersonic combustion processes in scramjet engines, evaluate the role of isolators, and understand the impact of different combustor configurations on combustion performance.
CO5	Evaluate combustion processes in liquid, solid, and hybrid propellant rockets, address combustion instability, and determine specific impulse using MATLAB for different rocket propulsion systems.

Text Books	
1.	Kuo K.K. “Principles of Combustion” John Wiley and Sons, 2005.
2.	Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, Second edition 2014.
3.	Mishra D. P., “Fundamentals of Combustion”, Prentice Hall of India, New Delhi, 2008.
4.	Warren C. Strahle, “An Introduction to Combustion”, Taylor & Francis, 1993.

Reference Books	
1.	Beer, J.M., and Chegar, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
2.	Loh, W.H.T., “Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design (Applied Physics and Engineering)”, Springer Verlag, New York, 2012.
3.	Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons; Eighth Edition 2010.
4.	Mukunda H. S., “Understanding Combustion”, Second edition, Orient Blackswan, 2009.

Programme Coordinator

BoS Chairman

B.E.	B23AEE912 – ADVANCED PROPULSION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To cover the basic aspects of thermodynamic cycle analysis of air-breathing propulsion systems.
2.	To impart knowledge on advanced air breathing propulsion systems like air augmented rockets.
3.	To give the knowledge on the basic aspects of scramjet propulsion system.
4.	To provide in-depth knowledge about the nozzle performance
5.	To study the vast knowledge on the operating principles of nuclear, electric and ion propulsion

UNIT - I	THERMODYNAMIC CYCLE ANALYSIS OF AIR-BREATHING PROPULSION SYSTEMS	9

Air breathing propulsion systems like Turbojet, turboprop, ducted fan, Ramjet and Air augmented rockets – Thermodynamic cycles – Pulse propulsion – Combustion process in pulse jet engines – inlet charging process – Subcritical, Critical and Supercritical charging –Air breathing Engine Performance Measures – Aerospace System Performance Measures

UNIT - II	RAMJETS AND AIR AUGMENTED ROCKETS	9

Preliminary performance calculations – Diffuser design with and without spike, Supersonic inlets – combustor and nozzle design – Integral Ram rocket.

UNIT - III	SCRAMJET PROPULSION SYSTEM	9

Fundamental considerations of hypersonic air breathing vehicles – Preliminary concepts in engine airframe integration – calculation of propulsion flow path – flow path integration – Various types of supersonic combustors – fundamental requirements of supersonic combustors – Mixing of fuel jets in supersonic cross flow – performance estimation of supersonic combustors.

UNIT - IV	NUCLEAR PROPULSION	9

Nuclear rocket engine design and performance – nuclear rocket reactors – nuclear rocket nozzles – nuclear rocket engine control – radioisotope propulsion – basic thruster configurations – thruster technology – heat source development – nozzle development – nozzle performance of radioisotope propulsion systems.

UNIT - V	ELECTRIC AND ION PROPULSION	9

Basic concepts in electric propulsion – power requirements and rocket efficiency – classification of thrusters – electrostatic thrusters – plasma thruster– Fundamentals of ion propulsion – performance analysis – ion rocket engine.

Total Instructional hours : 45

Programme Coordinator	BoS Chairman

Course Outcomes : Students will be able to	
CO1	Analyse in detail the thermodynamics cycles of air breathing propulsion systems.
CO2	Gain idea on the concepts of supersonic combustion for hypersonic vehicles and its performance.
CO3	Demonstrate the fundamental requirements of supersonic combustors.
CO4	Estimate the performance parameters of nuclear and electrical rockets
CO5	Acquire knowledge on the concepts of engine-body installation on hypersonic vehicles.

Text Books	
1.	Cullity, BD & Stock, SR, “Elements of X-ray diffraction”, Prentice Hall, Inc. USA, 2001
2.	Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, “Structural Health Monitoring”, Wiley- ISTE, 2006.
3.	A. S. Paipetis,T. E Matikas and D. G. Aggelis, Emerging Technologies in NonDestructive Testing, CRC Press, (2012).

Reference Books	
1.	Cumpsty, “Jet propulsion”, Cambridge University Press, 2003.
2.	Fortescue and Stark, “Spacecraft Systems Engineering”, Wiley, 4th edition, 2011
3.	Sutton, GP, “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 1998.
4.	William H. Heiser and David T. Pratt, “Hypersonic Air breathing propulsion”, AIAA Education Series, 2001.

Programme Coordinator

BoS Chairman

B.E.	B19AEE913– ROCKETS AND MISSILES	L	T	P	C
		3	0	0	3

Course Objectives

1.	To gain knowledge about the classification of rockets and missile.
2.	To give exposure on rockets and missile aerodynamics.
3.	To identify the motion of rocket in free space and gravitational field.
4.	To enrich the knowledge in staging of rockets and missile.
5.	To recognize about the control systems of rockets and missile.

UNIT - I	CLASSIFICATION OF ROCKETS AND MISSILES	6

History of rockets and missiles – Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket and missile programme.

UNIT - II	ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD	10

One Dimensional and Two-Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields – description of Vertical, Inclined and Gravity Turn Trajectories – Determination of range and Altitude, Simple Approximations to Burnout Velocity and altitude-estimation of culmination time and altitude.

UNIT - III	AERODYNAMICS OF ROCKETS AND MISSILES	10

Airframe Components of Rockets and Missiles – Forces Acting on a Missile While Passing Through Atmosphere – Classification of Missiles – methods of Describing Aerodynamic Forces and Moments – Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces – Drag Estimation.

UNIT - IV	STAGING AND CONTROL OF ROCKETS AND MISSILES	10

Multistage of rockets and ballistic missiles – Multistage Vehicle Optimization – Stage Separation Dynamics – Stage Separation Techniques in atmosphere and in space, Introduction to aerodynamic and jet control methods – various types of aerodynamic control methods for tactical and short range missiles – aerodynamic characteristics - various types of rocket thrust vector control methods.

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UNIT - V	ROCKET PROPULSION SYSTEMS AND MATERIALS FOR ROCKETS AND MISSILES	9
Ignition System in rockets – types of Igniters– Design Consideration of liquid Rocket Combustion Chamber, Injector Propellant Feed Lines, Valves, Propellant Tanks Outlet and propellant feed Systems – Propellant Slash and Propellant Hammer – Elimination of Geysering Effect in Missiles – Selection of Materials – Special Requirements of Materials to Perform under Adverse Conditions.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Classify the different types of rockets and missiles with respect to Indian and International standard.
CO2	Apply the aerodynamics of rockets and missiles.
CO3	Determine the range & altitude of rocket motion in free space and gravitational field.
CO4	Evaluate the multi staging philosophy of rockets and missiles.
CO5	Apply the various thrust vector control methods for rockets & missiles.

Text Books	
1.	Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W., Freeman & Co. Ltd., London, 1982.
2.	Sutton, G.P., et al., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 1993.

Reference Books	
1.	Mathur, M. and Sharma, R.P., “Gas Turbines and Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1998.
2.	Parker, E.R., “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co. Inc., 1982.

Programme Coordinator

BoS Chairman

B.E.	B23AEE914 – ELECTRIC PROPULSION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the atomic structure and ionization processes in gases, the effects of collisions in ionized gases, and the principles of electrical conductivity and kinetic theory of gases.
2.	To explore the historical development of electric propulsion, power supply considerations, and the fundamental principles of electric charges, electrostatic fields, magnetic interactions, and electromagnetic wave propagation.
3.	To analyze the enthalpy of high-temperature gases, calculate efficiency for frozen flow conditions, and evaluate the working principles, applications, advantages, and disadvantages of resisto jets and arc jets.
4.	To examine one-dimensional space-charge flows, establish basic relationships in electrostatic propulsion, and assess the applications, advantages, and disadvantages of ion engines and Hall thrusters compared to electrothermal thrusters.
5.	To understand the principles of Lorentz force and ideal steady flow acceleration, evaluate the geometry considerations for electromagnetic propulsion systems, and investigate the characteristics and advantages of magneto plasma dynamic thrusters and pulsed plasma thrusters

UNIT - I	FUNDAMENTALS OF IONISED GASES	9
Atomic structure and ionization processes in gases - Collisions in ionized gases and their effects - Electrical conductivity of ionized gases - kinetic theory of gases		

UNIT - II	OVERVIEW OF ELECTRIC PROPULSION SYSTEMS	9
Historical development of electric propulsion - Power supply considerations and limitations - Electric charges and electrostatic fields - Currents and magnetic interactions - Time-dependent fields and electromagnetic wave propagation		

UNIT - III	ELECTROTHERMAL PROPULSION	9
Enthalpy of high temperature gases, Efficiency calculations for frozen flow conditions, Resisto jets - Working principles, applications, advantages and disadvantages, Arc jets - Working principles, applications, advantages and disadvantages		

UNIT - IV	ELECTROSTATIC PROPULSION	9
One-dimensional space-charge flows and their characteristics - Basic relationships in electrostatic propulsion - applications of ion engines, Hall effect and Hall thrusters, Advantages and disadvantages of electrostatic thrusters over electrothermal thrusters		

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UNIT - V	ELECTROMAGNETIC PROPULSION	9
Lorentz force - Ideal steady flow acceleration - Geometry considerations for electromagnetic propulsion systems - Magneto plasma dynamic (MPD) thrusters and their characteristics - Pulsed plasma acceleration and its advantages, Types of Pulsed plasma thrusters		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain atomic structure and ionization processes in gases, analyze collisions in ionized gases, and understand the principles of electrical conductivity and kinetic theory of gases.
CO2	Discuss the historical development of electric propulsion, understand power supply limitations, and apply the fundamental principles of electric charges, electrostatic fields, magnetic interactions, and electromagnetic wave propagation.
CO3	Perform efficiency calculations for high-temperature gases, and evaluate the working principles, applications, advantages, and disadvantages of resisto jets and arc jets.
CO4	Analyze one-dimensional space-charge flows, apply basic relationships in electrostatic propulsion, and assess the applications, advantages, and disadvantages of ion engines and Hall thrusters compared to electrothermal thrusters.
CO5	Understand the principles of Lorentz force and ideal steady flow acceleration, evaluate geometry considerations for electromagnetic propulsion systems, and investigate the characteristics and advantages of magneto plasma dynamic thrusters and pulsed plasma thrusters.

Text Books	
1.	Robert G. Jahn, "Physics of Electric Propulsion", Dover Publications, 2012.
2.	Sutton, G. P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 9th Edition, 2016

Reference Books	
1.	George W. Sutton, "Engineering Magnetohydrodynamics", Dover Publications Inc., New York, 2006

Programme Coordinator

BoS Chairman

B.E.	B23AEE915 – AIRCRAFT ENGINE DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce basic design concepts of cycles and optimization for aerospace applications.
2.	To make students familiarize with the design parameter for propellers.
3.	To give the students adequate design exposure to design procedure for intake and exhaust systems.
4.	To make the students to learn the aspects of various propulsion systems.
5.	To make students familiarize with the concept of future propulsion systems for aerospace applications.

UNIT - I	PRELIMINARY DESIGN REQUIREMENTS	9
Cycle Optimization- Design Requirements and specifications- Matching of Power plant components- Overall engine efficiency estimation.		

UNIT - II	PROPELLERS	9
Elements of Propeller- Representative Blade Element Theory- Vortex Theory and Momentum Theory- Propeller Characteristics- Performance Graph and Propeller Design criteria- Propeller fans – Minimization of propeller flow losses.		

UNIT - III	INTAKES	9
Subsonic Intakes and Supersonic Intakes- Various Intake configurations- Intake Design criteria and Intake Flow Analysis- Hypersonic vehicle intakes-intake starting.		

UNIT - IV	EXHAUST NOZZLES	9
Various Nozzle configurations – Nozzle contour design aspects - Variable geometry nozzle and Vectored thrust nozzles – Real flow in nozzles – Single side expansion nozzles .		

UNIT - V	FUTURE APPLICATIONS AND ENGINE PERFORMANCE	9
Evolution of future propulsion systems for passenger aircraft, helicopters and military aircraft and the design needs - Power plant component testing, Engine Testing and Performance Evaluation		
		Total Instructional hours : 45

Programme Coordinator

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Predict performance characteristics of propellers, intakes and exhaust nozzles
CO2	Acquire knowledge on the cycle optimization for aircraft and helicopter engines
CO3	Get exposure the aerodynamic concepts for propeller design
CO4	Acquire knowledge on future propulsion systems
CO5	Performance evaluation of engine air intake

Text Books	
1.	D.O. Dommasch, S.S. Sherby and T.L. Connolly `Airplane Aerodynamics, Pitman, 1967.
2.	J.Seddon, E.L. Goldsmith, `Intake Aerodynamics, Collins, 1985.
3.	J.Chauvin, `Supersonic Turbojet Propulsion Systematic & Components

Reference Books	
1.	Thomas W.Wild, Aircraft Power plants

Programme Coordinator

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B.E.	B23AEE916– TURBOMACHINES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the energy, transfer in rotor and stator parts of the turbo machines
2.	To study the function of various elements of centrifugal fans and blowers.
3.	To evaluating the working and performance of centrifugal compressor
4.	To analyzing flow behavior and flow losses in axial flow compressor.
5.	To study the types and working of axial and radial flow turbines.

UNIT - I	INTRODUCTION	9

Classification of Turbomachines- Energy transfer between fluid and rotor - Euler equation and its interpretation- Velocity triangles- Efficiencies in Compressor and Turbine stages. Degree of reaction- Dimensionless parameters in design and performance estimation for Turbomachines.

UNIT - II	CENTRIFUGAL FANS AND BLOWERS	9

Types – components – working principle - Flow analysis in impeller blades-volute and diffusers- Velocity triangles - h-s diagram. Stage design and geometrical parameters in fans and blowers- Performance characteristic curves – various losses. Fan – bearings, drives and noise.

UNIT - III	CENTRIFUGAL COMPRESSOR	9

Components - blade types. Velocity triangles - h-s diagram, stage work - Slip factor and Degree of Reaction- Performance characteristics, rotating stall and various losses- Single sided and double sided designs and performance calculation.

UNIT - IV	AXIAL FLOW COMPRESSOR	9

Construction details- Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor- Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow – Comparison of axial flow and centrifugal flow compressors.

UNIT - V	AXIAL AND RADIAL FLOW TURBINES	9

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages- Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work -Performance coefficients and losses – areas of application of axial and radial flow turbines-Matching of Compressor and turbine.

Total Instructional hours : 45

Programme Coordinator

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Recall and describe the energy transfer mechanisms in the rotor and stator parts of turbo machines.
CO2	Explain the purpose and function of various elements/components in centrifugal fans and blowers.
CO3	Evaluate the working principles and performance characteristics of centrifugal compressors.
CO4	Analyze the flow behavior and identify flow losses in axial flow compressors.
CO5	Describe the types of axial and radial flow turbines and explain their working principles.

Text Books	
1.	Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011.
2.	Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011

Reference Books	
1.	Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, ButterworthHeinemann, 2014.
2.	Gopalakrishnan. G and Prithvi Raj. D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3.	Lewis, R.I., “Turbomachinery Performance Analysis” 1st Edition, Arnold Publisher, 1996.
4.	Saravanamutto, Rogers, Cohen, Straznicky., “Gas Turbine Theory” 6th Edition, Pearson Education Ltd, 2009.
5.	Venkanna, B.K., “Fundamentals of Turbomachinery”, PHI Learning Pvt. Ltd., 2009.

Programme Coordinator

BoS Chairman

B.E.	B23AEE917 – STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To distinguish the basic concepts on mechanical systems with matrix approach.
2.	To gain knowledge about the different types of vibration systems.
3.	To study about different modes of vibration.
4.	To gain knowledge about different energy methods.
5.	To study about the natural characteristics of large sized problems using approximate methods.

UNIT - I	FORCE DEFLECTION PROPERTIES OF STRUCTURES	9

Constraints and Generalized coordinates – Virtual work and generalized forces – Force – Deflection influence functions – stiffness and flexibility methods.

UNIT - II	PRINCIPLES OF DYNAMICS	9

Free and forced vibrations of systems with finite degrees of freedom – Response to periodic excitation – Impulse Response Function – Convolution Integral.

UNIT - III	NATURAL MODES OF VIBRATION	9

Equations of motion for Multi degree of freedom Systems – Solution of Eigen value problems – Normal coordinates and orthogonality Conditions – Modal Analysis.

UNIT - IV	ENERGY METHODS	9

Rayleigh's principle – Rayleigh – Ritz method – Coupled natural modes – Effect of rotary inertia and shear on lateral vibrations of beams – Natural vibrations of plates.

UNIT - V	APPROXIMATE METHODS	9

Approximate methods of evaluating the Eigen frequencies and eigen vectors by reduced, subspace, Lanczos, Power, Matrix condensation and QR methods.

Total Instructional hours : 45

Programme Coordinator	BoS Chairman

Course Outcomes : Students will be able to	
CO1	Illustrate the various options of mathematical modeling of structures.
CO2	Evaluate the response of structures under various dynamically loaded conditions.
CO3	Analyze natural modes of vibration of structures.
CO4	Measure the natural frequency for multi degree of freedom system.
CO5	Explain numerical and approximate methods of evaluating natural modes of vibration.

Text Books	
1.	Hurty. W.C. and M.F. Rubinstein, “Dynamics of Structures”, Prentice Hall of India Pvt. Ltd., New Delhi 1987.
2.	Tse. F.S., Morse. I.E. and Hinkle. H.T., “Mechanical Vibrations : Theory and Applications”, Prentice Hall of India Pvt. Ltd, New Delhi, 2004.

Reference Books	
1.	Ramamurthi. V., “Mechanical Vibration Practice and Noise Control” Narosa Publishing House Pvt. Ltd, 2008.
2.	Timoshenko. S.P., and D.H. Young, “Vibration Problems in Engineering”, John Willey & Sons Inc., 1984.
3.	Vierck. R.K., “Vibration Analysis”, 2nd Edition, Thomas Y. Crowell & Co Harper & Row Publishers, New York, U.S.A. 1989.

Programme Coordinator

BoS Chairman

B.E.	B23AEE918 – ADVANCED AEROSPACE MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the elements of aerospace materials, mechanical behaviour of materials, ceramics and composites.
2.	To explain the theory, concepts, principles and governing equations of solid mechanics.
3.	To analyse the stresses in simple structures as used in the aerospace industry.
4.	To learn the concepts of corrosion and heat treatment.
5.	To acquire knowledge in high temperature materials and characterization.

UNIT - I	FUNDAMENTAL CONCEPTS	8

General Requirements of Materials for Aerospace Applications – Mechanical Behaviour of Materials in Tension, Compression, Impact & Fatigue and Physical Terms (Brittleness, Ductility, etc.) – Concepts in Material Fatigue – S-N Curve – Comparative Study of Different Types of Materials – Case Studies for the Selection of Materials for Aircraft Components.

UNIT - II	METAL ALLOYS	10

Internal Structure of Metallic Materials – Microscopic Examination – Review of Concepts in Material Science – Different Types of Material Defects – Physical Properties & Failure Modes – Fracture Toughness of Metals – Effect of Individual Alloying Elements – SAE Numbering System – Standards Adopted – Aerospace Application of Various Metallic Alloys.

UNIT - III	CORROSION & HEAT TREATMENT	10

Types of Corrosion – Effect of Corrosion on Mechanical Properties – Stress Corrosion Cracking – Theory of Different Types of Heat Treatment for Aluminium Alloys and Different Grades of Steel – Wrought Aluminium Alloys – Corrosion Resistant Alloys – Surface Treatment & Other Methods of Corrosion Prevention – Application & Case Studies.

UNIT - IV	HIGH TEMPERATURE MATERIALS	9

Modern Ceramic Materials & Their Properties – Cermets – Application of Carbon/Carbon Composites – Properties & Application of Metal Matrix Composites – Metallic Alloys for High Temperature Engineering Applications – Determination of Mechanical and Thermal Properties of Materials at Elevated Temperatures – Types of Material Degradation – Design Considerations – Case Study – The Spacecraft Thermal Protection System.

Programme Coordinator	BoS Chairman

UNIT - V	ELEMENTS OF SMART MATERIALS	8
Different Categories of Smart Materials – Current Application & Future Potential – Piezoelectric Material Behaviour – Examples & Study of Piezoelectric Actuator and Sensor Systems – Shape Memory Alloys (SMA) – Phase Transformation – Shape Memory Effect – Material Modelling & Constitutive Equations for Piezoelectric and SMA Material Systems – Sensors & Actuators Using Smart Materials.		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Explain the advanced concepts of aerospace materials.
CO2	Describe the necessary mathematical knowledge that are needed in understanding their significance and operation.
CO3	Explain various topics such as elements of aerospace materials, mechanical behaviour of materials, ceramics and composites.
CO4	Deploy the skills effectively in the understanding of aerospace materials.
CO5	Characterize high temperature materials.

Text Books	
1.	Martin, J.W., “Engineering Materials, Their properties and Applications”, Wykedham Publications (London) Ltd, 1987.
2.	Titterton.G., “Aircraft Materials and Processes”, 5th Ed., Pitman Publishing Co., 1998.
3.	Inderjit Chopra & Jayanth Sirohi, “Smart Structures Theory”, 3rd Edition, Cambridge University Press.

Reference Books	
1.	Inderjit Chopra & Jayanth Sirohi, “Smart Structures Theory”, 3rd Edition, Cambridge University Press.
2.	Van Vlack.L.H., “Materials Science for Engineers”, Addison Wesley, 1985.
3.	CGK Nair " Aircraft Materials and Processes" Jain University Press,2019.

Programme Coordinator

BoS Chairman

B.E.	B23AEE919 – EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the various experimental techniques in extensometer types and displacement sensor.
2.	To understand about the types and operation of strain gauge.
3.	To learn the concept of light, photo elastic effect and various functional process.
4.	To understand the strain analysis, brittle coating and moiré techniques.
5.	To study the fundamental of non-destructive testing and their types.

UNIT - I	EXTENSOMETERS AND DISPLACEMENT SENSORS	8

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages, Capacitance gauges, Laser displacement sensors.

UNIT - II	ELECTRICAL RESISTANCE STRAIN GAUGES	12

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.

UNIT - III	PHOTO ELASTICITY	11

Two dimensional photo Elasticity, Photo elastic materials, Concept of light - Photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polariscopes, Interpretation of fringe pattern, Calibration of photoelastic materials, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT - IV	BRITTLE COATING AND MOIRE TECHNIQUES	7

Relation between stresses in coating and specimen, Use of failure theories in brittle coating, Moire method of strain analysis.

Programme Coordinator

BoS Chairman

UNIT - V	NON – DESTRUCTIVE TESTING	7
Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing.		
		Total Instructional Hours : 45

Course Outcomes : Students will be able to	
CO1	Classify the stress and strain measurements in various extensometers.
CO2	Analyze the strain at various loading conditions for rosette gauges.
CO3	Evaluate photo elastic materials by compensation and separation techniques.
CO4	Make use of brittle coating and Moire techniques for stress and strain analysis.
CO5	Evaluate the location and size of defect in aircraft materials by non-destructive testing methods.

Text Books	
1.	Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw Hill Inc., New York 1998.
2.	Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., "Experimental Stress Analysis", Tata McGraw Hill, New Delhi, 1984.
3.	Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 1996.

