HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai) (Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade) Valley Campus, Pollachi Highway, COIMBATORE 641 032

B. E. AERONAUTICAL ENGINEERING

Common to all B.E. / B.Tech. Degree Programmes

(CHOICE BASED CREDIT SYSTEM)

Curriculum & Syllabus

2022-2023

Department of Aeronautical Engineering

Vision of the Institute

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills, and high ethical values

Mission of the Institute

IM1: To provide academic excellence in technical education through novel teaching methods

IM2: To empower students with creative skills and leadership qualities

IM3: To produce dedicated professionals with social responsibility

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Vision of the Department

To be a global player and prepare the students with knowledge, skills, and ethics for their successful deployment in Aeronautical Engineering.

Mission of the Department

DM1: To nurture the students technically based on current trends and opportunities in the global Aerospace industry.

DM2: To develop the students as innovative engineers to address the contemporary issues in the Aeronautical field.

DM3: To inculcate professional and social responsibility based on an innate ethical value system.

Program Educational Objectives (PEOs) of the Department

PEO1: Graduates shall exhibit their sound theoretical and practical knowledge with skills for successful employment, advanced education, research, and entrepreneurial endeavors.

PEO2: Graduates shall establish deep-rooted mastering abilities, professional ethics, and communication alongside business abilities and initiative through lifelong learning experiences.

PEO3: Graduates shall become leaders and innovators by devising engineering solutions to care for modern society.

Chairman - BoS
AERO - HiCET

ACADEMIC COUNCIL Chairman

Dean (Academics)
HiCET

Program Outcomes (POs)

PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	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.
PO4	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.
PO5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	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
PO7	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.
PO8	Ethics	Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
PO9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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
PO12	Life-long 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.

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Program Specific Outcomes (PSOs)

The graduates will be able to

PSO1: Apply the knowledge of aerodynamics, structures, propulsion, avionics, and aircraft maintenance to give solutions for complex engineering problems.

PSO2: Use progressive methodology and tools involving design, analyze, and experiment in aircraft design.

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CURRICULUM

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. AERONAUTICAL ENGINEERING (UG)

REGULATION-2019 and 2022

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

SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA1101**	Matrices and Calculus	BSC	3	1	0	4	4	40	60	100
2.	**22ME1201**	Engineering Drawing	ESC	1	4	0	3	5	40	60	100
THEORY WITH LAB COMPONENT											
3.	**22PH1151**	Physics for Non-Circuit Engineering	BSC	2	0	2	3	4	50	50	100
4.	**22HE1151**	English for Engineers	HSC	2	0	2	3	4	50	50	100
5.	**22IT1151**	Python Programming and practices	ESC	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6.	**22HE1071**	UHV	AEC	2	0	0	2	3	40	60	100
7.	**22HE1072**	Entrepreneurship & Innovation	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
8.	**22MC1091/ 22MC1092**	தமிழரும் தொழில் நுட்பமும் / Indian Constitution	MC	2	0	0	0	2	100	0	100
			TOTAL	**15**	**5**	**6**	**19**	**27**	**470**	**330**	**800**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	**22MA2101**	Differential Equations and Complex Analysis	BSC	3	1	0	4	4	40	60	100
2.	**22CY2101**	Environmental Studies	ESC	2	0	0	2	3	40	60	100
3.	**22PH2101**	Basics Of Material Science	BSC	2	0	0	2	3	40	60	100
4.	**22ME2101**	Engineering Mechanics	ESC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
5.	**22CY2152**	Applied Chemistry	BSC	2	0	2	3	4	50	50	100
6.	**22HE2151**	Effective Technical Communication	HSC	2	0	2	3	4	50	50	100
PRACTICAL											
7.	**22ME2001**	Engineering Practices	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8.	**22HE2071**	Design Thinking	AEC	1	0	2	2	2	100	0	100
9.	**22HE2072**	Soft Skills -1	SEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											

10.	**22MC2091/ 22MC2092**	தமிழர் மரபு / Heritage of Tamils	MC	2	0	0	0	2	100	0	100
11.	**22MC2093**	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**18**	**1**	**10**	**22**	**27**	**520**	**380**	**900**

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

SEMESTER III

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

SEMESTER IV

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	**21MA4101**	Numerical Methods	BS	3	1	0	4	40	60	100
2.	**21AE4201**	Aerodynamics	PC	3	1	0	4	40	60	100
3.	**21AE4202**	Gas Turbine Propulsion	PC	3	0	0	3	40	60	100
4.	**21AE4203**	Mechanics of Machines	PC	3	0	0	3	40	60	100
THEORY AND LAB COMPONENT										
5.	**21AE4251**	Aircraft Structures - I	PC	3	0	2	4	50	50	100
PRACTICALS										
6.	**21AE4001**	Aerodynamics Laboratory	PC	0	0	3	1.5	50	50	100
7.	**21AE4002**	Propulsion Laboratory	PC	0	0	3	1.5	50	50	100

MANDATORY COURSES										
8.	**21MC4191**	Essence of Indian tradition knowledge/Value Education	MC	2	0	0	0	100	0	100
9.	**21HE4072**	**Career Guidance Level – IV** Personality, Aptitude andCareer Development	EEC	2	0	0	0	100	0	100
10.	**21HE4073**	Ideation Skills	EEC	2	0	0	0	100	0	100
			Total	**21**	**2**	**8**	**21**	**610**	**390**	**1000**

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER V

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
1.	**19AE5201**	Advanced Propulsion	PC	3	0	0	3	25	75	100
2.	**19AE5202**	Aircraft Structures - II	PC	3	0	0	3	25	75	100
3.	**19AE5203**	Flight Dynamics	PC	3	1	0	4	25	75	100
4.	**19AE5204**	High Speed Aerodynamics	PC	3	0	0	3	25	75	100
5.	**19AE53XX**	Professional Elective -I	PE	3	0	0	3	25	75	100
THEORY AND LAB COMPONENT										
6.	**19AE5251**	Aircraft Systems and General Maintenance Practices	PC	2	0	2	3	50	50	100
PRACTICALS										
7.	**19AE5001**	UAV design and Aeromodelling Laboratory	PC	0	0	3	1.5	50	50	100
8.	**19AE5002**	Aircraft Structures Laboratory -II	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9.	**19HE5071**	Soft Skills - I	EEC	0	0	0	1	100	0	100
10.	**19HE5072**	Design Thinking	EEC	0	0	0	1	100	0	100
			TOTAL	**19**	**1**	**8**	**24**	**475**	**525**	**1000**

SEMESTER VI

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
THEORY										
1.	**19AE6201**	Finite Element Methods in Engineering	PC	3	0	0	3	25	75	100
2.	**19AE6202**	Composite Materials and Structures	PC	3	0	0	3	25	75	100
3.	**19AE6203**	Heat Transfer	PC	3	0	0	3	25	75	100
4.	**19AE6181**	Total Quality Management	HS	3	0	0	3	25	75	100
5.	**19AE63XX**	Professional Elective - II	PE	3	0	0	3	25	75	100
6.	**19XX64XX**	Open Elective– I	OE	3	0	0	3	25	75	100
PRACTICALS										
7.	**19AE6001**	Structural Simulation Laboratory	PC	0	0	3	1.5	50	50	100
8.	**19AE6002**	Aero Engine and Airframe Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9.	**19AE6701**	Internship / Industrial Training	EEC	0	0	0	1	100	0	100
10.	**19HE6071**	Soft Skills - II	EEC	1	0	0	1	100	0	100
11.	**19HE6072**	Intellectual Property Rights(IPR)	EEC	1	0	0	1	100	0	100
			TOTAL	**20**	**0**	**6**	**24**	**550**	**550**	**1100**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	19EI5331	Control Engineering	PE	3	0	0	3	25	75	100
2.	19AE5301	Aircraft Materials and Process	PE	3	0	0	3	25	75	100
3.	19AE5302	Wind tunnel techniques	PE	3	0	0	3	25	75	100
4.	19AE5303	UAV and MAV design	PE	3	0	0	3	25	75	100
5.	19AE5304	Non-Destructive Evaluation	PE	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE II