Reference Books	
1.	Durelli. A.J., "Applied Stress Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1970
2.	Hetenyi, M., "Hand book of Experimental Stress Analysis", John Wiley and Sons Inc., New York, 1972.
3.	Max Mark Frocht, "Photo Elasticity", John Wiley and Sons Inc., New York, 1968
4.	Pollock A.A., "Acoustic Emission in Acoustics and Vibration Progress", Ed. Stephens R.W.B., Chapman and Hall,1993.
5.	Ramesh, K., “Digital Photoelasticity", Springer, New York, 2000.

Programme Coordinator

BoS Chairman

B.E.	B23AEE920 – FATIGUE AND FRACTURE MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the basic principles involved in the structures due to fatigue.
2.	To study about the various theories related to the different aspects of fatigue behaviour.
3.	To gain knowledge about the different phases of fatigue life.
4.	To study the importance of fracture mechanics in aerospace application.
5.	To gain knowledge about the design and testing of structures related to fatigue.

UNIT - I	FATIGUE OF STRUCTURES	9

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 – Fatigue of composite materials.

UNIT - II	STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR	9

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.

UNIT - III	PHYSICAL ASPECTS OF FATIGUE	9

Phase in fatigue life – Crack initiation – Crack growth – Final Fracture – Dislocations – fatigue fracture surfaces.

UNIT - IV	FRACTURE MECHANICS	9

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" – stress intensity factors for typical geometries.

Programme Coordinator

BoS Chairman

UNIT - V	FATIGUE DESIGN AND TESTING	9
Safe life and Fail-safe design philosophies – Characterization of Safe life – Crack growth – COD Test - Importance of Fracture Mechanics in aerospace structures – Application to composite materials and structures.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the arithmetic knowledge to find the various relations on fatigue.
CO2	Explain the various techniques and relations related to the various aspects of fatigue behavior.
CO3	Analyze the various mechanisms and faces of fracture due to fatigue.
CO4	Analyze the various theories and geometries in the fracture mechanics.
CO5	Analyze the design philosophy, aerospace structures and testing due to fatigue.

Text Books	
1.	Barrois W, Ripely, E.L., “Fatigue of aircraft structure," Pergamon press. Oxford, 1983.
2.	Prasanth Kumar, "Elements of fracture mechanics", Wheeter publication, 1999.

Reference Books	
1.	Kare Hellan ,’Introduction to Fracture Mechanics’, McGraw Hill, Singapore,1985
2.	Knott, J.F., “Fundamentals of Fracture Mechanics,” - Buterworth& Co., Ltd., London, 1983.
3.	Sih C.G., “Mechanics of fracture.” Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.

Programme Coordinator

BoS Chairman

B.E.	B23AEE921 – THEORY OF VIBRATIONS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Impart knowledge to the student on the fundamentals and importance of vibration theory.
2.	To Impart knowledge to the student on the fundamentals and importance of vibration theory.
3.	To calculate natural frequencies and mode shapes for simple systems.
4.	To Familiarize with approximate solution techniques in vibration problems.
5.	To derive the governing differential equations of a continuous system.

UNIT - I	FUNDAMENTALS OF VIBRATION	9

Basic Concepts & Terminology – Degrees of Freedom – Types of Vibration – Spring, Mass & Damping Elements – Free Vibration of an Undamped Single Degree of Freedom (SDOF) System – Derivation of Governing Equation and Determination Natural Frequency of an Undamped System – Types of Damping – Free Vibration Response with Damping.

UNIT - II	FORCED VIBRATION OF A SINGLE DEGREE OF FREEDOM SYSTEM	9

Harmonic Excitation – Response of a Undamped SDOF System Under Harmonic Force – Response of a Damped SDOF System Under Periodic Force – Frequency Response Curves - Base Excitation – Transmitted Force – Role of Damping – Modelling of Physical Systems for Vibration Study – Practical Examples.

UNIT - III	MULTI DEGREE OF FREEDOM SYSTEMS	9

Derivation of Equations of Motion – Free Vibration Analysis of Translational and Torsional MDOF Systems – Coordinate Coupling & Principal Coordinates – Principal Modes of Vibration – Orthogonality of Normal Modes – Effect of Damping – Design of a Vibration Absorber Unit – Use of Lagrange's Equations – Generalized Coordinates.

UNIT - IV	SOLUTION TECHNIQUES	9

System Equations in Matrix Form – Use of Influence Coefficients – Flexibility Matrix Determination – Eigenvalue Problem & Solution – Matrix Iteration Method – Holzer Methods – Jacobi Method – Other Approximate Methods – Rayleigh's Method – Numerical Examples.

Programme Coordinator	BoS Chairman

UNIT - V	VIBRATION OF CONTINUOUS SYSTEMS	9
Deriving the Governing Differential Equation – Transverse Vibrations of a Cable – Axial Vibrations of a Bar – Torsional Vibrations of a Shaft – Lateral Beam Vibration – Determination of Natural Frequencies & Mode Shapes – Modal Analysis.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Model a given physical system into a single or multi-degree of freedom system.
CO2	Solve problems involving single and multi degrees of freedom
CO3	Analyze the vibration characteristics of both discrete and continuous systems
CO4	Analyze to extract natural frequencies of a multi degree of freedom
CO5	Predict the response of a physical system to initial excitation

Text Books	
1.	S SRao, “Mechanical Vibrations”, 6th Edition, Pearson, India, 2018
2.	William T. Thomson & Marie Dillon Dahleh, “Theory of Vibration with Application”, Prentice Hall publishers, 5th edition, 2008.
3.	Grover, G.K. “Mechanical Vibrations”, 8th Edition, Nem Chand Brothers, Roorkee, India, 2009.

Reference Books	
1.	LeonardMeirovitch, “Elements of VibrationAnalysis”–McGrawHill International Edition,2007.
2.	Morse and Hinkle, “Mechanical Vibrations Theory and Applications”, Allyn and Bacon, 2nd Edition, 2004.
3.	William Weaver, Stephen P. Timoshenko, Donovan H.Young,“Vibration Problems in Engineering”, John Wiley and Sons, New York, 2007.
4.	Den Hartog, “Mechanical Vibrations”, Crastre Press, 3rd Edition 2011.

Programme Coordinator

BoS Chairman

B.E.	B23AEE922 – THEORY OF ELASTICITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions.
2.	To recognize the plane stress strain problem.
3.	To gain knowledge on the stress strain relations in the polar coordinates.
4.	To apprehend the various torsion theories and its applications to shafts.
5.	To gain knowledge on Navier's method and Levy's method for rectangular plates under different boundary conditions.

UNIT - I	BASIC EQUATIONS OF ELASTICITY	9

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.

UNIT - II	PLANE STRESS AND PLANE STRAIN PROBLEMS	9

Airy's stress function – Bi-harmonic equations – Polynomial solutions – Simple two-dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT - III	ELASTICITY APPROACH TO AXISYMMETRIC PROBLEM	9

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.

UNIT - IV	TORSION	9

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.

Programme Coordinator	BoS Chairman

UNIT - V	INTRODUCTION TO THEORY OF PLATES	9
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.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Make use of 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	Make use of 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	
1.	Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Prentice Hall, New Jersey, 2003.
2.	Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.
3.	Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw – Hill Ltd., Tokyo, 1990.

Reference Books	
1.	Barber, J. R., "Elasticity", Kluwer Academic Publishers, 2004.
2.	Sokolnikoff, I.S., "Mathematical Theory of Elasticity", McGraw – Hill, New York, 1978.
3.	Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991.
4.	Wang, C. T., "Applied Elasticity", McGraw – Hill Co., New York, 1993.

Programme Coordinator

BoS Chairman

B.E.	B23AEE923– NON DESTRUCTIVE TESTING AND EVALUATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the various testing and physical characteristics of materials in NDT.
2.	To impart knowledge on the various evaluation methods related to NDT.
3.	To gain knowledge about the theories involved in NDT Methods.
4.	To study the principles and different scanning methods in the procedures of NDT.
5.	To gain knowledge about the industrial application of NDT in various fields.

UNIT - I	OVERVIEW OF NDT	9

NDT Versus Mechanical testing – Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization – Relative merits and limitations – Various physical characteristics of materials and their applications in NDT – Visual inspection – Unaided and aided.

UNIT - II	SURFACE NDE METHODS	9

Liquid Penetrant Testing - Principles – types and properties of liquid penetrants – developers – advantages and limitations of various methods – Testing Procedure – Interpretation of results – Magnetic Particle Testing – Theory of magnetism – inspection materials Magnetization methods – Interpretation and evaluation of test indications – Principles and methods of demagnetization – Residual magnetism.

UNIT - III	THERMOGRAPHY AND EDDY CURRENT TESTING (ET)	9

Thermography- Principles – Contact and non-contact inspection methods – Techniques for applying liquid crystals – Advantages and limitation – infrared radiation and infrared detectors – Instrumentations and methods – applications – Eddy Current Testing-Generation of eddy currents – Properties of eddy currents – Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation / Evaluation.

UNIT - IV	ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)	9

Ultrasonic Testing - Principle – Transducers – transmission and pulse - echo method – straight beam and angle beam – instrumentation – data representation – A/Scan, B-scan, C-scan – Phased Array Ultrasound – Time of Flight Diffraction – Acoustic Emission Technique – Principle – AE parameters – Applications.

Programme Coordinator

BoS Chairman

UNIT - V	RADIOGRAPHY (RT)	9
Principle – interaction of X-Ray with matter – imaging – film and film less techniques – types and use of filters and screens – geometric factors – Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves – Penetrometers – Exposure charts – Radiographic equivalence – Fluoroscopy – Xero-Radiography – Computed Radiography – Computed Tomography.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the fundamental concepts of NDT.
CO2	Categorize the different methods of NDE.
CO3	Explain the concept of Thermography and Eddy current testing.
CO4	Explain the concept of Ultrasonic Testing and Acoustic Emission.
CO5	Explain the concept of Radiography.

Text Books	
1.	Baldev Raj, T. Jayakumar, M. Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2014.
2.	Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

Reference Books	
1.	ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume - 17.
2.	ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
3.	Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.
4.	Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.

Programme Coordinator

BoS Chairman

B.E.	B23AEE924 – AERO ELASTICITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Familiarize with the Collars triangle of forces.
2.	Familiarize with wing torsional divergence and divergence speeds
3.	To have a thorough knowledge of the natural frequencies of structural members under different end conditions. .
4.	Apply aero elastic concepts of divergence, flutter, lift and roll effectiveness, aileron reversal, and mode coalescence.
5.	Knowledge to formulate and derive static and dynamic aeroelastic equations of motion.

UNIT - I	AERO ELASTICITY PHENOMENA	9
Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vortex induced vibration – Introduction to aero servo elasticity.		

UNIT - II	DIVERGENCE OF A LIFTING SURFACE	9
Simple two-dimensional idealizations – Strip theory – Fredholm integral equation of the second kind – Exact solutions for simple rectangular wings – Semi rigid assumption and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.		

UNIT - III	STEADY STATE AEROELASTIC PROBLEMS	9
Loss and reversal of aileron control–Critical aileron reversal speed–Aileron efficiency–emirigid theory and successive approximations–Lift distributions–Rigid and elastic wings. - Effect of elastic deformation on static and dynamic stability of airplanes.		

UNIT - IV	FLUTTER ANALYSIS	9
Non-dimensional parameters–Stiffness criteria-Dynamic mass balancing–Model experiments – Dimensional similarity – Flutter analysis – Two dimensional thin airfoils in steady incompressible flow – Prandtl- Glauret approximation - Quasi steady aerodynamic derivatives – Galerkin's method for critical speed – Stability of distributed motion – Torsion flexure flutter – Solution of the flutter determinant – Methods of determining the critical flutter speeds – Flutter prevention and control.		

Programme Coordinator	BoS Chairman

UNIT - V	EXAMPLES OF AEROELASTIC PROBLEMS	9
Gallopingoftransmissionlinesandflowinducedvibrationsoftallslenderstructuresandsuspensionbridges– Aeroelastic problems in building aerodynamics. Vortex induced vibration – Aircraft wing flutter-Vibrational problems in Helicopters. - buffeting flutter		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Investigate the coupled flexural torsional oscillation of an aircraft wing and estimation of natural frequencies and mode shapes.
CO2	Demonstrate wing torsional divergence and means to improve the divergence speed.
CO3	Investigate the effect of control reversal problems in the performance and stability aspects of airplanes and methods of counteracting it.
CO4	Analyze flutter problems in airplanes and methods of prevention of flutter
CO5	Estimate the critical divergence, reversal and flutter speeds of an airplane and to investigate the stability of the disturbed motion.

Text Books	
1.	Fung, Y.C. An Introduction to the theory of Aeroelasticity, Dover Publications Inc., 2008.

Reference Books	
1.	Bisplinghoff., R.L. Ashley, H., and Halfman, R.L, “Aeroelasticity” Addison Wesley Publishing Co., Inc. II ed. 1996.
2.	Broadbent, E.G., Elementary Theory of Aeroelasticity, Bunhill Publications Ltd, 1986
3.	Blevins R.D, “Flow induced vibrations”, Krieger Pub Co; 2 Reprint editions, 2001
4.	Scanlan, R.H. and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, Macmillan Co., N.Y., 1991.

Programme Coordinator

BoS Chairman

B.E.	B23AEE925 – NUMERICAL METHODS IN FLUID DYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To make students understand the complexity of general fluid dynamic equations in partial differential form in the mathematical nature of the equations.
2.	To make students understand the complexity of general fluid dynamic equations under different flow conditions
3.	To impart knowledge to students on the basic aspects of finite differences and finite volume methods
4.	To impart knowledge to students on the basic aspects of finite element methods
5.	To expose the students on obtaining solutions for a set of a large number of algebraic equations using the panel methods as examples and to trin them to obtain numerical solutions for steady supersonic flows

UNIT - I	MATHEMATICAL NATURE OF FLUID DYNAMIC EQUATIONS	9

Governing equations of fluid dynamics and modelling of fluid flow – Eulerian and Lagrangian approaches – Mathematical nature of fluid dynamic equations – Classification of partial differential equations – General behavior of different classes of fluid dynamic equations – Practical examples of fluid dynamic problems governed by different classes of partial differential equations – ill posed and well posed problems

UNIT - II	BOUNDARY CONDITIONS AND CHOICE OF NUMERICAL SCHEMES	9

Importance of boundary conditions in obtaining the numerical solution of fluid dynamic equations-Types of boundary conditions- Boundary conditions for momentum equations for viscous and inviscid flows – Boundary conditions for energy equation for different flow conditions – Practical examples – Symmetry and cyclic boundary conditions – Stability of numerical solution and the choice of numerical schemes for different classes of fluid dynamic equations

UNIT - III	INTRODUCTION TO FDM, FVM AND FEM	9

Introduction to finite difference, finite volume and finite element methods and their areas of application-A brief description of implementing methodologies for finite difference method, finite volume method and finite element method – Illustration of the methods using simple one dimensional fluid dynamic problems – Advantages and limitations of these methods.

UNIT - IV	PANEL METHODS	9

brief description of source, sink and vortex flows – Application of panel methods – Methodology involved in implementing panel methods – Source panel method and its implementation - Solution methods for solving a set of large number of algebraic equations and their applications for panel methods – Solution example of flow over a circular cylinder – Vortex panel method and its implementation – Vortex lattice method.

Programme Coordinator	BoS Chairman

UNIT - V	NUMERICAL METHODS FOR STEADY SUPERSONIC FLOWS	9
Two dimensional irrotational flow – Method of characteristics – Numerical methodology to obtain solution using method of characteristics for supersonic inviscid flows – Supersonic nozzle design using method of characteristics – Application of method of characteristics for axisymmetric irrotational flows – Description of Mc. Cormack's Predictor-corrector technique – Shock capturing and shock fitting techniques		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	understand the importance of numerical methods in finding solutions to complex engineering flow problems
CO2	develop interest in lifelong learning on numerical methods and apply the knowledge for the solution of aerospace related fluid dynamic problems
CO3	acquire basic knowledge to learn modern engineering tools such as CFD software tools to solve and analyse the flow fields over the airplanes
CO4	apply skills to develop algorithms for the solutions of inviscid supersonic flow problems pertaining to aerospace field
CO5	create new computational techniques in computational methods such as FVM using the imparted knowledge

Text Books	
1.	Fletcher C.A.J. , "Computational Techniques for Fluid Dynamics 1" Springer Verlag, 1996.
2.	Fletcher C.A.J., "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995

Reference Books	
1.	Chung T. J., "Computational Fluid Dynamics", Cambridge University Press; 2nd edition, 2010.
2.	Hirsch C., "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994.
3.	Joel H. Ferziger & Milovan Peric, "Computational Methods for Fluid Dynamics" Springer; 3rd edition 2002.
4.	John F Wendt , "Computational Fluid Dynamics – An Introduction", 3rd Edition, Springer-Verlag, Berlin Heidelberg, 2009.
5.	Versteeg H.K. and Malalsekera W. "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", PHI; 2nd edition 2007.

Programme Coordinator

BoS Chairman

B.E.	B23AEE926 – COMPUTATIONAL HEAT TRANSFER	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge to students in the fundamental principles of various numerical methods which are useful to obtain numerical solutions to heat transfer problems
2.	To make the students learn numerical methods to obtain solution to 1-D, 2-D and 3-D conductive heat transfer problems
3.	To introduce both implicit and explicit methods for numerical solution of transient heat conduction problems to students
4.	To make the students familiarize with the numerical treatment of convective heat transfer problems to compute velocity and temperature profiles in boundary problems
5.	To acquaint students with the use of finite volume method in radiative heat transfer problems

UNIT - I	INTRODUCTION	9
Finite Difference Method-Introduction-Taylor's series expansion - Discretization Methods Forward, backward and central differencing scheme for first order and second order Derivatives – Types of partial differential equations-Types of errors. Solution to algebraic equation-Direct Method and Indirect Method-Types of boundary condition. FDM - FEM - FVM.		

UNIT - II	CONDUCTIVE HEAT TRANSFER	9
General 3D-heat conduction equation in Cartesian, cylindrical and spherical coordinates. Computation (FDM) of One –dimensional steady state heat conduction with Heat generation-without Heat generation- 2D-heat conduction problem with different boundary conditions-Numerical treatment for extended surfaces. Numerical treatment for 3D-Heat conduction. Numerical treatment to 1D-steady heat conduction using FEM.		

UNIT - III	TRANSIENT HEAT CONDUCTION	9
Introduction to Implicit, explicit Schemes and crank-Nicolson Schemes Computation(FDM) of One – dimensional un-steady heat conduction –with heat Generation-without Heat generation - 2D-transient heat conduction problem with different boundary conditions using Implicit, explicit Schemes. Importance of Courant number. Analysis for I-D,2-D transient heat Conduction problems.		

UNIT - IV	CONVECTIVE HEAT TRANSFER	9
Convection- Numerical treatment (FDM) of steady and unsteady 1 -D and 2-d heat convection-diffusion steady-unsteady problems- Computation of thermal and Velocity boundary layer flows. Upwind scheme. Stream function-vorticity approach-Creeping flow.		

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UNIT - V	RADIATIVE HEAT TRANSFER	9
Radiation fundamentals-Shape factor calculation-Radiosity method- Absorption Method – Montacalro method- Introduction to Finite Volume Method- Numerical treatment of radiation enclosures using finite Volume method. Developing a numerical code for 1D, 2D heat transfer problems.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Acquire knowledge on the basic concepts on the applications of numerical methods for the heat transfer problem solutions.
CO2	Appreciate the role of boundary conditions in defining the complexities and the methodology for numerical solutions of heat transfer problems
CO3	Use both implicit and explicit schemes for transient heat conduction problems.
CO4	Compute the temperature profiles in thermal boundary layer.
CO5	Apply finite volume methods for radiative heat transfer problems and the role of Montecarlo methods in radiative heat transfer.

Text Books	
1.	Sachdeva,S.C., Fundamentals of Engineering Heat and Mass Transfer, NEW AGE publishers,2010
2.	Yunus A. Cengel, Heat Transfer – A Practical Approach Tata McGraw Hill 4thEdition, 2009.

Reference Books	
1.	NecatiOzisik, Finite Difference Method in Heat Transfer, CRC Press, 2nd edition, 2017.
2.	YogeshJaluria, Kenneth E Torrence, Computational Heat transfer, CRC Press, 3rd Edition, 2017.
3.	Pradip Majumdar, Computational Methods for Heat & Mass Transfer, CRC Press, 2005.

Programme Coordinator

BoS Chairman

B.E.	B23AEE927 – COMPUTER AIDED DESIGN AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Concepts of modelling of 2D and 3D geometrical elements
2.	Concepts of computer graphics
3.	CAD Packages and its features
4.	Indian standards on drawing practices and standard components
5.	The effects of real-world conditions on a part or assembly

UNIT - I	INTRODUCTION	9

Introduction to CAD – I/O devices – various graphics standards – coordinate systems – Geometric Modelling: Introduction – types of geometric modelling – wire frame – surface and solid modelling. Wireframe entities – types of curves and its mathematical representation - line- circle- ellipse- parabola- Cubic spline- Bezier and B-spline (Only Basic treatment). Solid modelling entities - Solid modelling techniques- CSG and BREP - Operations performed in CSG and BREP - Extrude- sweep - linear and Nonlinear- revolve

UNIT - II	GRAPHIC CONCEPTS (2D and 3D)	9

Transformations - translation- scaling- reflection- rotation. Concatenated transformation. Inverse transformation. Hidden line removal - Z-Buffer algorithm- brief description of shading and colour rendering techniques. Manipulation and editing of entities - selection methods – dragging - clipping- trimming- stretching- offsetting- pattern- copying- deleting - regenerating- measuring. Brief description of animation- types and techniques

UNIT - III	SOFTWARE PACKAGES AND RECENT TECHNOLOGY	9

All about popular commercial solid modelling packages — their salient features- technical comparison- modules and Tools available- brief outline of Data exchange standards. Brief outline of feature technology - classification of features- design by features- applications of features- its advantages- and limitations

UNIT - IV	FEM FUNDAMENTALS	9

Introduction to finite element method - principle- Steps involved in FEA - nodes- element and their types- shape function-constraints, forces and nodal displacements-stiffness matrix- solution techniques. Analysis of spring element. Simple problems involving stepped bars subjected to axial loading and simple structural members for triangular element.

Programme Coordinator	BoS Chairman

UNIT - V	ANALYSIS	9
Stages of FEA in a CAD environment - Pre-processor- solver and postprocessor. Pre-processing - FEA modelling - geometry generation- node generation- element generation- boundary constraints- load constraints- - mesh generation and refining. Solving - performing the actual analysis. Post processing - Types of 0/P available- interpretation of results. Demonstration of the above using any one popular commercial package. Other types of analysis: Brief outline of kinematical analysis- manufacturability analysis and simulation		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Plan and read engineering drawings
CO2	Identify engineering objects and components from drawings.
CO3	Utilize solid models created in computer
CO4	Compare the relation between 2D drafting and 3D models.
CO5	Choose the graphical models for further engineering applications

Text Books	
1.	Chairs Mcmahon and Jimmie Browne, “CAD / CAM: Principles, Practice and Manufacturing Management”, Prentice Hall, 2nd Ed., 1999.
2.	Ibrahim Zoid., “CAD / CAM”, Theory and Practice, TMH, 2001.
3.	Radhakrishnan, P., “CAD / CAM / CIM”, New Age International, 2000

Reference Books	
1.	Chandupatla and Bolagundu., “Introduction to Finite Element Methods in Engineering”, Pearson Education India, 4th Ed., 2015.
2.	Mikell P. Groover, “CAD/CAM: Computer-Aided Design and Manufacturing”, PHI, 2003.
3.	Newman and Sproull, R.F., “Principles of interactive Computer Graphics”, TMH,1997.