1.	19AE6301	Theory of Elasticity	PE	3	0	0	3	25	75	100
2.	19AE6302	Introduction to cryogenics	PE	3	0	0	3	25	75	100
3.	19AE6303	Boundary Layer Theory	PE	3	0	0	3	25	75	100
4.	19AE6304	AI & IoT for aviation	PE	3	0	0	3	25	75	100
5.	19AE6305	Airframe Maintenance and Repair	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

OPEN ELECTIVE- I

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	19AE6401	Introduction to Flight	OE	3	0	0	3	25	75	100

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER VII

S. No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	Total
THEORY										
1.	19AE7201	Computational Fluid Dynamics	PC	3	0	0	3	25	75	100
2.	19AE7202	Vibrations and Elements of Aero Elasticity	PC	3	0	0	3	25	75	100
3.	19AE73XX	Professional Elective-III	PC	3	0	0	3	25	75	100
4.	19XX74XX	Open Elective – II	PE	3	0	0	3	25	75	100
THEORY AND LAB COMPONENT										
5.	19AE7251	Avionics	PC	2	0	2	3	50	50	100
PRACTICALS										
6.	19AE7001	Aircraft Design Project	PC	0	0	3	1.5	50	50	100
7.	19AE7002	Flow Simulation Laboratory	PC	0	0	3	1.5	50	50	100
PROJECT WORK										
8.	19AE7901	Project Phase I	EEC	0	0	4	2	50	50	100
			TOTAL	**15**	**0**	**10**	**20**	**275**	**525**	**800**

SEMESTER VIII

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	**19AE83XX**	**Professional Elective –IV**	PE	3	0	0	3	25	75	100
2.	**19AE83XX**	**Professional Elective- V**	PE	3	0	0	3	25	75	100
PROJECT WORK										
3.	**19AE8901**	Project Work – Phase II	EEC	0	0	16	8	100	100	200
			Total	**6**	**0**	**16**	**14**	**150**	**250**	**400**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	**19AE7301**	Smart Materials and Structures	PE	3	0	0	3	25	75	100
2.	**19AE7302**	Satellite Technology	PE	3	0	0	3	25	75	100
3.	**19AE7303**	Fatigue and Fracture Mechanics	PE	3	0	0	3	25	75	100
4.	**19AE7304**	Aero Engine Maintenance and Repair	PE	3	0	0	3	25	75	100
5.	**19AE7305**	Space Mechanics	PE	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE IV

1.	**19AE8301**	Experimental Stress analysis	PE	3	0	0	3	25	75	100
2.	**19AE8302**	Aviation management and Air safety Engineering	PE	3	0	0	3	25	75	100
3.	**19AE8303**	Helicopter Theory	PE	3	0	0	3	25	75	100
4.	**19AE8304**	Hypersonic Aerodynamics	PE	3	0	0	3	25	75	100
5.	**19AE8305**	Additive Manufacturing and Tooling	PE	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE V

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	**19AE8306**	Rockets and Missiles	PE	3	0	0	3	25	75	100
2.	**19AE8307**	Aircraft Rules and Regulations	PE	3	0	0	3	25	75	100
3.	**19AE8308**	Product Design and Development	PE	3	0	0	3	25	75	100
4.	**19AE8309**	Air traffic control and Airport planning	PE	3	0	0	3	25	75	100
5.	**19AE8310**	Industrial Aerodynamics	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

OPEN ELECTIVE –II

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1.	**19AE7401**	Introduction to Drones	OE	3	0	0	3	25	75	100

LIFE SKILL COURSES										
1.	**19LSZ401**	General Studies for Competitive Examinations	OE	3	0	0	3	25	75	100
2.	**19LSZ402**	Human Rights, Women's Rights and Gender Equality	OE	3	0	0	3	25	75	100
3.	**19LSZ403**	Indian Ethos and Human Values	OE	3	0	0	3	25	75	100
4.	**19LSZ404**	Indian Constitution and Political System	OE	3	0	0	3	25	75	100
5.	**19LSZ405**	Yoga for Human Excellence	OE	3	0	0	3	25	75	100

CREDIT DISTRIBUTION

R-2019

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

R-2022

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

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Dean – Academics

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HINDUSTHAN COLLEGE OF ENGG. & TECH. ACADEMIC COUNCIL Chairman

SYLLABUS

SEMESTER I

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

Course Objective

1. Construct the characteristic polynomial of a matrix and use it to identify eigenvalues and Eigenvectors
2. To impart the knowledge of sequences and series.
3. Analyseanddiscussthemaximaandminimaofthefunctionsofseveralvariables.
4. Evaluate the multiple integrals and apply in solving problems.
5. Apply vector differential operator for vector function and theorems to solve engineering problems.

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

Course Outcome

CO1: Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.
CO2: Apply the concept of differentiation to identify the maximum and minimum values of curve.
CO3: Compute partial derivatives of function of several variables and write Taylor's series for functions with two variables.
CO4: Evaluate multiple integral and its applications in finding area, volume.
CO5: Apply the concept of vector calculus in two- and three-dimensional spaces.

TEXTBOOKS:

T1:G.B.ThomasandR.L.Finney,"CalculusandAnalyticalGeometry",9thEditionAddisonWesleyPublishingcompany,2016.
T2: Erwin Kreyszig,"AdvancedEngineeringMathematics",JohnWiley&Sons,2019.
T3: K.P.Uma and S.Padma,"Engineering MathematicsI (Matrices and Calculus) ",PearsonLtd,2022.

REFERENCEBOOKS:

R1-Jerrold E.Marsden,AnthonyTromba,"VectorCalculus",W.H.Freeman,2003
R2-Strauss M.J,G.L.BradleyandK.J.Smith,"Multivariablecalculus",PrenticeHall,2002.
R3-Veerarajan T,"EngineeringMathematics",McGrawHillEducation(India)PvtLtd,NewDelhi,2016.

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Programme/sem	Course Code	Name of the Course	L	T	P	C
B.E/ I	**22ME1201**	**ENGINEERING DRAWING**	**1**	**0**	**4**	**3**

Course Objective

The learner should be able to

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

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

Course Outcome

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

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

TEXT BOOK:

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

REFERENCES:

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

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

Course Objective

1. To improve the communicative proficiency of learners
2. To help learners use language effectively in professional writing
3. To advance the skill of maintaining the suitable tone of communication.
4. To introduce the professional life skills.
5. To impart official communication etiquette.