Programme Coordinator

BoS Chairman

B.E.	B23AEE928 - GRID GENERATION TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To make students understand the need for grid generation for numerical solutions
2.	To give them exposure to both structured and unstructured grid generation methods
3.	To impart knowledge on the areas of application and on the implementation methods for structured and unstructured grid generation techniques
4.	To expose the students on the benefits of adaptive meshing and its methodology
5.	To impart training to students on the control of grid quality

UNIT - I	BASIC ASPECTS IN GRID GENERATION	9

Methodology of grid generation- classification of grid generation techniques – Structured, Unstructured and Hybrid grids and their characteristic features – Areas of application –Geometry related issues for grid generation – Grid or mesh topology – Conformal Mapping-Domain decomposition with multiblocking.

UNIT - II	STRUCTURED GRID GENERATION	9

Algebraic methods for structured grid generation – Use of blending functions for grid generation-Use of partial differential equations for structured grid generation – Elliptic schemes for structured grid generation – Implementation of boundary conditions for smooth grid generation – Variational methods – Applications – A brief introduction to hyperbolic schemes for grid generation.

UNIT - III	UNSTRUCTURED GRID GENERATION	9

Use of triangular, quadrilateral and tetrahedral grids/meshes – Concept of dual mesh – Connectivity Information and data structure in unstructured grid generation – Hierarchy in unstructured grid Generation – Composite grid schemes in unstructured grid generation – Moving front technique- Delaunay base method – Octree approach

UNIT - IV	ADAPTIVE MESHING	9

Description of adaptive mesh refinement – Adaption control – Strategies for mesh adaption- Solution gradient based adaption – Discretization error and Recovery based adaption - r adaption, h adaption and p adaption methods – Elementary concepts in dynamic meshing and mesh motion – Role of adaptive meshing in solution accuracy and convergence.

Programme Coordinator	BoS Chairman

UNIT - V	GRID QUALITY AND QUALITY CONTROL	9
A brief description of metrics for grid quality – Aspect ratio – Orthogonality – Skewness – Warpage-Jacobian- Best practices for grid quality and grid control – mesh/grid quality aspects in surface meshing – Volume meshing and quality check – Grid quality aspects in boundary layer flows –Prismatic layers – Quality control in hybrid mesh transition – guideline for checking mesh quality and control		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	acquire knowledge on the basic principles of grid generation and be able to apply preliminary grid selection tasks in aerospace applications
CO2	understand the multi-block grid generation procedures and be able to evaluate multi-block grid designs of computational domain in aerospace related problems
CO3	evaluate structured and unstructured grid designs and be able to take decisions on selection of suitable grid blocks for the computational domains in aerospace applications
CO4	apply adaptive meshing methods for better management of computer resources and cost effective solutions in aerospace engineering
CO5	apply skills in ensuring the good quality of grid that is essential to get reasonably accurate numerical solutions for complex aerospace engineering problems

Text Books	
1.	Fletcher C.A.J. , “Computational Techniques for Fluid Dynamics 1” Springer Verlag, 1996.
2.	Liseikin V. D., “Grid Generation Methods:, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG 1st edition 1999

Reference Books	
1.	Chung T. J., “Computational Fluid Dynamics”, Cambridge University Press; 2nd edition, 2010.
2.	Patrick Knupp & Stanly Steinberg, “Fundamentals of Grid Generation” CRC Press 1st edition 1993.
3.	Versteeg H.K. and Malalsekera W. “An Introduction to Computational Fluid Dynamics, The Finite Volume Method”, PHI; 2nd edition 2007.
4.	John F Wendt , “Computational Fluid Dynamics – An Introduction”, 3rd Edition, Springer-Verlag, Berlin Heidelberg, 2009.

Programme Coordinator

BoS Chairman

B.E.	B23AEE929 – COMPUTAIONAL STRUCTURAL MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Understand the fundamental concepts and advantages of the finite element method (FEM) and its applications in engineering.
2.	Gain knowledge of the mathematical models and formulations used in FEM.
3.	Develop the ability to formulate and solve FEM equations including the assembly of stiffness matrices and element equations, and the use of isoparametric formulation and numerical integration.
4.	Acquire proficiency in implementing FEM codes by understanding the standard flowchart of a finite element code and the general methodology of FEM.
5.	Apply FEM to solve various engineering problems, including beam and plate structures, two and three-dimensional elasticity problems, and thermal and fluid flow problems, using commercial finite element software.

UNIT - I	FUNDAMENTAL PRINCIPLES OF THE FINITE ELEMENT METHOD	9

Constitutive Equations in Structural Mechanics – General Procedure of the Finite Element Method (FEM) – Discretization and Modelling of Physical Systems – Variational (Weak) Form – Problem Formulation – Principle of Stationary Total Potential – The Rayleigh-Ritz Method – Application of the Rayleigh-Ritz Method to Static Problems – Incorporation of Boundary Conditions – Selection of a Trial Function.

UNIT - II	FINITE ELEMENT ANALYSIS – STATIC PROBLEMS	9

Local, Global and Natural Coordinates – Shape Functions – Formulation of Finite Element Equations Using 1-D and 2-D Elements – The Galerkin Approach – Load Vector Formulation – Synthesis of Stiffness Matrix – Static Structural Analysis of 1-D & 2-D Problems – Assembly of Equations – Solution Techniques – Interpretation of Results – Utilization of FEM Software – Isoparametric Formulation using 2-D Elements

UNIT - III	DYNAMIC ANALYSIS USING THE FINITE ELEMENT METHOD	9

Fundamentals of Vibration Theory – Degrees of Freedom – Natural Frequencies & Mode Shapes – Lagrange's Equations – Equations of Motion Based on Weak Form – Axial Vibrations of a Bar – Transverse Vibrations of a Beam – Derivation of Mass Matrix – Formulation and Assembly of Finite Element Equations – Determination of Natural Frequencies – Column Buckling Analysis Using the Finite Element Method.

Programme Coordinator	BoS Chairman

UNIT - IV	OTHER APPROXIMATE METHODS	9

Weighted Residual Methods – Energy Theorems – Strain Energy in Structural Components – Application of the Rayleigh-Ritz Method in Free Vibration Problems and Stability Analysis – Finite Difference Method – Application to Structural Mechanics & Heat Transfer Problems – Improvement of Solution Accuracy and Comparison With Exact Solution.

UNIT - V	COMPUTATIONAL TOOLS	9

Mathematical Modelling of a Mechanical System – System Dynamics – The Laplace Transform Technique – Application to Engineering Problems – Transfer Function Approach – Transient Response Analysis – The Convolution Integral – Impulse Response – Use of Laplace Transform Technique to Obtain Transient and Steady-State Response – State-Space Approach to Dynamic System Modeling – Problem Solving Using MATLAB.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the advantages of the finite element method (FEM) and recognize its applications in various engineering fields
CO2	Understand the fundamental steps involved in the FEM analysis process.
CO3	Assemble stiffness matrices, formulate element equations, and perform numerical integration using FEM.
CO4	Be proficient in implementing FEM codes and the general methodology for solving engineering problems using FEM.
CO5	Utilize commercial finite element software to analyze and solve complex engineering problems.

Text Books	
1.	Weaver, W., and Gere, J.M., “Matrix Analysis of Framed Structures”, CBS Publishers and distributors pvt. Ltd., 2004.
2.	Rajasekaran, S., and Sankarasubramanian, G., “Computational Structural Mechanics”, PHI, New Dehi, 2001.
3.	Martin, H, C., “Introduction to Matrix Methods of Structural Analysis”, McGraw-Hill, New York, 1966.

Reference Books	
1.	Rubinstein, M.F., “Matrix Computer Analysis of Structures”, Prentice-Hall, Englewood Cliffs, New Jersey, 1966.
2.	Beaufait, F.W., Rowan, W. H., Jr., Hoadely, P. G., and Hackett, R. M., Computer Methods of Structural Analysis, Prentice-Hall, Englewood Cliffs, New Jersey, 1970.
3.	Kardestuncer, H.,” Elementary Matrix Analysis of Structures”, McGrawHill, New York, 1974.

Programme Coordinator

BoS Chairman

B.E.	B23AEE930 – CYBER SECURITY FOR AEROSPACE APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamental concepts of cyber security and global perspective of cybercrimes
2.	To explore various cyber-attacks, their vectors, and the countermeasures to mitigate these threats
3.	To learn techniques and tools for reconnaissance
4.	To understand the principles and methods of intrusion detection
5.	To apply cyber security principles to aerospace systems, focusing on the unique challenges and solutions

UNIT - I	INTRODUCTION	9

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT - II	ATTACKS AND COUNTERMEASURES	9

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures

UNIT - III	RECONNAISSANCE	9

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques

UNIT - IV	INTRUSION DETECTION	9

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Programme Coordinator	BoS Chairman

UNIT - V	INTRUSION PREVENTION AND AEROSPACE APPLICATIONS	9
Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products. Introduction to aerospace systems and their unique cyber security challenges-Identifying and assessing threats specific to aerospace systems-Principles of secure system design for aerospace applications-Secure communication protocols and their application in aerospace-Application of IDS/IPS in aerospace systems		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basics of cyber security, the impact of the internet and global perspective of cybercrimes
CO2	Identify different types of cyber-attacks and apply appropriate countermeasures to mitigate these threats
CO3	Perform reconnaissance using various tools and techniques
CO4	Implement intrusion detection techniques, using both host-based and network-based systems
CO5	Design secure aerospace systems, addressing specific cyber security challenges.

Text Books	
1.	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021
2.	Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011

Reference Books	
1.	Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011 (Unit 3) 3. Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007 (Unit 3).
2.	William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015

Programme Coordinator

BoS Chairman

B.E.	B23AEE931- ARTIFICIAL INTELLIGENCE SYSTEMS FOR UNMANNED AERIAL VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge to students on fundamentals of AI and ML technique for providing advanced design tools for UAV
2.	To make the students learn the basics of training algorithms of neural networks
3.	To introduce the various unmanned aerial systems to students
4.	To make the students familiarize with the UAV communication systems
5.	To acquaint students with the use of image processing and data processing in the applications of UAV

UNIT - I	OVERVIEW OF AI AND ML ALGORITHMS	9

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules.

UNIT - II	SINGLE LAYER FEED FORWARD NEURAL NETWORKS	9

Introduction- Perceptron Models: Discrete, Continuous and Multi-Category- Training Algorithms: Discrete and Continuous Perceptron Networks - Limitations of the Perceptron Model

UNIT - III	UNMANNED AERIAL SYSTEMS	9

Drone Basics, Unmanned Aerial Systems (UAS), Drone Sensors, Micro Controllers, Internet of Things (IOT) Systems, IOT Controls, Different Types of UAV and its Applications, Recent Trends in Artificial Intelligence Systems.

UNIT - IV	UAV COMMUNICATION SYSTEMS	9

Autonomous - Waypoints Navigations, Ground Control Station (GCS), UAV Telemetry Systems - Various Flight Controllers, Radar Communication Systems, UAV Stealth Technology, Radar Absorbing Material, Drone Jamming Technology.

UNIT - V	IMAGE PROCESSING & DATA PROCESSING	9

Drone Intelligent Modes, Drone Smart Modes, FPV & Image Processing Systems, Image Processing, Multispectral Camera, LIDAR, GIS Mapping. Orthomosaic Maps- 3D Point Cloud- Digital Surface Models (DSM)- Digital Terrain Models (DTM)- Contour Maps-3D textured mesh.

Total Instructional hours : 45

Programme Coordinator	BoS Chairman

Course Outcomes : Students will be able to	
CO1	Acquire knowledge on AI technique for providing advanced design tools for UAV
CO2	Apply the principles of training methodologies of neural networks
CO3	Identify the use of IoT and AI systems in Unmanned Aerial Vehicles
CO4	Illustrate the communication systems and its applications in UAVs
CO5	Analyze the image and data captured using UAVs with contours and graphs

Text Books	
1.	Russel R Russo, “Neural Networks for Beginners”, Zanshin Honya Limited, 2021.
2.	Kevin Gurney, “An Introduction to Neural Networks”, CRC press, 2018.

Reference Books	
1.	PK Garg, Introduction to Unmanned Aerial Vehicles, New Age International Publishers New Age International Private Limited; First edition, 2020.
2.	Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
3.	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
4.	Laurene Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Fourth edition, Pearson Education India, 2006.
5.	Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

Programme Coordinator

BoS Chairman

B.E.	B23AEE932 – COMPUTER INTEGRATED MANUFACTURING AND SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To gain the basic knowledge in the process of manufacturing with the help of computers.
2.	To gain knowledge about the different production planning methods in computers.
3.	To study the coding system and analysis related to cellular manufacturing.
4.	To impart understand the different manufacturing system related to computer manufacturing application.
5.	To gain knowledge about the production of industrial robots with the help of computers.

UNIT - I	INTRODUCTION	9
Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control – Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.		

UNIT - II	PRODUCTION PLANNING, CONTROL AND COMPUTER AIDED PROCESS PLANNING	9
Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning - Control Systems - Shop Floor Control - Inventory Control – Brief on Manufacturing Resource Planning - II (MRP-II) & Enterprise Resource Planning (ERP) – Simple Problems.		

UNIT - III	CELLULAR MANUFACTURING	9
Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.		

Programme Coordinator

BoS Chairman

UNIT - IV	FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)	9
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.		

UNIT - V	INDUSTRIAL ROBOTICS	9
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability – Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Summarize about the classical production system, the components of CIM.
CO2	Explain the concept of Computer Aided Process Planning (CAPP), Material Requirements Planning (MRP) and various Manufacturing support systems.
CO3	Illustrate the cellular manufacturing using Rank order, Clustering and Hollier method.
CO4	Explain Flexible Manufacturing system and applications of Automated Guided Vehicles in the implementation of CIM.
CO5	Identify the configurations of Industrial Robots, and their part programming.

Text Books	
1.	Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2.	Radhakrishnan P., Subramanyan S. and Raju V., “CAD / CAM / CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2004.

Reference Books	
1.	Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
2.	Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
3.	Rao P, N Tewari & T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

Programme Coordinator	BoS Chairman

B.E.	B23AEE933 – AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge in various ground support system for aircraft operations.
2.	To carry out ground servicing of critical aircraft systems.
3.	To understand the specifications standards of aircraft hardware systems.
4.	To understand the ground handling procedures and types of equipment's with special maintenance.
5.	To make student understand do shop safety, Environment cleanliness in an aircraft materials shop.

UNIT - I	AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT	9
Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions – Engine starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Ground power unit.		

UNIT - II	GROUND SERVICING OF VARIOUS SUB SYSTEMS	9
Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.		

UNIT - III	MAINTENANCE OF SAFETY AND AIRCRAFT SYSTEM PROCESSES	9
Shop safety – Environmental cleanliness – Precautions - Hand tools – Precision instruments – Special tools and equipment's in an airplane maintenance shop – Identification terminology.		

UNIT - IV	INSPECTION	9
Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications.		

UNIT - V	AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES	9
Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws) – 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.		
Total Instructional hours : 45		

Programme Coordinator	BoS Chairman

Course Outcomes : Students will be able to	
CO1	Apply the procedure and precaution for ground handling and its equipment.
CO2	Apply the ground servicing techniques for aircraft subsystems.
CO3	Utilize special tools and equipment's in airplane maintenance shop.
CO4	Summarize the airworthiness directives and various manuals for inspection of an aircraft.
CO5	Identify the specialization standards of aircraft hardware systems.

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

Reference Books	
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.

Programme Coordinator

BoS Chairman

B.E.	B23AEE934 – AEROENGINE MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To make the students to familiarize with the Aircraft engine maintenance procedure and practice.
2.	To gain knowledge of basics of Aeronautics and engine components.
3.	To gain knowledge on inspection and maintenance of the jet engine.
4.	To identify the defects by using NDT procedures,
5.	To perform the overhauling procedure to new engines.

UNIT - I	CALIBRATION OF PISTON ENGINES	9

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.

UNIT - II	PROPELLERS	9

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.

UNIT - III	JET ENGINES	9

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.

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BoS Chairman

UNIT - IV	TESTING AND INSPECTION	9
Symptoms of failure – Fault diagnostics – Case studies of different engine systems – Rectification during testing equipment's for overhaul – Tools and equipment's 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.		

UNIT - V	OVERHAULING	9
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.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply maintenance procedure to Aircraft Engines.
CO2	Interpret the propeller theory and its different characteristics.
CO3	Apply non-destructive testing procedures to identify the defects.
CO4	Identify the engine components and faults.
CO5	Apply overhauling procedure to new engines.

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

Reference Books	
1.	Turbomeca, " Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.
2.	United Technologies Pratt & Whitney, "The Aircraft Gas turbine Engine and its Operation", TheEnglish Book Store, New Delhi.

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B.E.	B23AEE935 - AIRFRAME MAINTENANCE AND REPAIR	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To make the students to understand the Airframe components and the tools used to maintain the components.
2.	Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.
3.	To perform the aircraft jacking and locate the CG for balancing.
4.	To inspect the hydraulic and pneumatic system mounted in the aircraft.
5.	To gain the knowledge on the handling and storage of hazardous materials.

UNIT - I	MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS	9

Equipment 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. Testing – Riveted repair design – Damage investigation – Reverse engineering.

UNIT - II	PLASTICS AND COMPOSITES IN AIRCRAFT	9

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.

UNIT - III	AIRCRAFT JACKING, ASSEMBLY AND RIGGING	9

Airplane jacking and weighing and C.G. Location – Balancing of control surfaces – Inspection maintenance – Helicopter flight controls – Tracking and balancing of main rotor.

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UNIT - IV	REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM	10
Trouble shooting and maintenance practices – Service and inspection – Inspection and maintenance of landing gear systems – Inspection and maintenance of air-conditioning and pressurization system – water and waste system – Installation and maintenance of Instruments - handling - Testing – Inspection – Inspection and maintenance of auxiliary systems – Rain removal system – Position and warning system – Auxiliary Power Units (APUs).		

UNIT - V	SAFETY PRACTICES	9
Hazardous materials storage and handling – Aircraft furnishing practices – Equipments. Trouble shooting – Theory and practices.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the damages and apply the repair techniques in aircraft structural equipment's.
CO2	Compare different types of plastics and composite repair procedures used in aircraft.
CO3	Inspect aircraft jacking, assembly and rigging.
CO4	Evaluate aircraft hydraulic & pneumatic system.
CO5	Utilize the safety practices for troubleshooting and material handling.

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

Reference Books	
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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B.E.	B23AEE936– HELICOPTER MAINTENANCE	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on basic concepts of Head maintenance, Vibration tracking of helicopter blades, Flight control systems and Mast adjustment concepts.
2.	To provide students with the fundamentals of Helicopter ground handling.
3.	To make students learn the basic concept of main rotor transmission and importance of torque meter maintenance.
4.	To give an understanding of power plants, tail rotor systems servicing of helicopters.
5.	To make the students familiar with the Fuselage maintenance and Special purpose equipment of helicopters.

UNIT - I	INTRODUCTION	9

Helicopter as an aircraft - Basic features - Evolution of helicopter - Helicopter configurations - rotor arrangements - Compound Helicopter - jet rotor-no tail rotor concepts - Basic directions – Ground handling - bearing – Gears.

UNIT - II	MAIN ROTOR ASSEMBLY	9

Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping – Electronic balancing. Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners. Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks. Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.

UNIT - III	MAIN ROTOR TRANSMISSIONS	9

Engine transmission coupling – Drive shaft Maintenance - clutch – Freewheeling units – Spray clutch - Roller unit – Torque meter – Rotor brake Maintenance of these components - Vibrations – Mounting systems –Transmissions.

UNIT - IV	POWER PLANTS & TAIL ROTORS	9

Fixed wing power plant modifications – Installation - Different type of power plant maintenance - Tail rotor system – Servicing tail rotor track - System rigging.

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UNIT - V	AIRFRAMES AND RELATED SYSTEMS	9
Rotary wing Fuselage structural construction - Tubular, sheet metal, Bonded - Bell 206, Hughes 500, Eurocopter BO - 105 Fuselage- Fuselage maintenance. Airframe Systems - Stress and loads on Airframe, Wheel and skid Gear, visibility. Structural components and materials, Special purpose equipment.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Appreciate the different configurations and basic elements of helicopters
CO2	Perform maintenance of main rotor assembly of helicopters.
CO3	Identify the various sources of vibration and the solutions to effectively control the vibrations in helicopters.
CO4	Perform maintenance of helicopter power plants.
CO5	Investigate the vibrational problems in helicopter airframe.

Text Books	
1.	Gupta. L “Helicopter Engineering”, Himalayan Books, 1996.
2.	Jeppesen, “Helicopter Maintenance Hand Book”, Jeppesons and Sons Inc., 2000.

Reference Books	
1.	“Civil Aircraft Inspection Procedures”, Part I and II, CAA, English Book House, New Delhi, 1986.
2.	LARRY REITHMIER, “Aircraft Repair Manual”, Palamar Books Marquette, 1992.

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B.E.	B23AEE937 – AIRCRAFT RULES AND REGULATION CAR PART I	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To enable knowledge about general aircraft rules
2.	To enrich idea about the airworthiness and air transport standards
3.	To introduce knowledge about aerodrome standards and licensing
4.	To impart on air safety standards awareness
5.	To familiarize with various aspects of certification and Air Safety Standards

UNIT - I	GENERAL AIRCRAFT RULES	9

Aircraft Registration and Airworthiness; Pilot Licensing and Training; Aircraft Operations, Flight Duty Time Limitations (FDTL); Safety and Maintenance; Security Protocols; Air Navigation and Airspace Management; Environmental Regulations; Passenger Safety and Comfort; Commercial Operations; Unmanned Aircraft Systems regulations.

UNIT - II	AIRWORTHINESS	9

Approval of Cockpit Check List, MEL, CDL - Defect Recording, Monitoring, Investigation And Reporting - Aircraft Maintenance Programme - Approval of Organisations - Airworthiness And Continued Airworthiness - Requirements Of Aircraft Fuel, Refuelling Of Aircraft And Calibration of Aircraft Fuels - Aircraft Instrument, Equipment And Accessories- Aircraft Maintenance Engineer – Licensing - Mandatory Modifications And Inspections - Operational Requirement for Aircraft - Airborne Communication, Navigation And Radar.

UNIT - III	AIR TRANSPORT	9

Air Operators Certification - Procedures And Requirements - Operations to Defence Airfields - Operations to Aerodromes Which are not in Regular Use - Non Scheduled Flight Clearance - Passenger Facilitation - Aerial Work – Surveillance – Miscellaneous.

UNIT - IV	AERODROME STANDARDS, LICENSING AND AIR SAFETY	9

Scope and Extent - Aerodrome Facilities - Aerodrome Licensing – Miscellaneous - Procedure For Accident/ Incident Investigation - Prevention of Accidents/ Incidents – Miscellaneous.