Unit	Description	Instructional Hours
I	**Language Proficiency:** Types of Sentences, Functional Units, Framing question. **Writing:** process description, Writing Checklist. **Vocabulary –** words on environment. **Practical Component: Listening**- Watching short videos and answer the questions, **Speaking**- Self introduction, formal & semi-formal	7+2
II	**Language Proficiency**: Tenses, Adjectives and adverbs. **Writing:** Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations& acronyms), reading comprehension**. Vocabulary**– words on entertainment. **Practical Component: Listening**-Comprehensions based on TED talks **Speaking-** Narrating a short story oranevent happened in their life	7+2
III	**Language Proficiency:** Prepositions, phrasal verbs. **Writing:** Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. **Vocabulary –** words on tools. **Practical Component: Listening**-Listentosongsandanswerthequestions**Speaking**-Justaminute	5+4
IV	**Language Proficiency:** Subject verb concord, Prefixes & suffixes. **Writing:** Preparing agenda &minutes, writing an event report. **Vocabulary–** words on engineering process. **Practical Component: Listening**- Comprehensions based on Talk of orators or interview shows **Speaking-**Presentationona general topic with ppt.	5+4
V	**Language Proficiency:** Modal Auxiliaries, Active & passive voice, **Writing:** Project report (proposal & progress), sequencing of sentences **Vocabulary –** words on engineering material **Practical Component: Listening**- Listening-Comprehensions based on Nat Geo/Discovery channel videos **Speaking-** Preparing posters and presenting asateam.	6+3
	Total Instructional Hours	**45**

Course Outcome

CO1: To communicate in a professional forum
CO2: To speak or write a content in the proficient language
CO3: To maintain and use appropriate tone of the communication.
CO4: To read, write and presentina professional way.
CO5: To follow the etiquettes informal communication.

TEXTBOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.T2-Raymond Murphy, "Essential English Grammar", Cambridge UniversityPress,2019.

REFERENCEBOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.
R2-RaymondMurphy, "EnglishGrammarinUse"-4theditionCambridgeUniversityPress,2004.
R3-Kamalesh Sadanan "A Foundation Course for the Speakers of T amil-Part- I& II", Orient Black swan,2010.

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Programme	Course Code	Name of the Course	L	T	P	C
BE/B.Tech	**22PH1151**	**PHYSICS FOR NON- CIRCUIT EGINEERING (Common to Non-Circuit branches)**	2	0	2	3

The student should be able to

Course Objective

1.Gain knowledge about laser, their applications and Conversant with principles of optical fiber, types and applications of optical fiber

Enhance the fundamental knowledge in properties of matter

3. Extend the knowledge about wave optics

4. Gain knowledge about magnetic materials.

5.Acquire fundamental knowledge of nano materials which is related to the engineering program

Unit	Description	Instructional Hours
	LASER AND FIBRE OPTICS	
I	Spontaneous emission and stimulated emission –Type of lasers – Nd:YAG laser - Laser Applications – Holography – Construction and reconstruction of images. Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index and modes) – Fiber optical communication link.	6
	Determination of Wavelength and particle size using Laser	3
	PROPERTIES OF MATTER	
II	Elasticity – Hooke's law –Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending theory and experiment. Twisting couple - torsion pendulum: theory and experiment	6
	Determination of Young's modulus by uniform bending method	3
	Determination of Rigidity modulus – Torsion pendulum	3
	WAVE OPTICS	6
III	Interference of light – air wedge –Thickness of thin paper - Diffraction of light –Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating.	
	Determination of wavelength of mercury spectrum – spectrometer grating	3
	Determination of thickness of a thin wire – Air wedge method	3
	QUANTUM PHYSICS	6
IV	Black body radiation –Compton effect: theory and experimental verification – wave particle duality –concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box .	

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THERMAL PHYSICS

V	Transfer of heat energy –thermal conduction, convection and radiation – thermal conductivity - Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – applications: solar water heaters.	6
	Total Instructional Hours	**45**

After completion of the course the learner will be able to

Course Outcome

CO1: Understand the advanced technology of LASER and optical communication in the field of Engineering

CO2: Illustrate the fundamental properties of matter

CO3: Discuss the Oscillatory motions of particles

CO4: Understand the advanced technology of magnetic materials in the field of Engineering

CO5: Develop the technology of smart materials and Nano materials in engineering field

TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi2016

R2 -Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2021

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Programme /sem	Course Code	Name of the Course	L	T	P	C
B.E/ I	**22IT1151**	**PYTHON PROGRAMMING ANDPRACTICES**	**2**	**0**	**2**	**3**

Course Objective

The learner should be able to

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

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

Course Outcome

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

CO1: Develop algorithmic solutions to simple computational problems

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

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

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

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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Programme/ sem	Course Code	Name of the Course	L	T	C
B.E./B.Tech/I	22HE1071	UNIVERSAL HUMAN VALUES –II (COMMON TO ALL BRANCHES)	2	0	2

Course Objective

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

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

Course Outcome

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

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

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

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

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

Reference Books:

R1.*A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria,

2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2. Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur,

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

R3. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.

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

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

1. To acquiretheknowledgeandskillsneededtomanagethedevelopmentofinnovation.
2.Torecognizeandevaluatepotentialopportunitiestomonetizetheseinnovations.
3.Toplanspecificanddetailedmethodtoexploittheseopportunities.
4.Toacquiretheresourcesnecessarytoimplementtheseplans.
5: To make students understand organizational performance and its importance.

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

Course Outcome

CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
CO3: Remember effectivelyandefficientlythepotentialofnewbusinessopportunities.
CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.
CO5: Develop a business model for a new venture, including grevenue. Margins, operations, Working capital, and investment

TEXTBOOKS

T1**:** Arya Kumar "Entrepreneurship–CreatingandleadinganEntrepreneurialOrganization", Pearson, Second Edition (2012).
T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition (2016).

REFERENCEBOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen &Unwin Publication, Fourth Edition (2007).
R2: Thomas Lock Wood & Edger Papke "Innovation by Design", CareerPress.com, Second Edition (2017).
R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition (2010).

WEBRESOURCES

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/III.	**22MC1092**	**INDIAN CONSTITUTION**	2	0	0	0

Course Objective

1. Sensitization of student towards self, family (relationship), society and nature
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals
3. Strengthening of self-reflection
4. Development of commitment and courage to act

Unit	Description	Instructionl Hours
	BASIC FEATURES AND FUNDAMENTAL PRINCIPLES	
I	Meaning of the constitution law and constitutionalism Historical perspective of the constitution of India– salient features and characteristics of the constitution of India.	**6**
	FUNDAMENTAL RIGHTS	
II	Scheme of the fundamental rights–fundamental duties and its legislative status–The directive principles of state policy– its importance and implementation-Federal structure and distribution of legislative and financial powers between the union and states.	**6**
III	**PARLIAMENTARY FORM OF GOVERNMENT**	
	The constitution powers and the status of the president in India. –Amendment of the constitutional Powers and procedures–The historical perspective of the constitutional amendment of India–Emergency provisions: National emergency, President rule, financial emergency.	**6**
	LOCAL GOVERNANCE	
IV	Local self-government-Rural Local Government-Panchayath Raj, Elections of Panchayat-StateElectionCommission-UrbanLocalGovernment-Amendment Act, Urban Local Government Structures in India -	**6**
	INDIAN SOCIETY	
V	Constitutional Remedies for citizens–Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	**6**
	Total Instructional Hours	**30**

Course Outcome

Upon completion of the course, students will be able to
CO1: Understand the functions of the Indian government.
CO2: Understand and a bide the rules of the Indian constitution

TEXTBOOKS:

T1-Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi, 1997.
T2-AgarwalRC., "Indian Political System", S.Chand and Company, NewDelhi,1997.
T3-Maciver and Page, "Society: An Introduction Analysis", Mac Milan India Ltd., New Delhi.
T4-SharmaKL., "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, NewDelhi,1997.