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UNIT - V	AIR SAFETY, DESIGN STANDARDS AND TYPE CERTIFICATION	9
Procedure for Accident/ Incident Investigation - Prevention of Accidents/ Incidents – Miscellaneous - Airworthiness Standards for Design - Airworthiness Standards for Emissions.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Ensure adherence to aviation laws, standards and protocols.
CO2	Develop skills in aircraft maintenance, inspection, and repair, ensuring that all components meet airworthiness standards.
CO3	Enhance career prospects for individuals in the aviation industry, opening up opportunities for roles in airport management, regulatory bodies, and consultancy
CO4	Gain technical proficiency in handling specific aircraft types, leading to better maintenance and troubleshooting.
CO5	To familiarize with various aspects of Air safety standards.

Text Books	
1.	Aircraft manual (India) volume – latest edition, the English book store, 17-I, Connaught circus, New Delhi, 2000.
2.	Civil aviation requirements with latest amendment (section 2 airworthiness) – published by DGCA, the English book store, 17-I, Connaught circus, New Delhi.
3.	Aeronautical information circulars (relating to airworthiness) from DGCA, India

Reference Books	
1.	Recent Advisory circulars issued from DGCA, India.
2.	"Indian Aircraft manual" - DGCA Publications.

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BoS Chairman

B.E.	B23AEE938 – AIRCRAFT RULES AND REGULATION CAR PART II	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn effective training methods and techniques for both initial and recurrent training of flight crew members
2.	To understand the principles of aircraft operation, including flight planning and flight management systems
3.	To understand Airspace Classification and Navigation Systems Proficiency
4.	To learn about various strategies and technologies aimed at reducing environmental impact
5.	To familiarize oneself with emergency response procedures in the event of a dangerous goods incident

UNIT - I	FLIGHT CREW STANDARDS AND TRAINING	9

Medical Standards, Experience Requirements, Knowledge Requirements; Training Requirements, Approved Training Organizations (ATOs), Integrated and Modular Training, Simulator Training, Flight Training; Licensing Process, student Pilot License (SPL), Private Pilot License (PPL), Commercial Pilot License (CPL), Airline Transport Pilot License (ATPL), Instrument Rating (IR), Type Rating; Recurrent Training and Proficiency; Continuing Medical Fitness.

UNIT - II	AIRCRAFT OPERATIONS	9

Flight Planning and Dispatch; Pre-Flight Procedures; In-Flight Operations; Landing and Post-Flight Procedures; Maintenance and Repairs; Safety and Emergency Procedures; Regulatory Compliance; Environmental Considerations.

UNIT - III	AIRSPACE AND AIR NAVIGATION STANDARDS	9

Classification of Airspace; Airspace Structure, Terminal Control Areas (TMA), Flight Information Regions (FIRs), Airways; Special Use Airspace; Air Navigation Standards, Navigation Systems, Communication Systems, Surveillance Systems, Air Traffic Control (ATC) Procedures, Performance-Based Navigation (PBN); Environmental and Technological Considerations.

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UNIT - IV	AVIATION ENVIRONMENT PROTECTION	9
Noise Management, Noise Standards for Aircraft, Noise Abatement Procedures, Noise Monitoring and Reporting; Emissions Reduction, CO2 Emissions Standards, Operational Measures, Market-Based Measures; Sustainable Aviation Fuels (SAF), Promotion of SAF, Regulatory Support; Environmental Management at Airport, Green Airport Initiatives, Ground Operations; Regulatory Framework and Compliance; Stakeholder Engagement and Awareness; Technological Innovation.		

UNIT - V	SAFE TRANSPORT OF DANGEROUS GOODS BY AIR	9
Classification of Dangerous Goods; Responsibilities and Requirements, Shippers and Operators, Training and Awareness; Key Safety Measures, Packaging and Labelling, Documentation, Handling and Storage, Emergency Response; ICAO Standards, Mutual Recognition.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Access and evaluate flight crew performance, providing constructive feedback, and implementing improvement plans.
CO2	Operate specific aircraft types, including taxiing, takeoff, landing, and maneuvering in various conditions.
CO3	Have an effective flight planning, considering airspace structure, navigation aids, and regulatory requirements
CO4	Practice sustainably within aviation, including carbon offsetting, eco-friendly airport operations, and biodiversity conservation.
CO5	Competence in selecting, preparing, and handling packaging suitable for transporting dangerous goods safely by air

Text Books	
1.	Aircraft manual (India) volume – latest edition, the English book store, 17-I, Connaught circus, New Delhi.
2.	Civil aviation requirements with latest amendment (section 2 airworthiness) Published by DGCA, the English book store, 17-I, Connaught circus, New Delhi. Aeronautical information circulars (relating to airworthiness) from DGCA. Advisory circulars from DGCA.
3.	Aeronautical information circulars (relating to airworthiness) from DGCA, India

Reference Books	
1.	DGCA issued revised Civil Aviation Requirement (145).

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B.E.	B23AEE939– AIRLINE AND AIRPORT MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the operational flow of airlines and air transportation maintenance.
2.	To understand the structure and management levels of aviation sectors.
3.	To attribute the financial influences those are structuring the airlines and airport operations.
4.	To impart knowledge on scheduling and flight plan.
5.	To expose the fleet planning, evaluation and

UNIT - I	INTRODUCTION	9
Historical Development of Aviation and Air Transportation - Global Air Transport Authority: Overview - Roles of International Air Transport Association and International Civil Aviation Organization - Airline Management System - Organization Levels and functions.		

UNIT - II	AIRLINE ECONOMICS	9
Airline Economics - Forecasting - general factors considered for Airlines economic Analysis - Margin Growth - Forecasting Approach of Indian Airline Economics - Airline Revenue and Gross Domestic Product - Operating cost of Airlines - Load Factor - Passenger fare and tariffs - influence of geographical, economic & political factors on routes and route selection.		

UNIT - III	AIRPORT OPERATIONAL STRUCTURE	9
Airport structures and sectors - Divisional responsibilities - Organizational Levels of Airport of Airport management system - Airport Authority of India: Organizational Structure - Functional policies and Objectives - Overview of DGCA.		

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UNIT - IV	PRINCIPLES OF AIRLINES SCHEDULING	9
Flight operations and crew scheduling - ground operations and facility - limitations, Equipment Maintenance scheduling - Principles of Airlines Scheduling - Types of Airline scheduling - Point to Point Scheduling - Hub and Spoke Scheduling - Preparation of Flight Plan.		

UNIT - V	FLEET PLANNING AND DESIGN	9
Introduction: Airline Fleet - Fleet Planning and Aircraft evaluation Process - Factors considered for Fleet planning - Fleet size - Fleet structure - Fleet Rationalism - Fleet commonality - Fleet cost planning - capital acquisition - valuation & depreciation - budgeting - Air crew Evalution.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Interpret the roles and functions of Airlines and Airport Industry.
CO2	Explain the economic flow in functioning Airline Sectors.
CO3	Apply the principles of management theories for Airport operations.
CO4	Analyze the scheduling methods to control the flight plan process of airlines
CO5	Analyze the factors influencing the design of fleet.

Text Books	
1.	Fedric J.H., "Airport Management", 2000.
2.	C.H. Friend, "Aircraft Maintenance Management", 2000.

Reference Books	
1.	Alexander T Wells, "Air Transportation", Wadsworth Publishing Company, California, 1993.
2.	"Indian Aircraft manual" - DGCA Publications.

Programme Coordinator

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B.E.	B23AEE940 – DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide students an exposure to disasters, their significance and types.
2.	To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
3.	To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4.	To enhance awareness of institutional processes in the country
5.	To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT - I	INTRODUCTION TO DISASTERS	9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters –Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT - II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT - III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

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UNIT - IV	DISASTER RISK MANAGEMENT IN INDIA	9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.		

UNIT - V	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELDWORKS	9
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Differentiate the types of disasters, causes and their impact on environment and society
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.
CO3	Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster Damage assessment and management.
CO4	Analyze the Disaster damage assessment and management.
CO5	Analyze the various applications of disaster management

Text Books	
1.	Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
2.	Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.
3.	Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4.	Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt.Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

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Reference Books	
1.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2.	Government of India, National Disaster Management Policy, 2009.

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B.E.	B23AEE941 –AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic of avionics and its need for civil and military aircrafts.
2.	To impart knowledge on different avionic architecture and various avionics data buses.
3.	To impart knowledge on different cockpit displays and display technologies.
4.	To impart knowledge on different navigation systems and their operating principles.
5.	To impart knowledge on air data systems and the functions of autopilot.

UNIT - I	INTRODUCTION TO AVIONICS	9
Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.		

UNIT - II	DIGITAL AVIONICS ARCHITECTURE AND BUSES	9
Avionics system architecture – System Integration - Data buses – MIL-STD-1553B – ARINC – 429 – ARINC – 629 – ARINC-664 (AFDX), ARINC 825 (CAN).		

UNIT - III	FLIGHT DECKS AND COCKPITS	9
Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil & Military Cockpits: MFDS, HUD, MFK, HOTAS, ARINC 661, ARINC 717, ARINC 818.		

UNIT - IV	INTRODUCTION TO NAVIGATION SYSTEMS	9
Dead Reckoning systems – Inertial sensors – Inertial Navigation Systems (INS) – INS block diagram – Kalman Filter, Radio navigation – Hyperbolic Navigation - ILS, MLS –– Satellite Navigation systems – GPS – Waypoint Navigation.		

UNIT - V	AIR DATA SYSTEMS AND AUTO PILOT	9
Air data quantities – Altitude, Air speed, Vertical speed, Mach number – FMS – Auto pilot – Basic principles, Longitudinal and Lateral auto pilot. Case study- Apollo 11 mission		
		Total Instructional Hours : 45

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Course Outcomes : Students will be able to	
CO1	Explain the need for avionics in aircrafts and explain the functions of basic aircraft systems.
CO2	Select a suitable avionics architecture based on requirements and explain the functions of a data bus.
CO3	Explain the working of cockpit displays and to distinguish the type of technology used in displays.
CO4	Explain the importance of navigation system and operating principles of different navigation systems
CO5	Explain the functions of autopilot and compare the different types of air speeds.

Text Books	
1.	Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 7th Edition, 2012.
2.	Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 2003.

Reference Books	
1.	Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2.	Pallet.E.H.J., Aircraft Instruments and Integrated Systems, Longman Scientific, 1992.
3.	Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
4.	Spitzer. C.R. The Avionics Hand Book, CRC Press, 2000.

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B.E.	B23AEE942 – AIRCRAFT NAVIGATION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on the concept of different axis systems and co-ordinate transformation techniques
2.	To impart knowledge on different short range radio navigation systems.
3.	To impart knowledge on different long range radio navigation systems and its integration.
4.	To impart knowledge on various approach and landing aids of aircraft.
5.	To impart knowledge on different functions of FMS and air traffic management

UNIT - I	INTRODUCTION	9
Principles of navigation – Different types of Navigation - Design Trade-offs – Evolution of Air navigation - Different co-ordinate frames - Transformation Techniques.		

UNIT - II	SHORT RANGE NAV AIDS	9
Non-directional Beacons - Operating Principles of VOR – DME – ADF – TACAN – VORTAC.		

UNIT - III	LONG RANGE NAV AIDS	9
Hyperbolic Navigation – Inertial Sensors & INS - GPS - System description – Principle of operation - position and velocity determination - Differential GPS - Integration of GPS and INS.		

UNIT - IV	APPROACH AND LANDING SYSTEMS	9
Visual flight Rules– Instrument Landing System - Microwave Landing System - Ground Controlled Approach System - Satellite based Landing system.		
UNIT - V	**FMS AND AIR TRAFFIC MANAGEMENT**	**9**
Flight Plan and Functions of FMS – ADSB - Collision avoidance systems - Surface movement and surveillance radars - Airfield lighting control and monitoring – METAR weather data.		
Total Instructional Hours : 45		

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Course Outcomes : Students will be able to	
CO1	Explain the need for different axis systems and select the suitable system for the given Condition.
CO2	Explain the operating principles of short range navigation systems
CO3	Compare different long range navigation systems.
CO4	Explain the operation of various Automatic Landing systems
CO5	Explain different functions of FMS and air traffic management

Text Books	
1.	Collinson R.P.G, 'Introduction to Avionics Systems', Springer Publisher, 3rd Edition 2011.
2.	David Wyatt, Mike Tooley, 'Aircraft Communications and Navigation Systems', Routledge Publication, 2017.

Reference Books	
1.	Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 2009.
2.	Collinson R.P.G, 'Introduction to Avionics Systems', Springer Publisher, 3rd Edition 2011.
3.	Nagaraja, N.S. Elements of Electronic Navigation‖, Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 2017.
4.	Paul. D. Groves. 'Principles of GNSS, Inertial, and Multi sensor Integrated Navigation Systems', Artech House, 2013.

Programme Coordinator

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B.E.	B23AEE943 – AIRCRAFT SYSTEM MODELING AND SIMULATION	L	P	T	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on different coordinate systems and coordinate transformation techniques.
2.	To introduce the concepts of aircraft mathematical model and Aircraft Equations of Motion.
3.	To impart knowledge on the systems requirements of a good flight simulator and its selection factors.
4.	To introduce the knowledge about various types of flight simulators.
5.	To introduce interfacing of Flight simulators with Aero Sim and Aerospace Blockset.

UNIT - I	INTRODUCTION	9

Continuous and discrete systems, Need for System Modelling, Different forces acting on an aircraft – Different Coordinate systems – Methods of Coordinate transformation - Static models, Dynamic models, Principles used in modelling the techniques of simulation.

UNIT - II	AIRCRAFT MODELLING	9

Aircraft Equations of Motion – Aircraft force equations – Moment Equations – Longitudinal and Lateral Directional EOM- Kinematic Equations – Linearizing the EOM – Moment of Inertia Calculation – Representation of aerodynamics data – Use of Look-up table in dynamic modelling – Dynamic modelling of the Quadrotor - Aircraft mathematical model, Analytical modelling of aircraft wing loads, Bending moment model

UNIT - III	AIRCRAFT SIMULATION REQUIREMENTS	9

Discrete events, Representation of time, Generation of arrival patterns, Simulation Programming tasks, Gathering statistics, Simulation language. Continuous System models, Differential equation, Continuous system simulation language (CSSLs), Motion system, Visual system, Instructor‘s facilities.

UNIT - IV	SIMULATION USING FLIGHT SIMULATORS	9

Historical background – Requirements of a good simulator, Simulator Certification, Interactive systems, Control interface with flight simulator software - AR and VR in simulation, Generation of guidance and control commands – Simulation of an autopilot, autonomous landing systems, Simulation of autonomous flight using Waypoint Navigation

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UNIT - V	FLIGHT SIMULATOR AS A TRAINING DEVICE AND RESEARCH TOOL	9
Introduction, advantage of simulator- Simulators in academic and research – the effectiveness of Simulator, The user‘s role, , Data sources, Validation, in- flight simulators - Interfacing Flight Gear Flight Simulator using AeroSim and Aerospace Blockset.		
		Total Instructional Hours : 45

Course Outcomes : Students will be able to	
CO1	Explain need for different coordinate systems and perform coordinate transformation.
CO2	Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO3	Explain the different requirements for a simulator and process associated with simulators.
CO4	Perform and compare the simulation on different flight simulators.
CO5	Apply the knowledge gained on flight simulator to test new aircraft designs, guidance and control schemes.

Text Books	
1.	Brian L. Stevens, Frank L. Lewis, Eric N. Johnson. ‘Aircraft Control and Simulation’, John Wiley & Sons, 2016.
2.	David Allerton. ‘Principles of Flight Simulation’, John Wiley & Sons, 2009.
3.	Gordon. G., System Simulation‖, Prentice – Hall Inc., 1992.
4.	Nandan K. Sinha, N. Ananthkrishnan, Advanced Flight Dynamics with Elements of Flight Control, CRC Press, 1st Edition, 2017.

Reference Books	
1.	Marcello R. Napolitano. ‘Aircraft Dynamics’, John Wiley & Sons, 2011.
2.	Stables, K.J. and Rolfe, J.M. Flight Simulation, Cambridge University Press, 1986.
3.	Thomas R. Yechout, Steven L. Morris, David E. Bossert, Wayne F. Hallgren, James K. Hall— Introduction to Aircraft Flight Mechanics, AIAA Education series, 2014.

Programme Coordinator

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B.E.	B23AEE944 – AIRCRAFT GUIDANCE AND CONTROL SYSTEM	L	P	T	C
		3	0	0	3

Course Objectives	
1.	To learn about the operating principle of guidance law and augmentation systems
2.	To study about the mathematical modelling of an aircraft system
3.	To understand the development of aircraft equations of motion
4.	To study longitudinal dynamics and to design the longitudinal autopilot
5.	To study lateral dynamics and to design the lateral autopilot and understand the basics of Fly-by-wire control

UNIT - I	INTRODUCTION	9
Introduction to Guidance and control - Historical background -Need for automatic flight control systems, Stability augmentation systems, control augmentation systems – Flight Guidance Systems.		

UNIT - II	MATHEMATICAL MODELLING	9
Coordinate Frames - Coordinate Transformations- Different methods – Velocities in moving axis system – Development of Equations of motion – Linearization – Separations of Equations of motion		

UNIT - III	LONGITUDINAL AUTOPILOT	9
Longitudinal Oscillatory motions - Introduction to Displacement Autopilot - Pitch Orientation Control system - Landing Geometry - Autopilot for Automatic Glide Slope Control system.		

UNIT - IV	LATERAL AUTOPILOT	9
Lateral Oscillatory motions – Dampers – Introduction to different methods of co-ordination -Yaw Orientation Control system.		

UNIT - V	FLY-BY-WIRE FLIGHT CONTROL SYSTEMS	9
Need for Fly-by-wire flight control systems – Introduction to ACT and CCV concepts - Redundancy Management – C* control law – Introduction to Digital Fly-by-wire and Fly by light concepts.		
		Total Instructional Hours : 45

Programme Coordinator

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Course Outcomes : Students will be able to	
CO1	Define the various guidance schemes and augmentation systems.
CO2	Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO3	Analyse the longitudinal oscillatory modes and design the autopilots for longitudinal modes and control of aircrafts.
CO4	Analyse the lateral oscillatory modes and design the autopilots for lateral modesand control of aircrafts.
CO5	Understand and apply the concepts of Fly by wire control systems.

Text Books	
1.	Blake Lock, J.H Automatic control of Aircraft and missiles, John Wiley Sons, New York, 1990.
2.	Collinson R.P.G, 'Introduction to Avionics', Chapman and Hall, India, 1996.
3.	Nandan K. Sinha, N. Ananthkrishnan, Advanced Flight Dynamics with Elements of Flight Control, CRC Press, 1st Edition, 2017.
4.	Nandan K. Sinha, N. Ananthkrishnan, "Elementary Flight Dynamics with an Introduction to Bifurcation and Continuation Methods, CRC Press, 2nd Edition, 2021

Reference Books	
1.	Michael V. Cook 'Flight Dynamics Principles: A Linear Systems Approach to Aircraft Stability and Control', Elsevier, 2013.
2.	Nelson R.C, 'Flight stability & Automatic Control', McGraw Hill, 1989.

Programme Coordinator

BoS Chairman

B.E.	B23AEE945 – AIR TRAFFIC CONTROL AND PLANNING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the basic concepts involved in Air traffic control system.
2.	To identify the concepts of area control service, clearance, flight plans in Air traffic control system.
3.	To gain knowledge related to radar control systems.
4.	To distinguish about the formation of aerodrome data.
5.	To gain knowledge about the various services such as navigation, landing, location, aerodrome beacon etc.

UNIT - I	BASIC CONCEPTS	9

Objectives of air traffic control systems – Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

UNIT - II	AIR TRAFFIC SYSTEMS	9

Area control service, assignment of cruising levels – minimum flight altitude - ATS routes andsignificant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance – ATC clearances – Flight plans – position report.

UNIT - III	FLIGHT INFORMATION SYSTEMS	9

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

UNIT - IV	AERODROME DATA	9

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics – length of primary / secondary runway – Width of runways – Minimum distance between parallel runways – obstacles restriction.

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UNIT - V	NAVIGATION AND OTHER SERVICES	9
Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Categorize various kinds of separation and ATS air spaces.
CO2	Identify the ATS routes, clearances, flight plans and position report for the safe flight.
CO3	Examine the flight information system and rules of ATS.
CO4	Explain the basic aerodrome data and runway characteristics with obstacle restrictions.
CO5	Inspect the various markings, lights and visual aids for navigation services.

Text Books	
1.	AIP (India) Vol. I & II, “The English Book Store”, 17-1, Connaught Place, New Delhi.

Reference Books	
1.	“Aircraft Manual (India) Volume I”, latest Edition – The English Book Store, 17-1, Connaught Place, New Delhi.
2.	“PANS – RAC – ICAO DOC 4444”, Latest Edition, The English Book Store, 17-1, Connaught Place, New Delhi.

Programme Coordinator

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B.E.	B23AEE946 – UAV SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of unmanned aerial vehicles
2.	To make students familiarise with the design aspects of UAV.
3.	To impart knowledge on the hardware components and their application in the UAV systems.
4.	To infer about the communication and control detail of UAV.
5.	To introduce the basic operational futures of UAV systems.

UNIT - I	INTRODUCTION TO UAV	9
History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications.		

UNIT - II	THE DESIGN OF UAV SYSTEM	9
Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations-Characteristics of Aircraft Types- Design Standards and Regulatory Aspects- UK,USA and Europe-Design for Stealth--control surfaces-specifications.		

UNIT - III	AVIONICS HARDWARE	9
Autopilot –AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing.		

UNIT - IV	COMMUNICATION PAYLOADS AND CONTROLS	9
Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting		

UNIT - V	DEVELOPMENT OF UAV SYSTEMS	9
Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing-Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.		
		Total Instructional Hours : 45

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Course Outcomes : Students will be able to	
CO1	Acquire knowledge on the importance of UAVs with respect to their applications.
CO2	Identify and distinguish between various subsystems and configurations of UAV.
CO3	Perform ground test and troubleshooting with respect to UAV operation
CO4	Distinguish between needs of mini and micro UAVs.
CO5	Gain insights with design standards and regulatory aspects of UAVs.

Text Books	
1.	Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998.
2.	Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

Reference Books	
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.
3.	Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

Programme Coordinator	BoS Chairman

B.E.	B23AEE947 – CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

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

UNIT - I	INTRODUCTION	9
Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.		

UNIT - II	OPEN AND CLOSED LOOP SYSTEMS	9
Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.		

UNIT - III	CHARACTERISTIC EQUATION AND FUNCTIONS	9
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.		

UNIT - IV	CONCEPT OF STABILITY	9
Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.		

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UNIT - V	SAMPLED DATA SYSTEMS	9
Z - Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers.		
		Total Instructional Hours : 45

Course Outcomes : Students will be able to	
CO1	Apply mathematical knowledge for Mechanical, Electrical component analogies-based problems.
CO2	Solve the block diagram representation of control systems, reduction of block diagram signal flow graph-based problems.
CO3	Analyze the stability of time and frequency.
CO4	Choose different graphical method for calculating frequency.
CO5	Classify the different control system, digital controllers and digital PID controllers.

Text Books	
1.	Azzo, J.J.D. and C.H. Houpis. "Feedback control system analysis and synthesis", McGraw-Hill International 3rd Edition, 1998.
2.	OGATO,. "Modern Control Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.

Reference Books	
1.	Houpis, C.H. and Lamont, G.B. "Digital control Systems", McGraw Hill Book Co., New York, U.S.A. 1995.
2.	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.

Programme Coordinator

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B.E.	B23AEE948 – AERODYNAMICS OF DRONES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce students to the basic concepts of payloads in UAV
2.	To understand the various sensor system of an UAV.
3.	To introduce with 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 - I	PAYLOAD FOR UAV	9
Introduction – Types – Non-dispensable Payloads - Electro-optic Payload Systems - Electro-optic Systems Integration - Radar Imaging Payloads - Other Non-dispensable Payloads - Dispensable Payloads - Payload Development		

UNIT - II	SENSOR	9
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		

UNIT - III	DATA FUSION ALGORITHMS AND ARCHITECTURES	9
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		

UNIT - IV	ARTIFICIAL NEURAL NETWORKS	9
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		

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UNIT - V	FUZZY LOGIC AND FUZZY NEURAL NETWORKS	9
Conditions under which fuzzy logic provides an appropriate solution - Illustration of fuzzy logic in an automobile antilock braking system - Basic elements of a fuzzy system - Fuzzy logic processing - Fuzzy centroid calculation.		
		Total Instructional Hours : 45

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

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

Reference Books	
1.	Lawrence A. Klein, “Sensor and Data Fusion: A Tool for Information Assessment and Decision Making”, Second Edition, SPIE Press, 2013
2.	Jitendra R. Raol, “Multi-Sensor Data Fusion with MATLAB”, CRC Press, 2010.

Programme Coordinator

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OPEN ELECTIVE

Open Elective - I

B.E.	B23AEO501- PRINCIPLES OF FLIGHT (Common to all Except AERO)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the different component systems and functions.
2.	To understand the basic properties and principles behind the flight.
3.	To study the basic concepts of Aerodynamics.
4.	To study the different structures & construction.
5.	To study the various types of power plants used in aircrafts.

UNIT - I	AIRCRAFT CONFIGURATIONS	9

Brief History-Components of an airplane and their functions. Different types of flight vehicles, classifications. Basic instruments for flying.

UNIT - II	INTRODUCTION TO PRINCIPLES OF FLIGHT	9

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Different types of drag.

UNIT - III	INTRODUCTION TO AERODYNAMICS	9

Aerodynamic forces on aircraft – classification of NACA aerofoils, aspect ratio, wing loading, Mach number, centre of pressure and aerodynamic centre-aerofoil characteristics lift, drag curves.

UNIT - IV	INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS	9

General types of construction, Monocoque, semi-monocoque. Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

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UNIT - V	POWER PLANTS USED IN AIRPLANES	9
Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production., Principles of operation of rocket, types of rockets		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the types and classification of components and control system.
CO2	Identify the properties and principles to analyze lift, drag (including types), moment, and their variation with altitude.
CO3	Identify the aerodynamics forces and NACA Airfoils.
CO4	Identify different type of fuselage and constructions.
CO5	Categorize the different types of engines and principles of rocket.

Text Books	
1.	Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition, 2015
2.	E Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021

Reference Books	
1.	Kermode, A.C., “Flight without Formulae”, McGraw-Hill, 1997.
2.	Sadhu Singh, “Internal Combustion Engines and Gas Turbine”, SS Kataraia & Sons, 2015.
3.	Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

Programme Coordinator

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B.Tech.	B23AGO501 - Farm Automation	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals and scope of farm automation systems.
2.	To study various types of sensors and their role in smart farming.
3.	To analyze the working of automation systems in field operations.
4.	To explore greenhouse automation and resource management.
5.	To examine the role of advanced technologies like AI, drones, and robotics in agriculture.

UNIT I	INTRODUCTION TO FARM AUTOMATION	9
Definition and scope – Historical development – Classification of automation systems: manual, semi-automated and fully automated – Benefits of automation – Limitations and challenges – Status of automation in Indian agriculture – Automation in small and large farms – Farm automation value chain – Socio-economic implications.		

UNIT II	SENSORS AND SMART FARMING COMPONENTS	9
Types of sensors: soil moisture, pH, temperature, humidity, light, nutrient sensors – Actuators – Microcontrollers and microprocessors (Arduino, Raspberry Pi) – IoT architecture for agriculture – Wireless sensor networks – Communication protocols – Data acquisition and cloud connectivity – Mobile apps and remote monitoring systems.		

UNIT III	AUTOMATION IN FIELD OPERATIONS	9
Automatic steering and GPS-guided tractors – Variable Rate Technology (VRT) – Autonomous planters and seeders – Spraying automation – Robotic weeders – Harvesting automation – Drones for crop health monitoring – Field mapping – Automation kits – Safety aspects in field automation.		

UNIT IV	GREENHOUSE AND RESOURCE MANAGEMENT AUTOMATION	9
Greenhouse control systems: Temperature, humidity, light, CO_2 , irrigation and nutrient management – Automation of fertigation and irrigation (drip, sprinkler) – Scheduling using weather data – Software tools and apps for DSS – Renewable energy-based automation – Case studies of protected cultivation systems.		

UNIT V	ADVANCED TECHNOLOGIES IN AUTOMATION	9
Artificial Intelligence (AI) and Machine Learning (ML) in farming decisions – Robotics in seeding, pruning, sorting and packaging – Machine vision systems – Drones and UAVs in agriculture – Automation for post-harvest management – Success stories from India and abroad – Future prospects and trends.		
		Total Instructional Hours: 45

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COURSE OUTCOMES: Students will be able to	
CO1	Explain the concept and scope of farm automation.
CO2	Identify and interpret various sensors and smart devices in agriculture.
CO3	Apply automation techniques in field operations.
CO4	Demonstrate the application of automation in greenhouse and resource management.
CO5	Evaluate advanced automation technologies and their integration into smart farming systems.

Text Books	
1.	Nageshwar Rao, *Precision Farming and Agricultural Automation*, Kalyani Publishers, 2020.
2.	Manjunatha K.S., *Farm Machinery and Automation*, Jain Brothers, New Delhi, 2018.
3.	Rajvir Yadav, *Agricultural Automation*, Biotech Books, New Delhi, 2021.

References	
1.	CIGR Handbook of Agricultural Engineering Volume VI – Information Technology, ASABE, USA.
2.	Mehta M.L., Verma S.R., and Sharma V.K., *Farm Machinery and Power Engineering*, Jain Brothers.
3.	Internet of Things: https://nptel.ac.in/courses/106105166
4.	Articles and Case Studies from ICAR, IARI, and SmartFarm India

Approved by BoS Chairman

B.E/ B.TECH	B23ADO501– GEN AI WITH OPEN SOURCE FRAMEWORK	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To Understand the Core Concepts of Artificial Intelligence
2.	To explain the Fundamentals of Generative AI and Its Architectures
3.	To Outline Open-Source GenAI Tools and Frameworks
4.	To identify the Prompt Engineering Techniques and Build Chatbots
5.	To study the Real-World Applications of Generative AI in Open-Source Domains

UNIT-I	BASICS OF AI	9

Introduction to AI - Future of AI – Applications of AI – History of AI- Types of AI- Intelligent Agent: Types of Agents- Characteristics of Intelligent Agents - Structure of Agents – Agents and Environments- Examples of AI.

UNIT-II	GEN AI MODELS	9

Introduction of Gen Ai- Sub Sets of Gen Ai- Model Creation - Types of Generative Ai transformer Based Architecture -LLM- GAN architecture - Training GANs and challenges) - Variants of GANs- VAE : Encoder, Decoder, and Latent space- Applications of VAEs

UNIT-III	OPEN SOURCE GEN AI	9

Gen AI in open source - Benefits of Open source AI -Open source tools for generative AI - Deep learning frameworks for generative AI- Advantages and Disadvantages of these frameworks

UNIT-IV	PROMPT ENGINEERING & CHATBOT DEVELOPMENT	9

Basics of Prompt Engineering- Few-shot - Zero-shot prompting - Prompt tuning vs Fine-tuning - Building a chatbot using: Lang Chain -RAG (Retrieval-Augmented Generation)

UNIT-V	USE CASES OF GEN AI IN OPEN SOURCE	9

Open-Source Generative AI Models-generative ai use cases in open source- visual content- audio generation- Text generation- Manufacturing- Supply chain and logistics- Retail & e-commerce- Automotive.

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	Total Instructional hours: 45

Course Outcomes: Students will be able to	
CO1	Explain Intelligent agents, and their interaction with environments.
CO2	Identify the structure and working principles of various Generative AI models
CO3	Apply open-source tools, frameworks, and platforms
CO4	Discover prompt engineering techniques
CO5	Examine use cases of Generative AI across various domains
TextBooks	
1.	Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson, 2021.
2.	Goodfellow I, Bengio Y and Courville, "A Deep Learning", MIT Press. Foster, D, 2022
Reference Books	
1.	Chollet, F. "Deep Learning with Python", Manning Publications, 2018
2.	Martin Musiol, "Generative Ai: Navigating the Course to the Artificial General Intelligence Future", John Wiley Sons, 2024

Approved By BoS Chairman

B.E / B.Tech	B23AMO501 – PRINCIPLES OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of Machine Learning.
2.	To study the Supervised Learning with Classifications.
3.	To analyse Random Forest methods and Backpropagation.
4.	To identify the Clustering Techniques for Data Analysis.
5.	To infer the applications of Machine Learning and Dimensionality Analysis.

UNIT - I	INTRODUCTION	9

Introduction to Machine Learning – Need of Machine Learning – Machine Learning Applications – Types of Machine Learning Systems – Challenges – Machine Learning Process – Data Collection – Exploration – Preparation – Training – Optimization – Performance Measures.

UNIT - II	SUPERVISED LEARNING	9

Classification and Regression Technique – Linear Regression – Polynomial Regression – Logistic Regression – Generalization – Overfitting – Underfitting – Support Vector Machine – Kernels – KNN – Naïve Bayes Classifiers – Decision Tree.

UNIT - III	ENSEMBLE LEARNING TECHNIQUES	9

Random Forest – Ensemble Learning – Bagging – Boosting – Ada Boost – Gradient Boosting – Neural Networks – ANN Perceptron – MLP's and Backpropagation – Hyperparameter Optimization – Dimensionality Reduction.

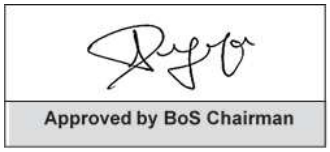
UNIT - IV	UNSUPERVISED LEARNING	9

Clustering – Techniques – K-Means Clustering – AGNES – DIANA – Density Based Clustering (DBSCAN) – Grid Based Clustering – Gaussian Mixtures – Clustering High Dimensionality Data – Outlier Analysis.

UNIT - V	APPLICATIONS OF ENSEMBLE LEARNING	9

Dimensionality Reduction Applications – Factor Analysis – Model Selection & Evaluation – Visualization of Results – Applications of ML : Medical Science, Fraud Detection, Traffic Prediction, Personal Assist, Stock Prediction.

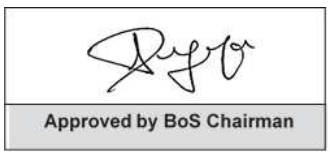
Total Instructional hours: 45



Text Books	
1.	Muller, Andreas C., and Sarah Guido. "Introduction to Machine Learning with Python : A Guide for Data Scientists." 3rd Edition, "O'Reilly Media, Inc.", 2016.
2.	Geron, Aurelien. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow : Concepts, Tools, and Techniques to build intelligent systems. 1st Edition, "O'Reilly Media, Inc.",

Reference Books	
1.	Himanshu Singh, Yunis Ahmed Lone, Deep Neuro-Fuzzy Systems with Python : With Case Studies and Applications from the Industry, 3rd Edition, 2019.
2	Leonardo De Marchi, Hands-On Neural Networks : Learn how to Build and Train Your First Neural Network Model using Python Book, 1st Edition, 2019.
3	James Loy, Neural Network Projects with Python : The Ultimate Guide to using Python to explore the true power of neural networks through six projects. 1st Edition, Kindle Edition,

Course Outcomes : Students will be able to	
CO1	Recall the basics of Machine Learning
CO2	Illustrate the Classification and Regressions
CO3	Identify the Concepts of Neural Networks and Ensemble Learning
CO4	Analyze the features of unsupervised Learning
CO5	Explain the applications of Machine Learning



B.E / B.Tech	BM23BMO501- PRINCIPLES OF BIOSENSORS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the basic structural ,functional elements, the gaseous exchange and fluid maintenance of the human body.
2.	To learn the organs and structures involved in system formation and functions.
3.	To understand the functions of physiological system
4.	To Know the activity of sensory and motor nerves
5.	To analyse Different Physiological Conditions in the Human Body.

UNIT - I	INTRODUCTION TO BIOSENSOR	9
Biosensors- Advantages and limitations, various components of biosensors, Classification of Biosensors Based on Type of Transduction - Electrochemical, Optical, Acoustic, Calorimetric. Classification of Biosensors Based on Biological Element - Enzyme Sensor, Immunosensors, Cell-based Sensors		

UNIT - II	DESIGN OF BIOSENSOR	9
Introduction, Assay format, Immobilisation-Ligand Activity, Regeneration, Analysis of regeneration data, Signal correction, Buffer scouting, Extracting kinetic affinity constant, Extracting kinetic rate constant, Sensor Surfaces and Receptor Depth, Molecular Interaction.		

UNIT - III	OPTICAL AND BIOCHEMICAL BIOSENSORS	9
Principles of Optical biosensing, Immobilization of bio-recognition elements, Types of optical biosensor: Fiber optic, planar waveguide, Evanescent, Interferometric, and Surface plasmon resonance-biosensor-Applications. Chemical and other sensors - Biocatalysis based biosensors, Bio affinity based biosensors & Microorganisms based biosensors, Biologically active material and analyte. Types of membranes used		

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in biosensor constructions.

UNIT - IV	IMMUNOSENSOR	9
introduction to Immuno biosensor- Enzyme Biosensor, Bio Affinity Biosensor, Labelled Immuno sensors, Non-Labelled Immuno sensors. Transducer Aspects of Immuno sensor Optical Immunosensor, Piezoelectric Crystal Immunosensors, Electrochemical Immunosensors. Biological Aspects of biosensor- Antibody Development, Immunosensor based Assay Development.		
UNIT - V	**DIAGNOSTIC APPLICATION OF BIOSENSOR**	**9**
Preparation of Doped Sol-Gel Glasses, Application of Sol-Gel Glasses in Biosensors- Glucose Biosensor, Urea Biosensor, Cholesterol Biosensor, Lactate Biosensor. Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in healthcare.		
Total Instructional hours : 45		

Course Outcomes: Students will be able to	
CO1	Apply principles and concepts of biology and engineering to design biosensors.
CO2	Apply principles and concepts of electronics and electrochemistry to design electrochemical biosensors.
CO3	Recognize different types of transducers, and their application in biosensor design.
CO4	Apply principles and concepts of sensing and engineering to design biosensors for detection of markers in biofluids.
CO5	Apply engineering tools to evaluate parameters needed for point-of-care devices.

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Text book	
1.	Bansi D Malhotra, Anthony, Advances in Biosensors, Volume 5, 2003, Elsevier, Oxford.
2.	Brian R Eggins - Biosensors an Introduction, First edition, John Wiley & Sons Publishers, 1996
3.	Loic J Blum, Pierre R Coulet - Biosensors Principles and Applications, First edition, Marcel Dekker,Inc, 1991.
4.	Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing. Co, Inc, 1993.

Reference Books	
1.	Elizabeth A Hall - Biosensors, First Edition, Open University, Milton Keynes, 1990.
2.	Graham Ramsay - Commercial Biosensors, First edition, John Wiley & Sons, Inc. 1998.
3.	Tran Minh Canh - Sensor Physics & Technology – Biosensors, First Edition, Champan & Hall, 1993.
4.	Mathew A.Cooper, Label free Biosensors Techniques and Applications, Cambridge, 2009.

Program Coordinator

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B. TECH.	B23BTO501 – BIOFERTILIZER PRODUCTION AND MUSHROOM CULTIVATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide a comprehensive understanding of the principles and practices of biofertilizer production and mushroom cultivation.
2.	To equip students with knowledge of microbial inoculants and their applications in sustainable agriculture.
3.	To explore the cultivation techniques and nutritional aspects of various edible mushrooms.
4.	To enable students to understand industrial mushroom processing, value addition, and quality control, including nutraceuticals and waste management.
5.	To familiarize students with the quality control and commercial aspects of biofertilizers and mushroom production.

UNIT - I	INTRODUCTION TO BIOFERTILIZERS AND MICROBIAL INOCULANTS	9

Introduction to biofertilizers: Significance and scope. Types of biofertilizers: Nitrogen-fixing, phosphate-solubilizing, potassium-mobilizing, and mycorrhizal biofertilizers. Microbial inoculants: *Rhizobium, Azotobacter, Azospirillum, Pseudomonas, Bacillus, Trichoderma*, and mycorrhizal fungi. Mechanisms of action of biofertilizers: Nitrogen fixation, phosphate solubilization, plant growth promotion. Carrier materials and their properties. Quality control of biofertilizers: Viability, purity, and efficacy testing.

UNIT - II	PRODUCTION TECHNOLOGY OF BIOFERTILIZERS	9

Isolation and characterization of effective microbial strains. Fermentation technology for biofertilizer production: Batch, fed-batch, and continuous fermentation. Scale-up and optimization of biofertilizer production. Formulation and packaging of biofertilizers. Storage and shelf-life of biofertilizers. Quality standards and FCO.

UNIT - III	MUSHROOM CULTIVATION: PRINCIPLES AND PRACTICES	9

Introduction to edible mushrooms: Nutritional and medicinal value. Cultivation techniques for various mushrooms: Oyster, button, shiitake, and milky mushrooms. Substrate preparation and sterilization. Spawn production and inoculation. Environmental control in mushroom cultivation: Temperature, humidity, and ventilation. Pest and disease management in mushroom cultivation.

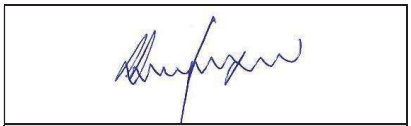
UNIT - IV	MUSHROOM PROCESSING AND VALUE ADDITION	9

Post-harvest handling and preservation of mushrooms. Processing of mushrooms: Drying, canning, and pickling. Value-added products from mushrooms: Mushroom powder, extracts, and nutraceuticals. Mushroom waste utilization. Quality assessment of mushrooms: Sensory, chemical, and microbiological analysis.

UNIT - V	COMMERCIAL ASPECTS AND ENTREPRENEURSHIP	9

Market potential and demand for biofertilizers and mushrooms. Economic analysis of biofertilizer and mushroom production. Entrepreneurial opportunities in biofertilizer and mushroom industries. Marketing and distribution strategies. Intellectual property rights (IPR) and patenting. Government schemes and subsidies.

Total Instructional hours : 45



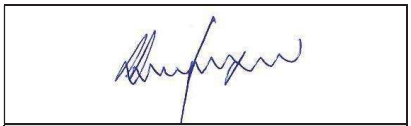
Approved by BoS Chairman

Course Outcomes After the successful completion of the course, the students will be able to,		Knowledge Level
CO1	Illustrate the principles of microbial inoculant production and application.	K2
CO2	Classify the different types of biofertilizers and their impact on soil fertility.	K2
CO3	Explain the cultivation techniques and nutritional value of various edible mushrooms.	K2
CO4	Demonstrate the quality and safety parameters of biofertilizers and mushroom products.	K2
CO5	Identify the commercial aspects and entrepreneurial opportunities in biofertilizer and mushroom industries.	K3

Text Books	
1.	Subba Rao N.S., "Soil Microbiology", Oxford & IBH Publishing Company, New Delhi, 2002.
2.	Himadri Panda H., "Manufacture of Biofertilizer and Organic Farming", Asia Pacific Business Press Inc., 2024.
3.	Tewari R.P., "Mushrooms: Cultivation, Marketing and Consumption", Daya Publishing House, Delhi, 2005.
4.	Chang S.T., Miles P.G., "Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact", CRC Press, Boca Raton, 2004.

References Books	
1.	Alexander M., "Introduction to Soil Microbiology", John Wiley & Sons, New York, 1977.
2.	Stamets P., "Mycelium Running: How Mushrooms Can Help Save the World", Ten Speed Press, Berkeley, 2005.

CO-PO-PSO Mapping														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	2	-	-	2	3	3
CO2	2	1	-	-	-	-	-	2	2	-	-	2	3	3
CO3	2	2	-	-	-	-	-	2	2	-	-	2	3	3
CO4	2	2	-	-	-	-	-	2	2	-	-	2	3	3
CO5	2	2	-	-	-	-	-	2	2	-	-	2	3	3
Wt. Avg.	2	2	-	-	-	-	-	2	2	-	-	2	3	3



Approved by BoS Chairman

B.E.	B23CSO501- FOUNDATIONS OF DBMS (Except CSE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn the fundamentals of data models, relational algebra and SQL.
2.	To represent a database system using ER diagrams and to learn normalization techniques.
3.	To understand the concepts of transaction, concurrency and recovery processing.
4.	To understand the internal storage structures using different file and indexing techniques
5.	To have basic knowledge about the Distributed databases, NOSQL and DB security

UNIT - I	RELATIONAL DATABASES	9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT - II	DATABASE DESIGN	9

Entity-Relationship model – ER Diagrams – Enhanced-ER Model – ER to Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT - III	TRANSACTIONS	9

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm.

UNIT - IV	IMPLEMENTATION TECHNIQUES	9

RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics - Cost Estimation.

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UNIT - V	ADVANCED TOPICS	9
Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges.		
Total Instructional hours: 45		

Course Outcomes: Students will be able to	
CO1	Construct basic SQL Queries using relational algebra
CO2	Build database using ER model and normalize the database
CO3	Organize transaction-related queries while ensuring consistency and concurrency control
CO4	Evaluate various indexing and file organization strategies to optimize query performance
CO5	Analyze relational DB and NoSQL DB

Text Books	
1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2020.
2.	Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2017.

Reference Books	
1.	C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

Approved by BoS Chairman

CO Mapping with PO & PSO

CO/PO & PSO		PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K6)	PO6 (K3) (A3)	PO7 (K2) (A3)	PO8 (K3) (A3)	PO9 (A3)	PO10 (A3)	PO11 (K3) (A3)	PO12 (A3)	PSO1 (K4) (A3)	PSO2 (K3) (A3)
CO1	K3														
CO2	K3														
CO3	K3														
CO4	K5														
CO5	K4														
Weighted Average															

3 – Substantial **2- Moderate** **1- Low** **'-' – No Correlation**

Approved by BoS Chairman

B.E / B. TECH	B23ECO501 COMMUNICATION ENGINEERING (Common to All Except ECE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of modulation techniques in generation of amplitude modulation and angle modulation.
2.	To impart knowledge in random process
3.	To familiarize students' optimum receivers for binary digital modulation schemes
4.	To examine digital modulation formats and their power spectral
5.	To understand the properties of spread spectrum techniques to design robust and efficient communication systems

UNIT – I FUNDAMENTALS OF ANALOG COMMUNICATION	9
Basics of communication systems; Fundamentals of Principles of amplitude modulation; AM envelope; frequency spectrum and bandwidth; modulation index and percent modulation; AM Voltage distribution; AM power distribution; Angle modulation; FM and PM waveforms; phase deviation and modulation index; frequency deviation and percent modulation; Frequency analysis of angle modulated waves; Bandwidth requirements for Angle modulated wave.	