REFERENCEBOOKS:

R1-Sharma, Brij Kishore, "Introduction to the Constitution of India: Prentice Hall of India, New Delhi.
R2-GahaiUR., "Indian Political System ", New Academic Publishing House, Jalaendhar.
R3-Sharma RN., "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

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Programme/ sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ IV	22MC2092	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Objective

1. TofacilitatethestudentswiththeconceptsofIndiantraditionalknowledgeandtomakethem understand the Importance of roots of knowledge system.
2. TomakethestudentsunderstandthetraditionalknowledgeandanalyzeitandapplyIttotheirday todaylife.
3. To impart basic principles of thought process, Itihas and Dharma Shastra and Connecting society and nature.
4. To understand the concept to intellectual and intellectual property rights with special Reference.
5. The course focuses on introduction to Indian Knowledge System, Indian perspectiveofamodernscientificworld-viewandbasicprinciplesofYoga and Indian philosophy.

Unit	Description	Instructional Hours
I	**Introduction to traditional knowledge:** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vs indigenous knowledge, traditional knowledge vs western knowledge	6
II	**Protection of traditional knowledge:** The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6
III	**Itihas and Dharma-Shastra** **Itihas:** The Mahabharata-The Puranas-The Ramayana **Dharma- Shastra**: ManuNeedhi-The Tirukkural–ThiruArutpa	6
IV	**Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	6
V	**Indian philosophy** Jain–Buddhist–Charvaka–Samkhya-Yoga-Nyaya-Vaisheshika-SaivaSiddhanta	6
	Total Instructional Hours	**30**

Course Outcome

CO1: Identify the concept of Traditional knowledge and its importance.
CO2: Explain the need and importance of protecting traditional knowledge.
CO3: Explain the need and importance of Itihas and DharmaShastra.
CO4: Interpret the concepts of Intellectual property to protect the traditional knowledge.
CO5: Interpret the concepts of Indian philosophy to protect the traditional knowledge

REFERENCEBOOKS

R1. Traditional Knowledge System in India, byAmitJha,2009.
R2. Traditional Knowledge System in India by AmitJha Atlantic publishers, 2002.
R3."KnowledgeTraditionsandPracticesofIndia"KapilKapoor1, Michel Danino2.
R4. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material,Bharatiya Vidya Bhavan, Mumbai, 5thEdition, 2014.
R5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Amaku, am.
R6. Human Values, A.N. Tripathi, New Age Intl. Publishers, NewDelhi,2004.

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SEMESTER II

Programme / Sem	Course Code	Name of the Course	L	T	P	C
B.E/ II	22MA2101	DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS (AERO, AGRI, AUTO,MECH,MECT)	3	1	0	4

Course Objective

The learner should be able to

1. Describe some methods to solve different types of first order differential equations.
2. Understand the various approach to find general solution of the ordinary differential equations
3. Evaluate the various types of Partial differential equations and methods to find solution.
4. Introduction to analytic functions and its properties.
5. Understand Cauchy's theorem and its applications in evaluation of integral.

Unit	Description	Instructional Hours
I	**ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER** Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation.	12
II	**LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER** Second order linear differential equations with constant with RHS of the form e^{ax} , x^n , sinax, cosax- – Cauchy's linear equations– Method of variation of parameters.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by eliminating arbitrary constants and functions – Solution of first order partial differential equations of the form f(p,q)=0, Clairaut's equation – Lagrange's equation.	12
IV	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne – Thomson's method – Conformal mapping w = A+z , Az, 1/z and bilinear transformations.	12
V	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) –Residues - Cauchy's Residue theorem - Contour Integration with unit circle only.	12
	Total Instructional Hours	60

Course Outcome

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

CO1: Apply few methods to solve different types of first order differential equations.
CO2: Evaluate the solutions of higher order ordinary differential equations and its properties.
CO3: Compute the solution of first order partial differential equations.
CO4: Understand the concept of analytic functions and discuss its properties.
CO5: Evaluate various integrals by using Cauchy's residue theorem and classify singularities and derive Laurent series expansion

TEXT BOOKS:

T1 – Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2019.
T2 - William E. Boyce, Richard C. DiPrima, Douglas B. Meade, Elementary Differential Equations and Boundary Value Problems, Wiley, 2017.
T3 - Veerarajan T, "Engineering Mathematics ", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS:

R1 - James Ward Brown, Ruel Vance Churchill, Complex Variables and Applications, McGraw-Hill Higher Education, 2004
R2 - Dennis Zill, Warren S. Wright, Michael R. Cullen, Advanced Engineering Mathematics, Jones & Bartlett Learning, 2011
R3 - Ian N. Sneddon, Elements of Partial Differential Equations, Courier Corporation, 2013

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E/ II	22CY2101	ENVIRONMENTAL STUDIES (common to all branches except CSE,IT & AIML)	3	0	0	2

Course Objective

The learner should be able to

1. Grasp the importance and issues related to ecosystem and biodiversity and their protection.
2. Acquire knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
3. Identify the various natural resources, exploitation and its conservation
4. Gain knowledge on the scientific, technological, economic and political solutions to environmental problems.
5. Become aware on the national and international concern for environment and its protection

Unit	Description	Instructional Hours
I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Main objectives and scope of environmental studies-Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – food chain, food web and ecological pyramids - energy flow in the ecosystem – ecological succession processes - Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	9
II	**NATURAL RESOURCES** Renewable and Non renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non renewable energy sources – Solar energy and wind energy - role of an individual in conservation of natural resources.	9
III	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution.	9
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones.	9
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health.	9
	Total Instructional Hours	**45**

Course Outcome

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

CO1: Discuss the importance of ecosystem and biodiversity for maintaining ecological balance.
CO2: Identify the causes of environmental pollution and hazards due to manmade activities.
CO3: Develop an understanding of different natural resources including renewable resources.
CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
CO5: Describe about the importance of women and child education, existing technology to protect environment.

TEXT BOOKS:

T1 – S.Annadurai and P.N. Magudeswaran, “Environmental studies”, Cengage Learning India Pvt.Ltd, Delhi, 2020
T2 - Anubha Kaushik and C. P. Kaushik, “Perspectives in Environmental studies”, Sixth edition, New Age International Publishers, New Delhi, 2019.

REFERENCE BOOKS:

R1 - Erach Bharucha, “Textbook of environmental studies” University Press (I) Pvt.ltd, Hyderabad, 2015
R2 - G.Tyler Miller, Jr and Scott E. Spoolman“Environmental Science” Thirteenth Edition, Cengage Learning, 2010.
R3 – Gilbert M. Masters and Wendell P. Ela “Introduction to Environmental Engineering and Science“, 3rd edition, Pearson Education, 2013.