UNIT–II RANDOM PROCESS AND SAMPLING	9
Review of probability and random process; Gaussian and white noise characteristics; Noise in amplitude modulation systems; Noise in Frequency modulation systems; Pre-emphasis and Deemphasis; Threshold effect in angle modulation; Low pass sampling; Aliasing; Signal Reconstruction; Quantization; Uniform & non-uniform quantization; quantization noise; Nyquist criterion; Logarithmic Companding; PAM; PPM; PWM; PCM; TDM; FDM.	

UNIT – III DIGITAL TRANSMISSION	9
Optimum Receiver for Binary Digital Modulation Schemes; Description of Binary ASK; PSK; and FSK Schemes; Binary PSK Signaling Schemes; M-ary Signaling Schemes; Synchronization Methods.	

UNIT – IV DIGITAL MODULATION TECHNIQUES	9
Digital modulation formats; Coherent Binary Modulation Techniques: BFSK and BPSK; QPSK; MSK; M-ary QAM; Power spectra of BFSK; BPSK; QPSK and MSK.	
UNIT – V SPREAD SPECTRUM AND MULTIPLE ACCESS	**9**

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PN sequences: properties; m-sequence; DSSS; Processing gain; Jamming; FHSS; Synchronization and tracking; Multiple Access: FDMA; TDMA; CDMA.
Total Instructional hours:45

Course Outcomes: Students will be able to	
CO1	Apply principles of basic communication systems to design basic modulation schemes for efficient signal transmission.
CO2	Apply probability and random process principles to analyze noise in communication systems
CO3	Apply knowledge to design and assess optimum receivers for binary digital modulation schemes like ASK, PSK, FSK, and M-ary systems.
CO4	Analyze and differentiate between digital modulation formats and their power spectral.
CO5	Apply and evaluate concepts of PN sequences, DSSS, FHSS, and multiple access techniques

Text Books	
1.	K Sam Shanmugam, Digital and Analog Communication Systems, Wiley, 2019.
2.	Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2018.
3.	Simon Haykin, "Communication Systems", Wiley India, 4th edition, 2014.

Reference Books	
1.	H.Taub, D L Schilling and G Saha, "Principles of Communication", 4th Edition, Pearson Education, 2017.
2.	B.P.Lathi, Zhi Ding, Hari Mohan Gupta "Modern Analog and Digital Communication Systems", 4th Edition, Oxford University Press, 2017.
3.	Sanjay Sharma, "Communication Systems (Analog and Digital)", S.K. Kataria & Sons; Reprint 2013.
4.	B.Sklar, "Digital communications: Fundamentals and Applications", 2nd Edition, Pearson Education, 2012.

Evaluation Pattern:				
Continuous Internal Assessment				**End Semester Examinations**
CIA I (Theory) (100 Marks)		CIA II (Theory) (100 Marks)		
* Alternate Assessment Tool (AAT)	Written Test	* Alternate Assessment Tool (AAT)	Written Test	Theory End Semester Examinations (Examinations will be conducted for 100 Marks)
40 Marks	60 Marks	40 Marks	60 Marks	
40 Marks				60 Marks
Total: 100 Marks				

* AAT - Individual Assignment/ Case Study/ Seminar/ Mini project/ MCQ/ Role Play/ Group Discussion/ Debates/ Oral Presentations/ Poster Presentations/ Technical Presentations can also be provided course coordinator can choose any one/two components based on the nature of the course.

Approved by BOS Chairman

B.E	B23EEO501- ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of electric vehicle history and components.
2.	To understand properties of batteries.
3.	To understand the electrical machine properties and classifications.
4.	To understand the properties of electric vehicle drive systems.
5.	To understand the concepts of hybrid electric vehicles.

UNIT-I	INTRODUCTION TO ELECTRIC VEHICLES	9

Present scenario of electric vehicles, Need of electric vehicles, economics, environmental impacts of using electric vehicles, challenges faced by electric vehicles in replacing ICE, major requirements of electric vehicles.

UNIT-II	TYPES OF ELECTRIC VEHICLES AND THE CHALLENGES	9

Types of electric vehicles: Plug-in Electric Vehicle (PEV), Battery Electric vehicle (BEV), Fuel Cell electric vehicle (FCEV), Hybrid electric vehicle (HEV), Challenges of battery electric vehicle, hybrid electric vehicle and fuel cell electric vehicle.

UNIT-III	BATTERY ELECTRIC VEHICLE	9

Components of BEV drive train: electric propulsion subsystem - power converter, driving wheels, suspension system, driveshaft, mechanical transmission, electric Motor, power electronics converters (DC-AC/DC-DC), electronic control unit, energy source subsystem, battery pack with battery management system, On board charger, auxiliary subsystem, power steering unit, common parts between ICE drive train and EV drive train.

UNIT-IV	HYBRID AND FUEL CELL ELECTRIC VEHICLE	9

Basic architecture of hybrid drive trains, components of HEV drive train system, classification of HEV: conventional HEV (Micro, Mild and Full hybrid- series hybrid, parallel hybrid, series-parallel hybrid, complex hybrid), Basic architecture of FCEV, components of FCEV drive train system.

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UNIT-V	ENERGY STORAGE	9
Battery-based energy storage, Overview of batteries, Battery parameters, battery charging, regenerative braking, alternative novel energy sources: solar photovoltaic cells, fuel cells, super capacitors, and flywheels.		
		Total Instructional hours:45

Course Outcomes: **Students will be able to**	
CO1	Illustrate the basics of electric vehicle history and components.
CO2	Classify the different types of electric vehicles.
CO3	Apply the battery properties in an electric vehicle.
CO4	Develop the hybrid and fuel cell electric vehicle.
CO5	Illustrate the concept of energy storage devices.

Text Books	
1.	Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018.
2.	Electric & Hybrid Vehicles – Design Fundamentals – Iqbal Hussain, Second Edition, CRC Press, 2011.
3.	Electric Vehicle Battery Systems – Sandeep Dhameja, Newnes, 2000.
4.	Husain, I. (2021). Electric and Hybrid Vehicles: Design Fundamentals (3rd Edition). CRC Press.

Reference Books	
1.	Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003
2.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals – Mehrdad Ehsani,Yimin Gao, Ali Emadi, CRC Press, 2010.
3.	Chan, C. C., & Chau, K. T. (2001). Modern Electric Vehicle Technology. Oxford University Press.
4.	Larminie, J., & Lowry, J. (2023). Electric Vehicle Technology Explained (3rd Edition). Wiley.

Approved by BoS Chairman

B.E.	B23MEO501 - ROBOTICS	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of the basic components of a robot
2.	To apply the distinct drive systems and end effectors to control the robot actuation
3.	To study the role and application of various types of sensors and machine vision system
4.	To make use of the knowledge in the robot kinematics and to write Robot Programs
5.	To identify the social and economic challenges while implementing the robot systems

UNIT - I	FUNDAMENTALS OF ROBOT	9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Robot Parts and their Functions- Different Applications - A view on Global and Indian manufacturers of Robots - Need for Robots in Indian environment.

UNIT - II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Drives - hydraulic, pneumatic, mechanical, electrical, Servo motors, Stepper motors - salient features, application; End effectors – types; Grippers - mechanical, pneumatic, hydraulic, magnetic, vacuum - limitations, Multiple grippers.

UNIT - III	SENSORS AND MACHINE VISION	9

Requirements of sensors, principles, types and applications of Proximity (Inductive, Hall effect, Capacitive, Ultrasonic and Optical); – Range (Triangulation, Structured light approach); Speed, Position (resolvers, optical encoders); – Force – Torque – Touch sensors (binary, analog sensor). Introduction to Machine Vision; applications, functions; image processing and analysis; training the vision system.

UNIT - IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9

Forward kinematics and Reverse kinematics of manipulators; two, three degrees of freedom, homogeneous transformation matrix; introduction to manipulator dynamics, trajectory generator, manipulator mechanism, Degeneracy and Dexterity; Lead through programming, Robot programming languages; VAL programming, motion commands, sensor commands, end effecter commands, simple programs (for loading, unloading and palletizing operations), introduction to advances in Robot Programming.

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UNIT - V	APPLICATION, IMPLEMENTATION AND ROBOT ECONOMICS	9
Robot cell design; types, application of robots in processing, assembly, inspection, material handling in automobile, medical, Nuclear Industries, RGV, AGV; Implementation of Robots in Industries; Safety considerations for robot operations, safety codes, Economic analysis of robots.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the concepts of industrial robots, classification, specifications and coordinate systems.
CO2	Illustrate the different types of robot drive systems as well as robot end effectors.
CO3	Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4	Develop robotic programs for different operations and familiarize with the kinematics motions of robot.
CO5	Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

Text Books	
1.	Groover M.P., “Industrial Robotics - Technology Programming and Applications”, McGraw Hill, 2012.
2.	Deb S R and Deb S, Robotics Technology and Flexible Automation, Tata McGraw Hill Education Pvt. Ltd, 2010.
3.	Saha S K, Introduction to Robotics, Tata McGraw Hill Education Pvt. Ltd, 2010, 2nd Ed, 2014.

Reference Books	
1.	Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, Global Edition, 3rd Edition, 2014.
2.	Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
3.	Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis, Oxford University Press, Sixth impression, 2010.

Approved by BoS Chairman

B.E / B.TECH	B23CBO501 FRONT END DEVELOPMENT	T	P	TU	C
		3	0	1	3

Course Objectives	
1.	To interpret the basics of front end development and modern development tools.
2.	To device a front end design with HTML Tags.
3.	To work with HTML Forms and Implement Layouts Using Frames and iFrames
4.	To design a dynamic webpage using CSS.
5.	To articulate client side activities on a web site using Javascript.

UNIT- I INTRODUCTION TO FRONT END DEVELOPMENT	9
Introduction to web - WWW - Web server and client, URL, URI,URN-Internet addresses and IP classes Web protocols -TCP/IP,UDP, MIME.SMTP,POP3,HTTP & HTTPS-MVC-Model, View, Controller of Web design-Role of front end developer and Modern Front end Tools.	

UNIT-II HTML (HYPERTEXT MARKUP LANGUAGE)	9
Introduction to HT ML - HTML s HTML5 - Basic HTML Structure - HTML Elements, Attributes and properties - Formatting tags - Lists & symbols -Ordered Lists -Unordered Lists- Descriptive Lists - Hyperlinks- Multimedia: Images, Audio, Video tags	

UNIT- III HTML TABLES & FORMS	9
HTML table :Table border, row, column header, rowspan & colspan, cell spacing and cell padding HTML forms: Form elements- Text, Textarea, Password field, Label-Checkbox, Radio Button. Selection List - Button -Frames & iFrames	

UNIT- IV CSS (Cascading style sheets)	9
Introduction to style sheets: Cascading style sheets-CSS properties - CSS selectors - Pseudo classes and elements - Types of CSS: Inline, Embedded, External style sheet-Case study Talwind CSS	

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UNIT- V CLIENT SIDE SCRIPTING	9
Introduction to Javascript, Javascript features -Datatypes, Variables , Literals & Operators – Control structures -Arrays - Predefine functions & User defined functions – Javascript - DOM objects - Case study- npm, NodeJs.	
Total Instructional hours: 45	

Course Outcomes: Students will be able to	
CO1	**Interpret the working of web sites, web servers and modern front-end**
CO2	Build web pages of a website with HTML
CO3	Develop web site for process and Implement Layouts Using Frames and
CO4	Construct dynamic styles using CSS.
CO5	Build client side activities with Javascript.

Text Books:

1.Uttam K.Roy,"Web Technologies" by, Oxford University Press 2010, First edition, eight impression 2014.

Reference Books :

1.Thomas Powell , "HTML& css: The Complete Reference", Fifth Edition Paperback - 1, Tata McGrawHill, July 2017.

2.. Laurence Lars Svekis , Maaike Van Putten , Rob Percival ," JavaScript from Beginner to Professional: Leam JavaScript quickly by building fun, interactive, and dynamic web apps. games, and pages", Packt, December 2021.

Approved by BoS Chairman

Open Elective - II

B.E.	B23AEO601 – UNMANNED AIRCRAFT SYSTEMS OPERATION AND MRO (Common to all Except AERO)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the working principles of aircraft engine and fuel systems.
2.	To understand the lighting technologies and pressurization system of the aircraft cabin.
3.	To realize the warning and protection systems of the aircraft.
4.	To expose on terrain warning systems of the safety of the aircraft.
5.	To gain knowledge on FDR and anti-fire protection system.

UNIT - I	DRONE RULES & BASIC PRINCIPLES OF FLIGHT	9

International Rules- Regulations, Standards & Practices, Dos and Do not, Civil Aviation Requirements- AIPs, NOTAM, Classification & Categorization of drones, Type Certification of Drones, Registration, Sale & De-Registration of Drones, Operations of Drones, Dos and Donts, Remote Pilot Licensing, Drone Insurance Fundamentals of flight, Aerodynamics, Take-off, flight, and landing. Maneuvers, turns and circuit pattern.

UNIT - II	ATC PROCEDURES & RADIO TELEPHONY (NON FRTOL) WEATHER AND METEOROLOGY	9

Understanding ATC operations, Airspace structure and Airspace, Restrictions with knowledge of no drone zones, RT Phraseology & Communicating with ATC including Position and Altitude Reporting. Flight Planning Procedures including Altimeter setting procedures. Collision avoidance. Radio Telephony (RT) techniques, The standard atmosphere, Measuring air pressure, Heat and temperature, Wind. Moisture, cloud formation, icing and its effects. Effect of atmosphere on RPAS operation & hazardous weather avoidance, Met Terminal Aviation Routine Weather Report (METAR).

UNIT - III	FIXED-WING & ROTORCRAFT OPERATIONS AND AERODYNAMICS	9

Types of fixed wing drones, make, parts, terminology, Operation and maneuvers of fixed wing drones, Flight Performance. Intro to Mission Planning, Instrument Flying & Navigation (GCS). Applications of fixed-wing UAVs. Pros and Cons of Fixed Wing Drones Rotorcraft- Basic drone terminology & parts,

Programme Coordinator

BoS Chairman

Types of drones, material used and size of drones, Drone Anatomy: Different parts of drones, Avionics & C2 Link, Intro to Mission Planning, Instrument Flying & Navigation (GCS). Applications and operations of Multirotor, Flight Performance. Pros and Cons of Rotorcraft Drones.

UNIT - IV	HYBRID OPERATIONS, AERODYNAMICS & EQUIPMENT MAINTENANCE	9
Principles of Aerodynamics, Types of Hybrid Drones & Parts, Intro to Mission Planning, Instrument Flying & Navigation (GCS), Applications of Hybrid UAVs, Comparison with Rotorcraft & Aeroplane Drone Equipment Maintenance- Maintenance of drone, flight control box, ground station, Maintenance of ground equipment, batteries and payloads, Scheduled servicing, Repair of equipment, Fault finding and rectification.		

UNIT - V	SAFETY MANAGEMENT, PAYLOAD, & DATA & ANALYSIS	9
Drothe Emergency & Handling, Loss of C2-link, Fly-aways (Straying), Loss of power, Other Emergencies, Control surface failures, Human Performance & Pilot Incapacitation, Fail-Safe Features, Types of payloads - What to carry, what not to carry, Parts of payloads, Installation, Features of payloads, Utilization, Principles of Observation, Elements of Image & Video Interpretation, Introduction to Photogrammetry, Types of Image & Video Data, Analysis.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the Basics of Ignition and Fuel System of an Aircraft. (K2)
CO2	Illustrate the Flight Compartment Lighting Technologies and Cabin Air Conditioning system. (K2)
CO3	Identify the Warning and Protection Systems for the Ice Formation and Rain in the Airframe of the Aircraft During Flight. (K3)
CO4	Apply the Terrain Warning Systems to avoid the Terrain Collision of an Aircraft. (K3)
CO5	Examine the FDR and Fire Protection System to Monitor the Flying Performance of the Aircraft. (K4)

Text Books	
1.	“Aircraft Electrical and Electronic Systems”, Principles, operation and maintenance by Mike Tooley and David Wyatt.

Programme Coordinator	**BoS Chairman**

Reference Books	
1.	Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
2.	Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3.	Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000.

Programme Coordinator

BoS Chairman

B.Tech.	B23AGO601 - Environmental Management in Agriculture	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide knowledge on natural resource use and environmental sustainability in agriculture.
2.	To understand the causes and impacts of pollution from agricultural activities.
3.	To explore the principles and methods of environmental impact assessment (EIA).
4.	To study the role of waste management and resource recycling in agriculture.
5.	To introduce climate-smart agriculture and mitigation strategies for sustainable development.

UNIT I	NATURAL RESOURCES AND SUSTAINABILITY	9

Natural resources – classification and utilization in agriculture – Sustainable use of soil, water, biodiversity – Ecological footprint – Concept of carrying capacity – Environmental indicators – Role of agriculture in environmental degradation – Policies for sustainable agriculture – SDGs related to environment and agriculture.

UNIT II	AGRICULTURE AND POLLUTION	9

Agricultural pollution – causes and effects – Soil pollution due to fertilizers, pesticides and heavy metals – Water pollution: runoff, eutrophication, groundwater contamination – Air pollution: burning of residues, methane, ammonia emissions – Noise pollution from farm machinery – Agrochemical residues and food chain contamination – Preventive strategies.

UNIT III	ENVIRONMENTAL IMPACT ASSESSMENT (EIA)	9

Concept and need for EIA – Components and stages of EIA – Screening, scoping, impact prediction, mitigation – EIA methods (checklist, matrix, network) – Public participation – Environmental Management Plan (EMP) – Environmental audit – Case studies of agricultural projects (dams, irrigation, fertilizer units).

UNIT IV	AGRICULTURAL WASTE AND RESOURCE MANAGEMENT	9

Types of agricultural waste – crop residues, livestock waste, agro-industrial waste – Collection, handling and disposal – Waste minimization – Composting, vermicomposting, biogas production – Biomass energy – Circular economy in agriculture – Integrated farming and nutrient recycling – Wastewater reuse in agriculture.

UNIT V	CLIMATE CHANGE AND SUSTAINABLE FARMING	9

Climate change: causes and impact on agriculture – GHG emissions from agriculture – Carbon sequestration – Climate-smart agriculture – Conservation agriculture – Precision farming – Agroforestry and carbon farming – Green technologies in agriculture – Institutional frameworks (UNFCCC, IPCC, ICAR).

Total Instructional Hours: 45

COURSE OUTCOMES: Students will be able to

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CO1	Understand the sustainable use of natural resources in agriculture.
CO2	Identify environmental pollution sources and their impact from agriculture.
CO3	Apply EIA techniques for environmental planning in agricultural projects.
CO4	Utilize waste management techniques for environmental protection.
CO5	Implement climate-resilient and sustainable agricultural practices.

Text Books	
1.	Rattan Lal and B.A. Stewart, *Soil and Environmental Management*, CRC Press, 2020.
2.	N.T. Kumbhar, *Environmental Management in Agriculture*, Himalaya Publishing House, 2018.
3.	G.N. Tiwari and R.K. Mishra, *Environmental Pollution and Management*, Narosa Publishing House, 2015.

References	
1.	D.W. Sims, *Agricultural Waste Management*, FAO Publications.
2.	Shukla, S.K. & Pandey, P., *Climate Smart Agriculture*, Springer, 2021.
3.	EIA Guidelines – Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India.
4.	NPTEL: https://nptel.ac.in/courses/120108004

Approved by BoS Chairman

B.E/ B.TECH	B23ADO601-HUMAN COMPUTER COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To outline the basic knowledge of HCI.
2.	To classify the design process and rules.
3.	To apply the evaluation techniques and HCI models.
4.	To make use of communications and human factors.
5.	To develop the understanding of user interface.

UNIT - I	INTRODUCTION TO HCI	9

Introduction to HCI - A discipline involved in HCI- Importance of HCI - The psychology of everyday things - Principles of HCI - Input–output channels - Human memory -Thinking: reasoning and problem solving - Conceptual Models – Interface Metaphors – Interaction Types – Paradigms and Frameworks. Cognitive Aspects: Cognition – Cognitive Framework. Social Interaction – Emotional Interaction.

UNIT - II	HCI DESIGN PROCESS AND DESIGN RULES	9

The software design process - User focus – Scenarios - Navigation Design - Screen Design - Prototyping techniques - Wire-Framing - Understanding the UI Layer and Its Execution Framework, Model-View-Controller(MVC) Framework - Principles that support usability, Design standards, Design Guidelines, Golden rules and heuristics, User interface management system (UIMS).

UNIT - III	EVALUATION TECHNIQUES AND HCI MODELS	9

Goals of evaluation - Evaluation Criteria - Evaluation through expert analysis - Evaluation through user participation - Choosing an Evaluation Method - Goal and task hierarchy model - Linguistic model - Physical and device models - Cognitive architectures - Hierarchical task analysis (HTA) - Uses of task analysis - Diagrammatic dialog design notations - Computer mediated communication - Ubiquitous Computing.

Approved by BoS Chairman

UNIT - IV	COMMUNICATION AND HUMAN FACTORS	9

Face-to-face Communication - Conversation - Text-based Communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design – Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.

UNIT - V	FUTURE OF HCI AND USER INTERFACE	9

The future of HCI - perceptual interfaces, context-awareness and perception –User centered design - Interfaces: Types – Natural User Interfaces, Importance of user Interface and good design - Principles of user interface. - The graphical user interface – popularity of graphics, the concept of direct manipulation - graphical system - Characteristics - Web user – Interface popularity.

Total Instructional hours: 45

Course Outcomes: Students will be able to	
CO1	Illustrate the importance of human computer interaction.
CO2	Explain the design process and design rules.
CO3	Develop the understanding of evaluation techniques and HCI models.
CO4	Demonstrate the concept of communication and human factors.
CO5	Apply the user centered deign methods.

Text Books	
1.	A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers,2018
2.	Wilbert O. Galitz, "The Essential Guide to User Interface Design: An Introduction to Gui Design Principles and Techniques", Third Edition, John Wiley Sons, 2017..

Reference Books	
1.	Sharp, H., Rogers, Y., and Preece, J, "Interaction Design: Beyond Human – Computer Interaction", Third Edition, John Wiley & Sons, Inc., 2021.
2.	Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2020.

Approved by BoS Chairman

B.E / B.Tech	B23AMO601 - AI FOR SMART SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To recall the different types of AI based on capabilities and functionality
2.	To discuss the ethical implications of AI and how they affect societal impact
3.	To analyze a case study of AI-enhanced weather forecasting and evaluate its effectiveness in agricultural applications
4.	To evaluate the potential future trends and ethical dilemmas in the integration of AI in healthcare and autonomous systems
5.	To design a functional interactive AI system, such as a food delivery app, integrating AI technologies like voice recognition and user interaction design

UNIT - I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	9

Basics of AI: Definition and origins - Intelligence and its measurement - History and evolution of AI technologies - Overview of AI applications in smart systems - Types of AI: Based on Capabilities and Functionality - The Role of Ethics in AI Governance - Symbolic AI vs. Connectionist AI - Autonomous Vehicles and Intelligent Transportation Systems

UNIT – II	AI METHODOLOGIES AND TECHNIQUES	9

Introduction to Robotics and AI – Ethics of AI – Machine learning basics – Supervised learning - Unsupervised learning – AI in smart homes - Impact of AI in society

UNIT – III	ADVANCED AI TOPICS	9

Soft Computing: Overview and applications - Chat Bots and Conversational AI: Design and development - AI in Cyber-Physical Systems: Integration and challenges - AI-enabled IoT: Concepts – Case study : Agriculture: AI-Enhanced Weather Forecasting

UNIT – IV	APPLICATIONS OF AI IN SMART SYSTEMS	9

AI in Healthcare: Diagnostics and personalized medicine - AI in Automotive Systems: Autonomous vehicles - AI in Robotics: Intelligent control and navigation - Ethical considerations and future trends in AI

UNIT – V	INTERACTIVE AI SYSTEM DESIGN	9

Fundamentals of Human-AI Interaction - Role of AI in personal assistants – Interactive AI in customer service – AI in Education – Voice recognition systems - Future Trends in Interactive AI Design - Case Study: Designing an Interactive Food Delivery App

Total Instructional hours: 45

Approved by BoS Chairman

Course Outcomes : Students will be able to	
CO1	Recall the definition and origins of AI, including its historical evolution and types based on capabilities and functionality.
CO2	Apply AI methodologies, such as machine learning, to analyze and solve problems in smart home systems.
CO3	Evaluate the effectiveness of AI in solving real-world problems.
CO4	Discuss the ethical considerations and predict future trends in the development of AI technologies.
CO5	Analyze trends in the future of interactive AI design, including advancements in voice recognition systems and their potential impact on different sectors.

Text Books	
1.	Khan, I. U., Ouaissa, M., Ouaissa, M., Fayaz, M., & Ullah, R., Artificial Intelligence for Intelligent Systems: Fundamentals, Challenges, and Applications, CRC Press, 1st Edition, 2024.
2.	Ramana, T. V., Ghantasala, G. S. P., Sathiyaraj, R., & Khan, M., Artificial Intelligence and Machine Learning for Smart Community, CRC Press, 1st Edition, 2023.

Reference Books	
1.	P, M., Kumar, M. V., & Umamaheswari, R., Machine Learning and IoT for Intelligent Systems and Smart Applications, CRC Press, 1st Edition, 2022.
2.	Venkatesh, C., Rengarajan, N., Ponmurugan, P., & Balamurugan, S., Smart Systems for Industrial Applications, Scrivener Publishing, 1st Edition, 2022.
3.	Tanwar, R., Bhatia, S., Sapra, V., & Ahuja, N. J. (Eds.). (2024). Artificial Intelligence and Machine Learning: An Intelligent Perspective of Emerging Technologies. CRC Press.
4.	Kose, U., Prasath, V. B., Mondal, M., Podder, P., & Bharati, S. (Eds.). (2022). Artificial Intelligence and Smart Agriculture Technology. *Auerbach Publications.*

Approved by BoS Chairman

B.E / B.Tech	BM23BMO601- MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the electrode behavior and amplifiers
2.	To gain knowledge of various biopotential measurement
3.	To familiarize various electrical and non-electrical physiological parameters.
4.	To learn biochemical measurement
5.	To learn recent trends for biomedical applications

UNIT - I	BIOPOTENTIAL ELECTRODES AND AMPLIFIERS	9

Cell potential- Resting and Action potential, Electrode Electrolyte Interface, Types of electrodes, Bio signal characteristics– frequency and amplitude ranges, Bioamplifier, isolation amplifiers – transformer and optical isolation, Artifacts and removal.

UNIT - II	BIOPOTENTIAL MEASUREMENT	9

ECG – Einthoven 's triangle, standard 12 lead system, block diagram. Measurement of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG

UNIT - III	PHYSIOLOGICAL PARAMETER MEASUREMENT	9

Temperature, Respiration rate and pulse rate measurements, Plethysmography, Pulse oximetry, Blood Pressure measurement-direct and indirect method. Blood flow - Ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermodilution method, GSR Measurement, Patient Monitoring system

Program Coordinator

Approved by BOS Chairman

UNIT - IV	BIOCHEMICAL MEASUREMENT	9
Blood gas Analyzer, Blood Glucose measurement, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyser.		
UNIT - V	**RECENT TRENDS**	**9**
Point of care devices, Endoscopy unit, Radio pill, laproscopy, Applications of Laser in medicine, cryogenic application. Biotelemetry, Telemedicine, m-health.		
Total Instructional hours : 45		

Course Outcomes: Students will be able to	
CO1	Understand the electrode behavior
CO2	Comprehend the fundamentals of Bio potential recording.
CO3	Design various bio amplifiers
CO4	Measure various electrical and non-electrical physiological parameters.
CO5	Understand different monitoring system

Text book	
1.	Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”,Pearson Education, 4th Edition, 2014.
	John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and and Sons,New York, 4th Edition, 2009.

Program Coordinator

Approved by BOS Chairman

Reference Books	
1.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi,3 rd Edition, 2014.
2.	Richard Aston, “Principles of Biomedical Instrumentation and Measurement” Merril PublishingCompany, 1990.
3.	L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3 rd Edition,John Wiley and Sons, Reprint 2008.

Program Coordinator

Approved by BOS Chairman

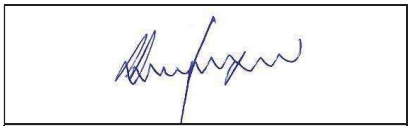
B. Tech.	B23BTO601 – BIOINFORMATICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the knowledge of databases and its maintenance.
2.	To provide the basic concept of various algorithms
3.	To deliver the knowledge on protein designing and its interactions.

Pre-requisite (if any)
Biochemistry, Molecular Biology, Protein Engineering

UNIT 1	INTRODUCTION TO BIOINFORMATICS	9
Scope of Bioinformatics, Databases- DBMS, Biological databases-classification-importance, Sequence Databases- GenBank, NCBI, DDBJ, EMBL, UniProt, SWISS-PROT, PIR, TrEMBL, Structural Databases-PDB, SCOP, CATH, pfam.		
UNIT 2	**SEQUENCE ANALYSIS**	**9**
Sequence Alignment- Sequence Homology Vs Sequence Identity Vs Sequence Similarity, Types of Sequence alignment methods- PSA, MSA, Scoring Function and Substitution Matrices-PAM & BLOSUM, Algorithms-Needleman-Wunch & Smith-Watermann, BLAST and its types, FASTA.		
UNIT 3	**PHYLOGENETIC RELATIONSHIPS**	**9**
Introduction to Phylogenetics-Parts of Phylogenetic Tree-Types of trees, Molecular Clock Theory, Distance Based Method- UPGMA, NJ, Character Based Method- Maximum Parsimony Method, Maximum Likelihood Method, Method of evaluating phylogenetic tree- Bootstrapping, Jackknife resampling, Data perturbation.		
UNIT 4	**STRUCTURAL ANALYSIS**	**9**
Protein Structure Visualization, Structural Prediction- Primary structure & Secondary Structure, tertiary Structure-Homology Modelling, Hidden Markov Model, Threading, Ab-initio method, Validation by Ramachandran plot.		
UNIT 5	**APPLICATIONS**	**9**
System Biology-Introduction and its importance, Microarray Data analysis, Approaches to drug designing and discovery.		
Total Instructional Hours: 45		

Course Outcomes After the successful completion of the course, the students will be able to,		Knowledge Level
CO1	Examine various biological databases.	K4
CO2	Compare genomic and proteomic sequences using various bioinformatics tools.	K5
CO3	Measure the evolutionary relationship using phylogenetic methods	K5
CO4	Compare vast genomic and proteomic dataset.	K5
CO5	Develop basic bioinformatics scripts with Perl programming.	K6

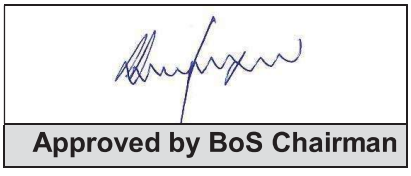


Approved by BoS Chairman

Text Books	
1.	Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press. ,4th edition 2014
2.	Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press. 1999
3.	Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison, Cambridge University Press. 2013
4.	Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press. 2nd edition, 2004.

Reference Books	
1.	Next Generation Sequencing Data Analysis, by Xinkun Wang CRC Press 2016

CO-PO-PSO Mapping														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	2	3	3	3	2	3	3	2	3
CO2	3	2	3	3	2	2	2	3	1	3	3	3	3	2
CO3	3	3	2	2	3	3	2	2	2	3	2	2	3	3
CO4	2	3	2	3	3	3	3	3	2	2	2	3	2	3
CO5	3	3	3	2	2	3	2	3	3	3	3	3	2	2
Wt. Avg.	**2.8**	**2.6**	**2.6**	**2.4**	**2.6**	**2.6**	**2.4**	**2.8**	**2.2**	**2.6**	**2.6**	**2.8**	**2.4**	**2.6**



Approved by BoS Chairman

B.E.	B23CSO601- FOUNDATIONS OF WEB DEVELOPMENT (Except CSE)	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the structure of websites and fundamental web technologies such as HTML5 and CSS3.
2.	To understand basic programming concepts using Java for web development.
3.	To explore dynamic client-side functionalities using JavaScript and DHTML.
4.	To identify the role of server-side programming and databases in web applications.
5.	To apply web development knowledge for building basic interactive applications.

UNIT - I	BASICS OF WEB	9

Basics of Internet – Web Clients and Servers – HTTP Protocol – Web Communication. HTML5: Tags, Forms, Tables, Lists, Multimedia Integration (Audio, Video). CSS3: Styling Text and Layout – Inline, Embedded, External Style Sheets – Responsive Layout

UNIT - II	PROGRAMMING CONCEPTS	9

Need for Programming in Web Development – Java Overview – Simple Java Program Structure – Variables, Data Types, Operators, Control Structures – Arrays – Methods – Introduction to Classes and Objects (no inheritance). Use of Java in Web and GUI Applications

UNIT - III	JAVASCRIPT AND DYNAMIC WEB PAGES	9

JavaScript Basics: Variables, Operators, Conditional Statements, Loops – Functions. Working with Forms – Validations – DOM Manipulation – Popups and Events. DHTML: Combining HTML, CSS, JavaScript for Simple Interactions.

UNIT - IV	SERVER-SIDE PROGRAMMING BASICS	9

Overview of Server-Side Scripting – Introduction to Java Servlets – Servlet Lifecycle – Handling Form Data using GET and POST – Session Management – Basics of Cookies. Web Server Setup: Apache Tomcat (Overview and Setup).

UNIT - V	DB CONNECTIVITY AND APPLICATIONS	9

Basics of Database for Web – Introduction to JDBC – Connecting Java Applications to Databases – Sample Data Insertion and Retrieval – Use Cases in Industry and Healthcare Systems. Mini Case Study: Simple Web Application with Form Input and Database Storage.

Total Instructional hours: 45

Approved by BoS Chairman

Course Outcomes: Students will be able to	
CO1	Outline core components of web applications including HTML5 and CSS3.
CO2	Apply basic Java programming for developing interactive functionalities
CO3	Develop dynamic client-side interactions using JavaScript and DHTML
CO4	Explain the workflow of server-side programs and sessions using Java servlets
CO5	Construct a simple web application integrating frontend, server-side logic, and database

Text Books	
1.	Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2018.
2.	Budi Kurniawan, Servlet & JSP: A Tutorial, 2nd Edition, Brainy Software Inc., 2015.

Reference Books	
1.	Deitel P.J. & Deitel H.M., Internet and World Wide Web How to Program, Pearson Education, 2020.
2.	Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2011.
3.	Herbert Schildt, Java: A Beginner's Guide, McGraw-Hill, 2018.

CO Mapping with PO & PSO

CO/PO & PSO		PO1 (K3)	PO2 (K4)	PO3 (K5)	PO4 (K5)	PO5 (K6)	PO6 (K3) (A3)	PO7 (K2) (A3)	PO8 (K3) (A3)	PO9 (A3)	PO10 (A3)	PO11 (K3) (A3)	PO12 (A3)	PSO1 (K4) (A3)	PSO2 (K3) (A3)
CO1	K2														
CO2	K3														
CO3	K3														
CO4	K2														
CO5	K3														
Weighted Average															

3 – Substantial **2- Moderate** **1- Low** **'-' – No Correlation**

Approved by BoS Chairman

B.E / B. TECH	B23ECO601 - WIRELESS TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Understand Introduction about wireless Communication.
2.	Study the basic concepts of channel modeling.
3.	Learn the access schemes in wireless communication.
4.	Understand channel capacity in wireless communication system.
5.	Learn evolution of wireless technologies.

UNIT I INTRODUCTION	9
Introduction to wireless communication systems-Cellular concept – system design fundamentals Handoff Strategies- Interference and system capacity, Improving Coverage and Capacity	

UNIT II CHANNEL MODELING	9
Free space propagation model, Reflection- Diffraction — Scattering - Log-normal shadowing. Small-scale multipath propagation, Types of small-scale fading, Rayleigh and Ricean distribution, Input /output model of the wireless channel-Time and frequency coherence-Statistical channel models	
UNIT III ACCESS SCHEMES AND DIVERSITY	**9**
FDMA, TDMA, CDMA, SDMA and CSMA, OFDMA. Diversity Techniques—Frequency diversity, Time diversity, Code diversity, Antenna diversity–RAKE Receiver-SIMO, MISO, MIMO, MIMO-OFDM Technique	
UNIT IV CAPACITY OF WIRELESS CHANNELS	**9**
AWGN channel capacity — capacity of flat fading channels, Frequency-selective fading channels, Multiuser capacity, Downlink channel capacity, Uplink channel capacity, Outage capacity	
UNIT V EVOLUTION OF WIRELESS TECHNOLOGIES	**9**
Mobile Technologies - GSM, 3G, 4G (LTE) and 5G technologies, Wireless LAN Technologies and WLL.	
	Total Instructional hours: 45

Approved by BOS Chairman

Course Outcomes: Students will be able to	
CO1	Learn fundamentals of wireless communication.
CO2	Understand the concepts of channel modeling.
CO3	Study various access schemes in wireless communication.
CO4	Understand channel capacity in wireless networks.
CO5	Learn evolution of wireless technologies.

Text Books	
1.	Andrea Gold smith, " Wireless Communications", Cambridge University Press, 2012.
2.	DavidTse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2015.

Reference Books	
1.	Kamilo Feher,"Wireless Digital Communications, Modulation & Spread Spectrum Applications", PHI, 2015.
2.	William C.Y.Lee, "Mobile Communication Engineering", McGraw Hill, 2014.
3.	Theodore S.Rappaport, "Wireless Communications", Pearson Education,2017
4.	Andreas F.Molisch,"Wireless Communications", Wiley, 2011.
5.	Learn evolution of wireless technologies.

<table>
<tr><th colspan="5">Evaluation Pattern:</th></tr>
<tr><th colspan="4">Continuous Internal Assessment</th><th>End Semester Examinations</th></tr>
<tr><td colspan="2">CIA I (Theory)
(100 Marks)</td><td colspan="2">CIA II (Theory)
(100 Marks)</td><td rowspan="2">Theory End Semester Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>* Alternate Assessment Tool (AAT)</td><td>Written Test</td><td>* Alternate Assessment Tool (AAT)</td><td>Written Test</td></tr>
<tr><td>40 Marks</td><td>60 Marks</td><td>40 Marks</td><td>60 Marks</td><td></td></tr>
<tr><td colspan="4">40 Marks</td><td>60 Marks</td></tr>
<tr><td colspan="5">Total: 100 Marks</td></tr>
</table>

- AAT - Individual Assignment/ Case Study/ Seminar/ Mini project/ MCQ/ Role Play/ Group Discussion/ Debates/ Oral Presentations/ Poster Presentations/ Technical Presentations can also be provided course coordinator can choose any one/two components based on the nature of the course.

Approved by BOS Chairman

B.E	B23EEO601 – GREEN ELECTRONICS AND SUSTAINABLE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of Green Electronics.
2.	To explain sustainable materials and design practices.
3.	To reveal the renewable energy in Electronics.
4.	To understand the E-Waste management and recycling strategies.
5.	To explain the emerging trends in sustainable technologies.

UNIT-I	Introduction to Green Electronics	9
Overview of Green Electronics and Sustainability-Environmental Impact of Electronic Waste (E-Waste)- Energy Consumption in Electronics Manufacturing-Green Engineering Principles-Life Cycle Assessment (LCA) of Electronic Devices.		

UNIT-II	Sustainable Materials and Design	9
Eco-friendly and Biodegradable Electronic Materials-Sustainable Circuit Design Techniques-Low-power and Energy-efficient Semiconductor Technologies-Flexible and Organic Electronics-Sustainable PCB (Printed Circuit Board) Manufacturing.		

UNIT-III	Renewable Energy for Electronics	9
Solar Energy: Photovoltaics in Electronics-Energy Harvesting Techniques (Piezoelectric, Thermoelectric, etc.)- Battery Technologies and Green Energy Storage Solutions- Supercapacitors and Fuel Cells for Sustainable Electronics-Smart Grid and IoT for Energy Efficiency.		

UNIT-IV	Waste Management and Recycling of Electronics	9
E-Waste Recycling Techniques and Challenges-Circular Economy in Electronics-Regulations and Policies for Electronic Waste Management-Extended Producer Responsibility (EPR)- Case Studies on Successful E-Waste Management.		

UNIT-V	Emerging Trends and Future of Green Electronics	9
AI and IoT for Energy-efficient Systems-Sustainable Computing and Cloud Technologies-Green 5G and Communication Technologies-Carbon Footprint Reduction in Semiconductor Industries-Future Innovations in Sustainable Electronics.		
Total Instructional hours:45		

Approved by BoS Chairman

Course Outcomes: Students will be able to	
CO1	Illustrate the concept of green electronics and sustainability.
CO2	Explain the Sustainable Materials and Design with low-power and energy-efficient semiconductor technologies.
CO3	Demonstrate green energy storage solutions such as batteries, supercapacitors, and fuel cells.
CO4	Interpret the principles of e-waste recycling and the circular economy.
CO5	Infer the advancements in green computing, energy-efficient communication, and semiconductor technologies.

Text Books	
1.	John Lamb, “Green Electronics/Green Bottom Line: A Commonsense Guide to Environmentally Responsible Engineering and Management”, CRC Press, 2007.
2.	Santosh K. Kurinec, Krzysztof Iniewski, “Energy-Efficient Computing and Electronics: Devices to Systems”, CRC Press, 2019.
3.	Sunil Kumar, Vineet Kumar, “Electronic Waste Management: Policies, Processes, Technologies, and Impact”, Wiley Publications, 2023.
4.	Wayne C. W. Chan, Alan C. L. Wong, “Sustainable Electronics and Photonics”, Wiley publications, 2021.

Reference Books	
1.	Mohammad S. Obaidat, Alagan Anpalagan, Isaac Woungang, “Handbook of Green Information and Communication Systems”, Academic Press, 2013.
2.	Kaka Ma, “Sustainable Materials and Green Processing for Energy Conversion”, Trans Tech Publications, Elsevier, 2021
3.	Muhammad Zaffar Hashmi, Ajit Varma, “Environmental Impact of Electronic Waste and Sustainable Recycling Methods”, Springer, 2019.

Approved by BoS Chairman

B.E. / B.Tech	B23MEO601 - 3D PRINTING AND TOOLING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To explore the technology used in additive manufacturing.
2.	To develop CAD models for 3D printing.
3.	To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
4.	To select a 3D printing process for an application.
5.	To produce a product using 3D Printing or Additive Manufacturing (AM).

UNIT - I	INTRODUCTION TO ADDITIVE MANUFACTURING (AM)	9

Overview – History – Need – classification - Additive Manufacturing Technology in product development – Materials for Additive Manufacturing.

UNIT - II	CAD AND REVERSE ENGINEERING	9

Basic concept – 3D scanning – digitization techniques – Model reconstruction – data processing for reverse engineering - Additive Manufacturing Technology : CAD model preparation – Part orientation and support generation – Model slicing – Tool path generation.

UNIT - III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING	9

Classification – liquid based system – stereo lithography apparatus (SLA) – principle, process, advantages and applications – solid based system – Fused Deposition Modeling – principle, process, advantages.

UNIT - IV	LASER BASED ADDITIVE MANUFACTURING SYSTEMS	9

Selective laser sintering – principles of SLS process – process, advantages and applications, 3D Printing - principle, process, advantages - Laser Engineered Net Shaping (LENS).

Approved by BoS Chairman

UNIT - V	RAPID TOOLING AND APPLICATIONS OF ADDITIVE MANUFACTURING	9
Principles and typical process for quick batch production of plastic and metal parts through quick tooling – applications for Aerospace, defence, automobile, Bio-medical and general engineering industries		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the importance of Additive Manufacturing.
CO2	Apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
CO3	Define the various process used in Additive Manufacturing.
CO4	Identify and select suitable process used in Additive Manufacturing.
CO5	Understand the basic concept of quick tooling and additive manufacturing application.

Text Books	
1.	Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies : Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2.	Andreas Gebhardt, “Understanding Additive Manufacturing : Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3.	Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.

Reference Books	
1.	J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
2.	Dougles Bryden, “CAD and Prototyping for Product Design”, 2014.
3.	CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”, World Scientific, 2017.

Approved by BoS Chairman

B.E / B.TECH	B23CBO601 DATA SCIENCE FOR BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of Data Science.
2.	To understand the Analytics Life Cycle.
3.	To understand the process of acquiring Business Intelligence & various types of analytics for Business Forecasting
4.	To model the supply chain management for Analytics.
5.	To apply analytics for different functions of a business

UNIT- I Introduction to Data Science	9
Need for Data Science – Benefits and uses – Facets of data – Types of data- Organization of data - Data Science process- Data Science life cycle- Role of Data Science - Big Data – sources and characteristics of Big Data	

UNIT-II Introduction to Business Analytics	9
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration	

UNIT- III Business Intelligence & Forecasting	9
Data Warehouses and Data Mart – Knowledge Management –Types of Decisions – Decision-Making Process – Decision Support Systems – Business Intelligence –OLAP – Analytic functions - Introduction to Business Forecasting and Predictive analytics – Logic and Data-Driven Models – Data Mining and Predictive Analysis Modeling –Machine Learning for Predictive analytics.	

Approved by BoS Chairman

UNIT- IV HR & Supply Chain Analytics	9
Human Resources – Planning and Recruitment – Training and Development – Supply chain network – Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year.	

UNIT- V Marketing & Sales Analytics	9
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales. Do predictive analytics for customers' behaviour in marketing and sales.	
Total Instructional hours: 45	

Course Outcomes: Students will be able to	
CO1	Understand the data science basics and its life cycle.
CO2	Understand the role of data science in business decision-making and strategy formulation.
CO3	Apply business intelligence tools and analytic functions.
CO4	Apply analytics in various HR functions such as recruitment, planning, and training.
CO5	Use predictive analytics to interpret and forecast customer behavior in marketing and sales contexts.

Text Books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Efrain Turban, Jay E.Aronson, Teng-Peng Liang, Ramesh Sharada "Decision Support Systems and Intelligent Systems" 8th Edition, Pearson Education, 2007.

Reference Books :

1. R. Evans James, Business Analytics, 2017.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2017.
3. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016.