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Programme / Sem	Course Code	Name of the Course	L	T	P	C
BE/B.Tech II	22PH2101	**BASICS OF MATERIAL SCIENCE (Common to all branches except MCT)**	2	0	0	2

Course Objective

The student should be able to

1.Gain knowledge about Crystal systems and crystal structures
2. Understand the knowledge about electrical properties of materials
3. Enhance the fundamental knowledge in semiconducting materials.
4. Gain knowledge about magnetic materials
5. Acquire fundamental knowledge new engineering materials which is related to the engineering program

Unit	Description	Instructional Hours
I	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices – Inter planar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
II	**ELECTRICAL PROPERTIES OF MATERIALS** Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression – Widemann - Franz law – Success and failures -– Fermi- Dirac statistics – Density of energy states .	6
III	**SEMICONDUCTING MATERIALS** Introduction – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Intrinsic semiconductor—electrical conductivity – band gap determination. Extrinsic semiconductor – n type and p type semiconductor – Light Emitting Diode.	6
IV	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magnetron – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications.	6
V	**NEW ENGINEERING MATERIALS** Metallic glasses: melt spinning process, Preparation and applications - shape memory alloys: phases, shape memory effect - Characteristics of SMA : Pseudoelastic effect, Super elasticity and Hystersis. Applications of SMA. Nanomaterials preparation (bottom up and top down approaches) – various techniques - pulsed laser deposition - Chemical vapor deposition	6
	Total Instructional Hours	30

Course Outcome

After completion of the course the learner will be able to

CO1: Understand the Crystal systems and crystal structures in the field of Engineering
CO2: Illustrate the fundamental of electrical properties of materials
CO3: Discuss concept of acceptor or donor levels and the band gap of a semiconducting materials
CO4: Develop the technology of the magnetic materials and its applications in engineering field
CO5: Understand the advanced technology of new engineering materials in the field of Engineering

TEXT BOOKS:

T1 - Rajendran V, “Materials Science”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- M.N Avadhanulu and PG Kshirsagar “A Text Book of Engineering physics” S. Chand and Company ltd., New Delhi 2022

REFERENCE BOOKS:

R1 – Charles Kittel “Introduction to Solid State Physics”. Wiley., New Delhi 2017
R2 - Dr. M.Arumugam “Materials Science ” Anuradha publications., 2019

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E. / II	22ME2101	ENGINEERING MECHANICS (AERO, AUTO,CIVIL,MECH)	3	0	0	3

Course Objective

The student should be able

1. To understand basic concepts and force systems in a real world environment.
2. To understand the static equilibrium of particles and rigid bodies both in two dimensions.
3. To understand the moment of surfaces and solids.
4. To understand the effect of static friction on equilibrium.
5. To understand the dynamic equilibrium equation.

Unit	Description	Instructional Hours
I	**STATICS OF PARTICLES** Introduction to engineering mechanics - Classifications, force vector, Law of mechanics, System of forces, transmissibility, Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle — forces in space – equilibrium of a particle in space..	9
II	**EQUILIBRIUM OF RIGID BODIES** Free body diagram, moment of a force – varignon's theorem – moment of a couple – resolution of a force and a couple. Support reactions of the beam.	9
III	**CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA** Centroids of simple plane areas, composite areas, determination of moment of inertia of composite plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids.	9
IV	**FRICTION** Laws of dry friction – angles of friction- angle of repose-coefficient of static and kinetic friction — Friction in inclined plane, Ladder friction, Screw friction– rolling resistance – belt friction.	9
V	**DYNAMICS OF PARTICLES** Rectilinear and Curvilinear motion, -Newton's II law – D'Alembert's principle- Energy - potential energy kinetic energy-conservation of energy-work done by a force - work energy method, Impulse momentum method, Impact of bodies, Translation and rotation of the particles.	9
	TOTAL INSTRUCTIONAL HOURS	**45**

Course Outcome

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

CO1: Define and illustrate the basic concepts of force system.
CO2: Identify the resultant force and couple, support reactions of the beam.
CO3: Calculate the Centre of gravity and moment of inertia of an object.
CO4: Examine the friction force of particles and objects for Impending Motion.
CO5: Determine the Displacement, velocity and acceleration of particles and objects

TEXT BOOKS:

T1. F.P.Beer, and Jr. E.R.Johnston., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 11th Edition, Tata McGraw-Hill Publishing company, New Delhi (2018).
T2. NH.Dubey, "Engineering Mechanics", Tata Mcraw Hill, New Delhi, 2016.

REFERENCE BOOKS:

1. R.C.Hibbeller, and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. S.S.Bhavikatti, and K.G.Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers, 2015.
3. P. JagetBabu, "Engineering Mechanics", Pearson Education, India Ltd, 2016.

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Programme/ sem	Course Code	Name of the Course	L	T	P	C
B.E/ II	22CY2152	APPLIED CHEMISTRY (MECH,AERO,CIVIL,AUTO,MCT)	2	0	2	3

Course Objective

The learner should be able to

1. Acquire knowledge on the concepts of chemistry involved in day today life.
2. Identify the water related problems and water treatment techniques.
3. Enhance the fundamental knowledge on electro chemistry and the mechanism of corrosion and its control.
4. Acquire knowledge on various thermo dynamical laws and its importance in engineering applications.
5. Acquire knowledge on the types of fuels, calorific value calculations, and manufacture of various types of fuels.

Unit	Description	Instructional Hours
I	**CHEMISTRY IN EVERYDAY LIFE** Chemicals in food – Food colors – Artificial sweeteners – Food preservatives. Soaps and Detergents – Soaps – Types of Soap – Detergents – Types of detergents. Drugs – Classification of drugs - Therapeutic Action of Different Classes of Drugs. Chemicals in Cosmetics – Creams – Talcum powders- Deodorants – Perfumes. Plastics – Thermoplastics- Preparation, properties and uses of PVC, Teflon and Thermosetting plastics - Preparation, properties and uses of Polyester and Polyurethane.	6
II	**WATER TECHNOLOGY** Impurities in Water, Hardness of Water, Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion- -Softening Methods (Zeolite & Ion-Exchange Methods)- Desalination of Brackish Water - Reverse Osmosis, Potable water and treatment. **Estimation of total, permanent and temporary hardness of water by EDTA Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method.**	6
III	**ELECTROCHEMISTRY AND CORROSION** Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electro chemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods. **Conductometric titration of strong acid vs strong base (HCl vs NaOH). Estimation of Ferrous iron by Potentiometry.**	6
IV	**CHEMICAL THERMODYNAMICS** Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs Helmholtz equation- Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore..	6
V	**FUELS AND COMBUSTION** Fuels : Classification of fuels - coal varieties - analysis of coal (proximate and ultimate analysis) - coke manufacture (Otto-Hoffman byproduct coke oven method) - characteristics of metallurgical coke - cracking (thermal and catalytic cracking definition only) – manufacturing of synthetic petrol (Fischer Tropsch method, Bergius process) – knocking (octane number, cetane number) - gaseous fuels (production, composition and uses of producer gas and water gas).Combustion : gross and net calorific value - explosive range - spontaneous ignition temperature - flue gas analysis (Orsat apparatus).	6
	Total Instructional Hours	**30**
	Total Lab Instructional Hours	**30**

Course Outcome

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

CO1: List out the chemicals used in food, soaps and detergents, drugs, cosmetics and plastics

CO2: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life

CO3:Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design

CO4: Develop sound knowledge on second law of thermodynamics and second law based derivations and its importance in engineering applications in all disciplines.

CO5: Classify the various types of fuel and their analysis and other techniques.

TEXT BOOKS

T1 - P. C. Jain & Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

T2 - O .G. Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

REFERENCES

R1 – Shikha Agarwal "Engineering Chemistry - Fundamentals and Applications, Cambridge University Press, Delhi, 2019

R2 - S. S. Dara "A Text book of Engineering Chemistry" S. Chand & Co. Ltd., New Delhi (2018).

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22HE2151	EFFECTIVE TECHNICAL COMMUNICATION (Common to all Branches)	2	0	2	3

Course Objective

The student should be able

1. To improve essential business communication skills.
2. To enrich employability knowledge.
3. To acquire the crucial organizing ability in official forum.
4. To impart important business writings.
5. To make effective presentation with essential etiquette.

Unit	Description	Instructional Hours
I	Language Proficiency: Types of sentences in English according to structure Writing: writing definitions, Describing product, work place and service (purpose, appearance, function) Vocabulary – words on nature **Practical Component: Listening- Watching and interpreting advertisements/short films Speaking- Extempore speech**	9
II	Language Proficiency: Direct and Indirect speech. Writing: Formal memos, Job application and resume preparation Vocabulary - words on offense and ethics**Practical Component: Listening- Comprehensions based on telephonic conversation Speaking- Vote of thanks& welcome address**	9
III	Language Proficiency: Homophones and Homonyms, Writing: Preparing a detail plan for an official visit, schedule and Itinerary, reading comprehension, Vocabulary– words on society **Practical Component: Listening- Listening- paraphrasing the listened content Speaking- Group Discussion with preparation**	9
IV	Language Proficiency: Idioms Writing: Report writing (marketing, investigating) Vocabulary-words involved in business **Practical Component: Listening- Watching technical discussions and preparing MoM Speaking- On the spot Group Discussion**	9
V	Language Proficiency: spotting errors Writing: making /interpreting chart, sequencing of sentences Vocabulary- words involved in finance **Practical Component: Listening- Comprehensions based on announcements Speaking- Presentation on a technical topic with ppt.**	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Interpret the structure and properties of carbohydrates
CO2	Recall the structure and properties of lipids
CO3	Recognize the structural and functional role of proteins
CO4	Classify the enzymes and interpret the enzyme action and their immobilization
CO5	Infer the structure of nucleic acids and illustrate the basics of energy metabolism

TEXT BOOK:

T1 Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2016.

T2 Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

REFERENCES:

R1 Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009.

R2 Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.

R3 Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	22ME2001	ENGINEERING PRACTICES	0	0	4	2

Course Objective

The student should be able

1 To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.

Unit **Description**

GROUP A (CIVIL AND MECHANICAL)

Instructional Hours

1. Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2. Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction
3. Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction
4. Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5. Practice on sheet metal Models– Trays and funnels
6. Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7. Practice on simple step turning, taper turning and drilling.
8. Demonstration on Smithy operation.
9. Demonstration on Foundry operation.
10. Demonstration on Power tools.

GROUP B (ELECTRICAL ENGINEERING)

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5. Measurement of energy using single phase energy meter.
6. Soldering practice using general purpose PCB.
7. Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8. Study of Energy Efficient Equipment's and Measuring Instruments.

Total Instructional Hours 45+15=60

Course Outcome

CO1 Fabricate wooden components and pipe connections including plumbing works.

CO2 Fabricate simple weld joints.

CO3 Fabricate different electrical wiring circuits and understand the AC Circuits.

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.TECH II	22HE2071	DESIGN THINKING	2	0	0	2

The student should be able to

Course Objective

1. To expose students to the design process
2. To develop and test innovative ideas through a rapid iteration cycle.
3. To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
I	**DESIGN ABILITY** Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	6
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	5
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	6
IV	**DESIGN EXPERTISE** Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	6
V	**DESIGN THINKING TOOLS AND METHODS** Purposeful Use of Tools and Alignment with Process - Journey Mapping - Value Chain Analysis - Mind Mapping – Brainstorming - Design Thinking Application: Design Thinking Applied to Product Development	7
	Total Instructional Hours	**30**

After completion of the course the learner will be able to

Course Outcome

CO1: Develop a strong understanding of the Design Process
CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.
CO3: Develop teamwork and leadership skills

TEXT BOOKS:

T1 - 1. Nigel Cross, “Design Thinking”, Kindle Edition.

REFERENCE BOOKS:

R1 - Tom Kelley, “Creative Confidence”, 2013.
R2 - 3. Tim Brown, “Change by Design”, 2009.

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
BE/B.TECH II	22HE2072	SOFT SKILLS AND APPTITUDE I	0	0	0	1

Course Objective

The student should be able to

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

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

Course Outcome

After completion of the course the learner will be able to

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

REFERENCE BOOKS:

R1 - Quantitative Aptitude – Dr. R S Agarwal
R2 -Speed Mathematics: Secret Skills for Quick Calculation - Bill Handley
R3 -Verbal and Non – Verbal Reasoning – Dr. R S Agarwal
R4- Objective General English – S.P.Bakshi

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GE3152	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 – சிற்பக் கலை**: 3

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

அலகு III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **தமிழர்களின் திணைக் கோட்பாடுகள்**: 3

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

அலகு V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

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

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22MC2092	HERITAGE OF TAMIL	2	0	0	0

Course Objective

The learner should be able to

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

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

Course Outcome

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

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

TEXTBOOKS:

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

REFERENCEBOOKS:

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

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22MC2093	SOCIAL SERVICES AND COMMUNITY DEVELOPMENT	1	0	0	1

Course Objectives:

The student should be able to

1. Acquire the knowledge and active participate in social service and community development activities.
2. Understand the concept of disaster management and role of NCC cadets in disaster management..
3. Understand the concept thinking and reasoning process..
4. Understand about maps and use of bearing and service protector
5. Know about the principles of flight and Aero foil structure and ATC procedures.

Unit	Description	Instructional Hours
I	**SOCIAL SERVICES AND COMMUNITY DEVELOPMENT** Basics of social services and its need - Rural development programs - Contribution of youth towards social welfare - NGOs in social services Swach bharath Abhiyan - Social evils - Mission Indra danush - Beti bacho Beti pado - Digital awareness - Constitution day.	3
II	**DISASTER MANAGEMENT** Organization of Disaster management -Types of emergencies - Natural and manmade disasters - fire service and fire fighting - prevention of fire.	3
III	**PERSONALITY DEVELOPMENT** Introduction to personality development - public speaking Intra and Inter personal skills -self awareness - critical thinking - Decision making and problem solving.	3
IV	**MAP READING** Types of maps - conventional signs - scales and Grid system - relief and contour gradient - cardinal points - Types of North - types of bearing and use of service protector - Prismatic compass and its uses - setting of map - finding North and own position.	3
V	**PRINCIPLES OF FLIGHT AND AIRMANSHIP** Introduction to principle of flight - Forces acting on the aircraft - Angle of attack - Angle of incidence - Newton's - law of motion - Bernauli's theorem and Venturi effect - Aerofoil - Airfield layout - ATC (Air Traffic Control) - circuit procedures - Aviation medicine.	3
	Total Instructional Hours	15

Course Outcome:

After completion of the course the learner will be able to

CO1:Perform the social services on various occasions for better community and social life

CO2:Appreciate the need and requirement for disaster management and NCC role in disaster management activities.

CO3: Define thinking, reasoning, critical thinking and creative thinking

CO4:Use of bearing and service protector and locate the places and objects on the ground.