Approved by BoS Chairman

MANDATORY COURSE I

B.E / B.Tech	B23MCT501- Environmental Sustainability (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand ecosystems and the environment**,** including how they work and their importance.
2.	To learn about biodiversity and ways to protect endangered species.
3.	To Identify causes and solutions for pollution and waste management.
4.	To explore natural resources and how human activities affect them.
5.	To discuss global issues like climate change, population growth, and sustainable living.

SYLLABUS:

UNIT - I	ENVIRONMENT AND ECOSYSTEM	6

Scope and importance of environment - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers –energy flow in the ecosystem - food chains and food webs – structure and function of the (a) forest ecosystem (b) desert ecosystem (c) aquatic ecosystems (pond & marine).

UNIT - II	BIODIVERSITY	6

Introduction to Biodiversity: Genetic, species and ecosystem diversity. Value of biodiversity - hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT - III	ENVIRONMENTAL POLLUTION	6

Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) soil pollution - solid waste management: causes, effects and control measures of municipal solid wastes.

Approved by BoS Chairman

UNIT - IV	NATURAL RESOURCES	6
Forest resources: Use and over-exploitation, deforestation - Water resources: Use and over-utilization of surface and ground water - Land as a resource, land degradation, man induced landslides, soil erosion and desertification.		

UNIT - V	HUMAN POPULATION, SOCIAL ISSUES AND THE ENVIRONMENT	6
Population growth, variation among Nations – Population explosion. climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.		
	TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Explain the structure and function of various ecosystems and explain the flow of energy through food chains and food webs.
CO2	Relate the types, values, and threats to biodiversity and differentiate between in-situ and ex-situ conservation methods.
CO3	Summarize the causes and impacts of major types of environmental pollution and suggest appropriate control measures.
CO4	Interpret the usage and over-exploitation of natural resources and analyse their environmental consequences.
CO5	Outline the impact of human population growth and social issues on environmental degradation and global climate phenomena.

Text Books	
1.	Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nedition,Pearson Education, 2004.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006

Reference Books	
1.	G.Tyler Miller and Scott E. Spoolman, —'Environmental Science',Cengage LearningIndia Pvt, Ltd, Delhi, 2014
2.	Erach Bharucha, —Textbook of Environmental Studies‖, Universities Press (I) PVT, LTD, Hydrabad, 2015.

Approved by BoS Chairman

B.E / B.Tech	B23MCT502 - ELEMENTS OF LITERATURE (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand and identify key literary elements in various texts.
2.	To analyze how authors use literary devices to convey themes and messages.
3.	To examine how character, setting, plot, and other elements contribute to the overall meaning of a work.
4.	To appreciate the different forms and genres of literature.
5.	To develop writing and analytical skills through discussions, essays, and presentations.

UNIT-I	INTRODUCTION TO LITERARY ELEMENTS	6

- **Overview of Literary Elements:** Definition and significance of literary elements
- **Introduction to the core components:** plot, setting, character, theme, and conflict
- Understanding literary genres (fiction, poetry, drama, nonfiction)

UNIT-II	PLOT AND STRUCTURE	6

- The five stages: Exposition, Rising Action, Climax, Falling Action, Resolution
- Types of conflict (man vs. man, man vs. self, man vs. nature, etc.)
- Plot devices (foreshadowing, flashbacks, etc.)

UNIT-III	CHARACTERIZATION	6

- **Types of Characters:** Protagonist, antagonist, dynamic, static, round, flat, etc. Direct vs. indirect characterization
- **Character Development:**
- How characters change or grow throughout a story
- Analyzing motivations, conflicts, and relationships

UNIT-IV	SETTING	6

- **Understanding Setting:**
- The time, place, and social environment of a story
- How setting influences plot and character development
- Symbolism and mood created through setting

Approved by BoS Chairman

UNIT-V	ANALYZING LITERARY WORKS	6
• **Close Reading and Analysis:** • Developing analytical skills through in-depth examination of texts • Understanding the role of diction, syntax, and tone in literature • **Comparative Analysis:** • Comparing works of literature across genres or time periods • Drawing connections between themes, characters, and literary devices		
		Total Instructional hours:30

Course Outcomes: Students will be able to	
CO1	Identify and Interpret Literary Elements. (K2)
CO2	Analyze Literary Devices. (K4)
CO3	Evaluate Narrative Structure. (K5)
CO4	Explore various literary forms and genres. (K3)
CO5	Develop Critical Thinking and Writing Skills. (K6)

Text Books	
1.	Narayan RK, “Malgudi Days”, Indian Thought Publications, New York, 2015
2.	Shaw, George Bernard, “Greatest works of George Bernard Shaw”, Maple Press, 2010
3.	Nair, Anita, “Ladies Coupe-A Novel in Parts”, Penguin Books, 2014

Reference Books	
1.	Abram, “A Glossary of Literary Terms”, Thomson India, 2008
2.	Trivedi, “India’s Shakespeare”, Pearson, 2008
3.	Orwell, George “Animal Farm”, Penguin Books Press, India, March 2011.
4.	Shakespeare, William “As You Like It”, Om Books International published, 2025.
5.	Allan Poe, Edgar, “The Raven”, Penguin Books Press, India, Oct 2013
6.	O. Henry, “The Gift Of The Magi”, Arcadia Publishing, December 2024

B.E / B.Tech	B23MCT503 - FOUNDATIONS OF YOGA	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To introduce the fundamental concepts and philosophy of Yoga and its relevance to modern life.
2.	To develop awareness of the physical, mental, and emotional benefits of Yoga through an understanding of its principles.
3.	To impart knowledge about the ethical and moral foundations of Yoga as described in Patanjali's Yoga Sutras (Yama, Niyama, etc.).
4.	To promote a healthy and disciplined lifestyle by integrating Yogic practices and values into daily routines.
5.	To enable students to manage stress and enhance concentration through the theoretical understanding of pranayama, meditation, and yogic relaxation techniques.

SYLLABUS:

UNIT - I	INTRODUCTION TO YOGA	6

- Definition, origin and evolution of Yoga.
- Aim, objectives, and relevance of Yoga in modern life.
- Different schools of Yoga (Raja Yoga, Karma Yoga, Bhakti Yoga, Jnana Yoga, Hatha Yoga).

UNIT - II	HEALTH AND YOGA	6

- Concept of health in Yoga.
- Holistic approach of Yoga to health and well-being.
- Role of Yoga in stress management.
- Yoga as preventive and therapeutic tool.

UNIT - III	YOGIC LIFESTYLE	6

- Yogic principles of food and diet.
- Importance of discipline (Yama, Niyama) in daily life.
- Daily routine and time management.
- Positive thinking and mental hygiene through Yoga.

Approved by BoS Chairman

UNIT - IV	ASANAS	6

- Standing Asanas: Tadasana, Trikonasana, Vrikshasana.
- Sitting Asanas: Padmasana, Vajrasana, Ardha Matsyendrasana.
- Lying Asanas: Bhujangasana, Shalabhasana, Sarvangasana, Savasana.
- Benefits and precautions.

UNIT - V	MEDITATION AND RELAXATION	6

- Basics of Meditation.
- Guided Meditation Techniques.
- Yoga Nidra / Deep Relaxation Technique (DRT).
- Stress management through meditation.

TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Illustrate the origin, definition, and philosophy of Yoga and its significance in holistic well-being.
CO2	Explain the principles and practices of Ashtanga Yoga as outlined by Patanjali.
CO3	Outline the role of Yoga in promoting physical health, mental clarity, and emotional stability.
CO4	Interpret the ethical and lifestyle principles of Yoga (Yama and Niyama) for personal development.
CO5	summarize how Yogic practices help in stress management and enhancing concentration in daily life.

Text Books	
1.	Light on Yoga – B.K.S. Iyengar. Publisher: HarperCollins,1966
2.	Patanjali Yoga Sutras – Swami Vivekananda commentary, Publisher: Advaita Ashrama, 1896.

Reference Books	
1.	Yoga for Health – Swami Kuvalayananda. *Publisher: Kaivalyadhama, Lonavala 1931.*
2.	Common Yoga Protocol – Ministry of AYUSH, Govt. of India, 2015

Approved by BoS Chairman

B.E /B.Tech	B25MCT504- EXPORT IMPORT MANAGEMENT (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To learn the basics of international trade and its importance for businesses.
2.	To understand how goods are transported, paid for, and insured in global trade.
3.	To know how to choose the right products and markets for export.
4.	To get hands-on knowledge of export-import documents and procedures.
5.	To use digital tools and government support to grow your export business.

SYLLABUS:

UNIT - I	Introduction to Export and Import	6

Overview of International Trade, Importance of Export and Import in Business, International Trade Bodies and Local Regulatory Authorities, Export-Import Cycle: Step-by-Step Process, Online IEC (Import Export Code) Application, Myths and Opportunities in Global Trade.

UNIT - II	Logistics, Transportation & Payment Terms	6

Types of Transportation in International Trade, Containers, Packaging, and Shipment Handling, IncoTerms: Delivery Terms, Costs & Risks, Payment Terms: Modes of Payment & Risk Involved, Insurance and Risk Management in Trade.

UNIT - III	Product & Market Selection, Buyer Identification	6

Selecting the Right Product for Export, Market Research and Identifying Potential Markets, Importance of Trade Fairs & Exhibitions, Finding Genuine Buyers & Verification Process, Effective Communication with International Buyers.

UNIT - IV	Export & Import Documentation and Procedures	6

Understanding Proforma Invoice & Letter of Credit (LC), Pre & Post Shipment Documents, GST, Customs Clearance & Compliance Procedures, How to Fill Pre & Post Shipment Documents – Practical Exercise, Import Documentation and Procedures.

Approved by BoS Chairman

UNIT - V	Marketing, Incentives & Digital Trade Strategies	6
Export Incentives and Government Benefits, Pricing Strategies & Preparing Export Quotations, B2B Listing and Online Marketplaces, Digital Marketing & Social Media for Export Promotion, Buyer Calling, Data Collection & Product Portfolio Development.		

Course Outcomes: Students will be able to	
CO1	Explain the fundamentals of international trade, the role of trade bodies, and the complete export-import process. (K2)
CO2	Outline various transportation methods, Incoterms, packaging, payment terms, and risk management in international trade. (K2)
CO3	Apply knowledge to select suitable products and markets for export, identify genuine buyers, and effectively communicate in global trade. (K3)
CO4	Develop the ability to prepare and process export/import documentation, customs clearance, and GST compliance. (K3)
CO5	Utilize digital marketing, government incentives, and online platforms to develop export strategies and expand business opportunities. (K3)

Text Books	
1.	Thomas E. Johnson & Donna L. Bade, *Export/Import Procedures and Documentation*, 8th Edition, Ashgate Publishing, 2016.
2.	S. Tamer Cavusgil, Gary Knight, John R. Riesenberger, *International Business: The New Realities*, 3rd Edition, Pearson, 2017.
3.	P.K. Khurana, *Export-Import Theory, Practices, and Procedures*, 1st Edition, Atlantic Publishers & Distributors, 2016.
4.	Warren J. Keegan, Mark C. Green, *Global Marketing Management*, 9th Edition, Pearson, 2017.
5.	Francis Cherunilam, *International Trade and Export Management*, 9th Edition, Himalaya Publishing House, 2020

Approved by BoS Chairman

Reference Books	
1.	Anders Grath, *The Handbook of International Trade and Finance*, 3rd Edition, Kogan Page, 2020.
2.	Francis Cherunilam, *International Trade and Export Management*, 9th Edition, Himalaya Publishing House, 2020.
3.	V.K. Bhalla, *International Business: Theories and Practices*, 2nd Edition, Anmol Publications, 2020.
4.	S.K. Bhatia, *Export Management*, 1st Edition, Vikas Publishing House, 2018.
5.	R. Palaniappan, *International Trade and Export Management*, 1st Edition, Oxford University Press, 2019.

Approved by BoS Chairman

MANDATORY COURSE II

B.E / B.Tech	B23MCT601 – EDUCATION PSYCHOLOGY (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To enable students to acquire knowledge about various methods of psychology.
2.	To gain knowledge about the concept of learning and its related theories.
3.	To understand motivation and its influence on human behaviour.
4.	To comprehend in-depth concepts of intelligence and creativity.
5.	To explain the concepts and theories of personality.

SYLLABUS:

UNIT - I	EDUCATIONAL PSYCHOLOGY AND HUMAN GROWTH AND DEVELOPMENT	6
Psychology: Meaning - Educational psychology: Meaning, scope and significance - Dimensions of human growth and development: Physical, cognitive, emotional, social, moral and language.		

UNIT - II	ATTENTION AND MEMORY	6
Attention: Meaning, nature and determinants of attention - Memory: Meaning, types of memory and Strategies for improving memory.		

UNIT - III	MOTIVATION AND LEARNING	6
Motivation: Meaning and definitions - Level of aspiration learning: Theories of learning and its educational implications Cognitive Theory: Jean Piajet, Behaviourist Theory- Pavlov's Classical, Conditioning.		

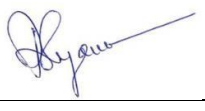
UNIT - IV	INTELLIGENCE AND CREATIVITY	6
Intelligence: Meaning, and types - Theories of Intelligence: Two factor, Thurston's Group factor - Intelligence Quotient (IQ) - Creativity: Concept, factors and process - Strategies for fostering creativity.		

UNIT - V	PERSONALITY	6
Personality: Meaning, definitions, and determinants of personality - Theories of Personality: Type, trait, and psychoanalytic Assessment of personality: Projective and non-projective techniques.		
TOTAL INSTRUCTIONAL HOURS		30

Course Outcomes: Students will be able to	
CO1	Explain various methods of psychology.
CO2	Describe the concept of learning and its related theories.
CO3	Discuss motivation and its influence on human behaviour.
CO4	Summarize the concepts of intelligence and creativity.
CO5	Interpret the concepts and theories of personality.

Text Books	
1.	Bert Laura, E. (2014). Child development. New Delhi: PHI Learning
2.	Chauhan, S. S. (2002). Advanced educational psychology. New Delhi: Vikas Publishing house.
3.	Hurlock, Elizabeth, B. (2015). Child development. New Delhi: McGraw Hill Education.
4.	Mangal, S.K. (2002). Advanced educational psychology. New Delhi: Prentice Hall of India.
5.	Matthews. G., Deary, L. J., & Whiteman, M.C. (2009). (2nd ed.). Personality: Theory and research. New York: Guilford Publications.

Reference Books	
1.	AnithaWoolfolk. (2004). Educational psychology. Singapore: Pearson Education.
2.	Cloninger, S.C. (2008) (5thed.). Theories of personality: Understanding persons. Englewood Cliffs, New Jersey: Prentice Hall.
3.	Schunk, D.H. (2007) (5thed.). Learning theories: An educational perspective. New York: Prentice Hall of India.
4.	Skinner, C.E. (2003) (4thed.). Educational psychology. New Delhi: Prentice Hall of India.
5.	Sprint Hall Norman, A, & Sprint Hall, Richard, C. (1990) (5thed.). Educational psychology: A developmental approach. New Delhi: McGraw Hill.



Approved by BoS Chairman

B.E / B.Tech	B23MCT602- Life Style Education (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand the importance of a healthy lifestyle and its impact on overall well-being.
2.	To learn about balanced nutrition, the role of essential nutrients, and healthy eating habits.
3.	To explore the benefits of regular exercise and different types of physical activities.
4.	To identify common lifestyle diseases and strategies for their prevention.
5.	To develop mental wellness through stress management, mindfulness, and better sleep habits.

UNIT - I	Introduction to a Healthy Lifestyle	6

- Definition & importance of a healthy lifestyle
- Nutrition, exercise, sleep, and mental well-being.
- Assessing current lifestyle habits.

UNIT - II	Nutrition & Balanced Diet	6

- Macronutrients & micronutrients: Their roles and sources.
- Healthy eating habits and meal planning.
- Importance of hydration.
- Harmful effects of processed food and unhealthy eating habits.

UNIT - III	Physical Fitness & Exercise	6

- Benefits of regular exercise on physical and mental health.
- Types of workouts: Cardio, strength training, yoga, and flexibility exercises.
- Designing a personalized fitness routine.

UNIT - IV	Lifestyle Diseases & Prevention	6

- Causes and prevention of obesity, diabetes, heart disease, and hypertension.
- Role of diet, exercise, and mental health in disease prevention.
- Importance of regular health check-ups.

UNIT - V	Mental Health & Stress Management	6

- Understanding stress, anxiety, and depression.
- Techniques for relaxation: Meditation, deep breathing, and mindfulness.
- Importance of sleep for overall health.
- Tips for improving sleep hygiene.

TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Explain the importance of a healthy lifestyle and its key aspects like nutrition, exercise, sleep, and mental well-being.
CO2	Describe the role of nutrients, healthy eating habits, and the effects of processed food.
CO3	Summarize different types of exercises and their benefits for physical and mental health.
CO4	Identify common lifestyle diseases, their causes, and ways to prevent them.
CO5	Discuss stress, anxiety, and sleep issues, along with techniques to manage them.

Text Books	
1.	*Francesc García, Héctor,Miralles*, Ikigai: The Japanese Secret to a Long and Happy Life, Penguin Audio, 2017.
2.	Relationship, wellbeing and behaviour, Harry T. Reis, World Library of Psychological series, Reutledge, Taylor and Francis Group, 2018.

Reference Books	
1.	Shawn Achor, The Happiness Advantage: How a Positive Brain Fuels Success in Work and Life, Crown Currency, 2018.
2.	James Clear, Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones, Penguin Audio, 2018.

Approved by BoS Chairman

B.E / B.Tech	B25MCT603 STARTUP AND VENTURE FUNDING (Common to ALL)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To understand new venture creation opportunities, its resources, and requirements for Enterprise Start-up
2.	To understand the legal environment.
3.	To learn about the start-up environment and survival.
4.	To study the various funding availabilities for startups.
5.	To analyse the venture capital funding and its stages.

UNIT - I	Start-up An Overview	6

Introduction to start ups - The rise of startup economy – Ideation- Venture Choices - The Start-up Equation – The Entrepreneurial Ecosystem – Entrepreneurship in India. Government Initiatives.

UNIT - II	Start-up Capital Requirements and Legal Environment	6

Identifying startup capital requirements - estimating startup cash requirements - Startup financing metrics – Risk mitigation strategies - The legal framework for startups - Incorporation and commencement of businesses and registration of a company.

UNIT - III	Start-up Survival and Growth	6

Feasibility Study - Stages of growth of start-ups – Reasons for new start up failures- Scaling new ventures – preparing for change - Leadership succession. Support for growth and sustainability of the venture.

UNIT - IV	Funding of Start Up Ventures	6

Financing Opportunities for startups – Equity investment process – Angel Investors - Funding startups with bootstrapping- crowd funding- strategic alliances.

UNIT - V	Venture Capital Funding	6
Venture Capital – Meaning and features – Seed capital – Financing various stages of startup ventures – Exit strategy for venture capital funds.		

Course Outcomes: Students will be able to	
CO1	Implement entrepreneurship concepts in a start-up idea. (K3)
CO2	Use budgeting and legal setup processes for the venture. (K3)
CO3	Demonstrate feasibility through market and financial analysis. (K3)
CO4	Execute funding strategies suited for a new business. (K3)
CO5	Apply suitable funding methods for different stages of a new business using basic financial models and strategies. (K3)

Text Books	
1.	Kathleen R Allen, Launching NewVentures, An Entrepreneurial Approach, Cengage Learning, 2016.
2.	AnjanRaichaudhuri, Managing New Ventures Concepts and Cases, Prentice Hall International, 2010.
3.	S. R. Bhowmik& M. Bhowmik, Entrepreneurship, New Age International, 2007.

Reference Books	
1.	Steven Fisher, Ja-nae' Duane, The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, Mc Graw Hill Education India Pvt. Ltd, 2016.
2.	Donald F Kuratko, Jeffrey S. Hornsby, New Venture Management: The Entrepreneur's Road Map, 2e, Routledge, 2017.
3.	Vijay Sathe, Corporate Entrepreneurship, 1e, Cambridge, 2009.

Approved by BoS Chairman

B.E / B.Tech	B23MCT604 – INDIAN KNOWLEDGE SYSTEM	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To introduce the scope and significance of Indian Knowledge Systems in the context of modern education and engineering.
2.	To explore ancient Indian contributions in science, mathematics, technology, and architecture.
3.	To understand core Indian philosophies, ethics, and values and their relevance in personal and professional life.
4.	To connect traditional practices with modern innovations through case studies and project-based learning.
5.	To promote sustainable thinking and design approaches inspired by indigenous knowledge and practices.

SYLLABUS:

UNIT - I	INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM	6

- Meaning and scope of IKS
- Importance of IKS in modern education
- Relevance of IKS to science, technology, and engineering.

UNIT - II	SCIENCE AND TECHNOLOGY IN ANCIENT INDIA	6

- Contributions in mathematics (e.g., zero, decimal system, algebra – Aryabhata, Bhaskara)
- Ancient metallurgy (e.g., Iron Pillar of Delhi, zinc extraction)
- Astronomy and calendar systems (e.g., Surya Siddhanta, Jantar Mantar)
- Ayurveda and traditional health sciences.

UNIT - III	ENGINEERING AND ARCHITECTURE	6

- Vastu Shastra and ancient Indian architecture
- Temple construction and civil engineering marvels
- Water management systems (step wells, tanks, canals)
- Town planning in Harappan civilization.

Approved by BoS Chairman

UNIT - IV	INDIAN PHILOSOPHY, ETHICS & VALUE SYSTEM	6

- Core concepts of Indian philosophy (Dharma, Karma, Yoga)
- Ethical principles in Indian tradition
- Role of values in professional and personal life
- Indian view on environmental sustainability.

UNIT - V	ARTS, CULTURE, AND LITERATURE	6

- Overview of Indian classical music and dance
- Ancient literature (Vedas, Upanishads, Ramayana, Mahabharata)
- Sanskrit and its scientific relevance
- Cultural practices and their scientific background.

	TOTAL INSTRUCTIONAL HOURS	30

Course Outcomes: Students will be able to	
CO1	Explain the meaning, scope, and importance of Indian Knowledge Systems in the context of modern education.
CO2	Outline the key scientific and technological advancements of ancient India in fields like mathematics, metallurgy, and astronomy.
CO3	Interpret traditional Indian architectural and engineering practices, including Vastu Shastra and water management systems.
CO4	Illustrate the ethical values and philosophical principles of Indian traditions and their relevance in contemporary life.
CO5	Summarize the applications of IKS in modern innovation, entrepreneurship, and sustainable engineering practices.

Text Books	
1.	Introduction to Indian Knowledge Systems: Concepts and Applications, B. Mahadevan, Publisher: PHI Learning Pvt. Ltd. 2016.
2.	Science and Technology in Ancient India,: Roshen Dalal,Publisher: Penguin Books.2003
3.	Foundations of Indian Culture, Govind Sadashiv Ghurye, Publisher: Popular Prakashan. 1951

Reference Books	
1.	Indian Knowledge Systems – Volume 1, Kapil Kapoor & Michel Danino Publisher: Central Sanskrit University & Bharatiya Vidya Bhavan, 2021.
2.	The Argumentative Indian, By: Amartya Sen, Publisher: Picador, 2005.

Approved by BoS Chairman