CO5:Understand the principles of flight and Aerofoil structure

Reference:

1. UGC and AICTE circulated syllabus.

Text Books :

1. NCC cadet Guide (SD/SW) Army
2. NCC cadet Guide (SD/SW) Airforce.
3. ANOs Guide (SD/SW) by DG NCC, Ministry of Defence, New Delhi
4. Digital Forum App 1.0 & 2.0, by DG NCC DG NCC, Ministry of Defence, New Delhi

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SYLLABUS

SEMESTER III

Programme	Course Code	Name of the Course	L	T	P	C
BE	21MA3101	**Fourier Series and Statistics**	3	1	0	4

Course Objective

1. Analyze Fourier series which is central to many applications in engineering.
2. Solve boundary value problems by applying Fourier series.
3. Demonstrate knowledge of large-sample statistical properties.
4. Apply basic concepts of statistical methods for testing the hypothesis.
Analyze design of experiment techniques to solve various engineering problem.

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	**BOUNDARY VALUE PROBLEMS** Classification – Solution of one dimensional wave equation – One dimensional heat equation - Fourier series solution in Cartesian coordinates.	12
III	**TESTS BASED ON LARGE SAMPLES** Large sample tests based on Normal distribution –Test of significance for single proportion- Test of significance for difference of proportions - Test of significance for single means -Test of significance for difference of means.	12
IV	**TESTS BASED ON SMALL SAMPLES** Tests based on t (for single mean and difference of means) - F distribution for testing difference of variance, Chi – Square test for Contingency table (Test for Independency) – Goodness of fit.	12
V	**ANOVA** Introduction, assumptions of analysis of variance - Completely randomized design – Randomized block design – Latin square design.	12
	Total	**60**

Instructional Hours

Course Outcome

CO1: Understand the mathematical principles of Fourier series which would provide them the ability to formulate and solve some of the physical problems of engineering.
CO2: Apply the concept of application of Fourier series in solving the heat and wave equations.
CO3: Understand the mix proportioning techniques for field applications.
CO4: Understand the concept of statistical methods for testing the hypothesis.
CO5: Apply design of experiment techniques to solve engineering problem.

TEXT BOOKS:

T1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Reprint, New Delhi, 2016.
T2 - Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Reprint2019.

REFERENCE BOOKS :

R1 - C.Ray Wylie " Advanced Engineering Mathematics" Louis C. Barret, 6th Edition, Mc Graw Hill Education India Private Limited, New Delhi 2003.
R2 - Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 2015.
R3 - Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2018.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE3201	**Elements of Aeronautics**	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

T1 - Anderson, J.D., "Introduction to flight", 8th edition, McGraw Hill, 2016.
T2 - A.C. Kermode, "Flight without formulae", Pearson education, 5th edition, 2010.

REFERENCE BOOKS:

R1 - Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.
R2 - Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", 5th edition, Butterworth-Heinemann Publishers, London, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE3202	Engineering Fluid Mechanics	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**PROPERTIES OF FLUID AND FLOW CHARACTERISTICS** Units and dimensions - Properties of fluids - Continuum, density, viscosity, surface tension, compressibility and bulk modulus, concept of pressure. Flow characteristics - concept of control volume - application of continuity, momentum and energy equation.	9
II	**FLOW THROUGH CIRCULAR CONDUITS** 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 - Moody diagram - commercial pipes - minor losses - Flow through pipes in series and parallel.	9
III	**DIMENSIONAL ANALYSIS** Need for dimensional analysis - methods of dimensional analysis - Similitude - types of similitude - Dimensionless parameters - application of dimensionless parameters - Model analysis.	7
IV	**HYDRAULIC PUMPS** Impact of jets –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 - Rotary pumps - classification.	10
V	**HYDRAULIC TURBINES** Classification of turbines - Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbine - working principles – velocity triangles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines - governing of turbines.	10
	Total Instructional Hours	**45**

Course Outcome

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

TEXT BOOKS:

T1 - R. K. Bansal, "Fluid Mechanics and Hydraulics Machines", 10th Edition, Laxmi Publications Ltd., New Delhi, 2018.
T2 - Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics",20th Edition Standard Book House, New Delhi 2015.

REFERENCE BOOKS:

R1 - Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
R2 - Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE3203	Solid Mechanics	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

T1 - William Nash, "Strength of Materials", Tata McGraw Hill, 6th edition, 2013.
T2 - Timoshenko,S. and Young, D.H., 'Elements of Strength of Materials',5th edition T.Van Nostrand Co. Inc., Princeton,
N.J., 1990.

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE3251	Aero Engineering Thermodynamics	3	0	2	4

Course Objective

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

Unit	Description	Instructional Hours
I	**FIRST LAW OF THERMODYNAMICS** Concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, State, Path and Process, Quasi-static Process, Work, modes of work, Zeroth law of thermodynamics - concept of temperature and heat, internal energy, specific heat capacities, enthalpy - concept of ideal and real gases. First law of thermodynamics - applications to closed and open systems - steady flow processes with references to various thermal equipment - **Determination of thermal conductivity of solid - Determination of thermal resistance of a composite wall**	11+4(P)
II	**SECOND LAW OF THERMODYNAMICS AND ENTROPY** Second law of thermodynamics - Kelvin Planck and Clausius statements of second law. Reversibility and Irreversibility –Exergy - Carnot theorem, Carnot cycle efficiency - Clausius inequality, concept of entropy, Entropy change for various processes.	9
III	**AIR STANDARD CYCLES** Otto, Diesel, Dual and Brayton cycles - air standard efficiency - mean effective pressure, Actual and theoretical PV diagrams of Four stroke and Two stroke IC engines - **Valve timing of a Four stroke engine and port timing of a two stroke engine.**	10+2(P)
IV	**REFRIGERATION AND AIR CONDITIONING** Reversed Carnot cycle – Standard Rankine cycle - Principles of refrigeration and Air conditioning -Vapor compression cycle - Vapor absorption cycle - Properties of refrigerants - Coefficient of performance - **test on a vapor compression refrigeration test rig - test on a vapor compression air-conditioning test rig**	12+4(P)
V	**BASICS OF AIRCRAFTPROPULSION** Classification of jet engines - simple jet propulsion system - thrust equation - specific impulse – fundamentals of rocket propulsion.	8
	Total Instructional Hours	**60 hours**

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE3001	**Aircraft Component Drawing Laboratory**	0	0	3	1.5

Course Objective

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

Expt. No.	Description of the Experiments
1.	Design and modeling of riveted and welded joints.
2.	Design and modeling of airfoil sections.
3.	Design and modeling of various structural components of wing.
4.	Design and modeling of various structural components of fuselage.
5.	Layout of Landing gear structure.
6.	Layout of aircraft conventional control system components (cam, bell crank, push pull rod and gears)
7.	Drafting three views of a typical aircraft
8.	Design and modeling of truss and beam.
9.	Study of basic principles of geometric dimensioning and tolerance.
10.	Study of Facing, Turning and Drilling operations in CNC

Total Practical Hours 45

Course Outcome

CO1: Ability to identify the tools used in modelling software.
CO2: Ability to design various aircraft components and control systems.
CO3: Acquire the knowledge on operations using CNC machine.

List of Equipment (for a batch of 30 students)

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE3002	Fluid Mechanics and Solid Mechanics Laboratory	0	0	3	1.5

Course Objective

1. To have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps and turbines
2. To enhance the basic knowledge on strength behavior of various materials.
3. To determine the compressive strength on helical springs and deflection of beams.

Expt. No.	Description of the Experiments
1.	Determination of the Coefficient of discharge of given Venturimeter.
2.	Calculation of the rate of flow using Water and Rota meter.
3.	Determination of friction factor for a given set of pipes.
4.	Conducting experiments and drawing the characteristic curves for the centrifugal pump
5.	Conducting experiments and drawing the characteristic curves for the given turbine.
6.	Tension test on mild steel rod.
7.	Double shear test on mild steel and Aluminum rods.
8.	Torsion test on mild steel rod.
9.	Impact test on metal specimen.
10.	Hardness test on metals -Brinell and Rockwell Hardness Number
11.	Compression test on helical spring.
12.	Deflection of a simply-supported beam and cantilever beam.
13.	Strain Measurement using Rosette strain gauge.
14.	Tempering- Improvement Mechanical properties Comparison (i) Unhardened specimen (ii) Quenched Specimen and (iii) Quenched and tempered specimen.
15.	Microscopic Examination of (i) Hardened samples and (ii) Hardened and tempered samples.

Total Practical Hours 45

Course Outcome

CO1: Ability to use the measurement equipment for flow measurement
CO2: Carryout Performance test on different fluid machinery
CO3: Exposure to the characteristics of Pumps and Turbines
CO4: Understand the structural behavior of various materials.
)5: Able to experimentally evaluate the structural characteristics of helical spring and beams.

List of Equipment (for a batch of 30 students)

Sl. No.	Name of the Equipment	Qty.	Exp. No.
1	Venturi meter.	each 1	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.E. / B.Tech	21MC3191	Indian Constitution	2	0	0	0

2	Water and Rota meter.	each 1	2
3	Pipe Flow analysis setup	1	3
4	Centrifugal pump	each 1	4
5	Pelton wheel, Francis, Kaplan turbine setup	each 1	5
6	400 kN Universal Testing Machine	1	1,2
7	Torsion testing machine (60 NM capacity)	1	3
8	Impact testing machine (300 J Capacity)	1	4
9	Brinell Hardness testing machine	1	5
10	Rockwell Hardness testing machine	1	5
11	Spring Testing Machine for tensile and compressive loads (2500 N)	1	6
12	Metallurgical Microscopes	3	5
13	Beams with weight hangers and dial gauges	2	7
14	Muffle Furnace (800° C)	1	14,15
15	Strain gauge assembly	1 set	13

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Course Objective	1. Sensitization of student towards self, family (relationship), society and nature. 2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals. 3. Strengthening of self reflection. 4. Development of commitment and courage to act.

Unit	Description	Instructional Hours
I	**BASIC FEATURES AND FUNDAMENTALE PRINCIPLES** Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.	4
II	**FUNDAMENTAL RIGHTS** Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.	4
III	**PARLIAMENTARY FORM OF GOVERNMENT** The constitution powers and the status of the president in India. – Amendement of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.	4
IV	**LOCAL GOVERNANCE** Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article19 – scope of the right to life and personal liberty under article 21.	4
V	**INDIAN SOCIETY** Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	4
	Total Instructional Hours	**20**

Course Outcome	CO1: Understand the functions of the Indian government CO2: Understand and abide the rules of the Indian constitution.

TEXT BOOKS:

T1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

T2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

T3. Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.

T4. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCE BOOKS:

R1. Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.

R2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

R3. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

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Course code	Course title	L	T	P	C
21HE3072	**Career Guidance – Level III** Personality, Aptitude and Career Development	**2**	**0**	**0**	**0**
Pre-requisite	**None**	**Syllabus version** 1			

Course Objectives:

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

Expected Course Outcome:

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

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

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

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

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

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

Time and work

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

Time, Speed and Distance

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

Profit and loss, Partnerships and averages

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

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

Sentence Correction

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

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- Determiners

Sentence Completion and Para-jumbles

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

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

Essay writing

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

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

Recommended by Board of Studies

Approved by Academic Council Date

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Programme	Course Code	Name of the Course	L	T	P	C
BE/BTECH	21HE3073	**Leadership Management Skills**	1	0	0	0

Course Objective`	1. To know about the leadership skills that is to be acquired for success. 2. To become a teamwork expert, real world problem solver, your views will be challenged 3. To gain global perspective and becoming an effective communicator 4. To understand about learning, negotiation and decision making 5: To get first hand information about the skills we possess and to work on improvement.

Module	Description	Instructional Hours
1.	Strategic thinking skills	
2.	Planning and Delivery skills	
3.	People management skills (Delegation)	
4.	Change management and Innovation skills	
5.	Communication skills	
6.	Persuasion and influencing skills	
7.	Learning Agility	
8.	Motivation	
9.	Personality	
10.	Emotions	
11.	Perception	
12.	Negotiation	
13.	Decision making	
14.	Problem solving	
15.	Building trust	
	Total Instructional Hours	**15**

Course Outcome	CO1: To practice essential leadership skills in day to day operations CO2: To work on leadership skills in the study environment CO3: To understand and develop the skills consciously. CO4: To know about the real worth of all the skills for success CO5: To Analyze the real worth of the person and suggestion for improvement

TEXT BOOKS

T1: A REVIEW OF LEADERSHIP THEORY AND COMPETENCY FRAMEWORKS, Bolden, R., Gosling, J., Marturano, A. and Dennison, P. June 2003

T2: LEADING FROM WITHIN: Building Organizational Leadership Capacity-David R. Kolzow, PhD, 2014

REFERENCE BOOKS

R1: Seven habits of highly effective people – Stephen R.Covey

R2: The Art of Business Leadership: Indian Experiences – G.Balasubramaniam

R3: DEVELOPING the LEADER WITHIN YOU-JOHN C. MAXWELL

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SEMESTER IV

Programme	Course Code	Name of the Course	L	T	P	C
BE	21MA4101	**Numerical Methods**	3	1	0	4

Course Objective

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Apply various methods to find the intermediate values for the given data.
3. Explain concepts of numerical differentiation and numerical integration of unknown functions.
4. Explain single and multi step methods to solve Ordinary differential equations.

Describe various methods to solve ordinary differential equations and partial differential equation.

Unit	Description	Instructional Hours
I	**SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of Algebraic and Transcendental equations: Newton Raphson method . Solution of linear system: Gauss Elilmination - Gauss Jordan method -Gauss seidel method. Matrix inversion by Gauss Jordan method.	12
II	**INTERPOLATION** Interpolation - Newton's forward and backward difference formulae – Newton's divided difference formula and Lagrangian interpolation for unequal intervals.	12
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical Differentiation: Newton's forward and backward interpolation formulae for equal intervals –Newton's divided difference formula for unequal intervals. Numerical integration: Trapezoidal and Simpson's 1/3 rule - Double integration using Trapezoidal and Simpson's rules.	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods for solving first order equations: Taylor's series method – Euler and Modified Euler methods – Fourth order Runge-kutta method -Multi step method: Milne's predictor and corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Solution of second order ordinary differential equation by Finite difference method – Solution of partial differential equation: one dimensional heat equation by Bender schmidt method – One dimensional Wave equation by Explicit method– Poisson Equations by Finite difference method.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Solve the system of linear algebraic equations which extends its applications in the field of engineering.
CO2: Apply various methods to find the intermediate values for the given data.
CO3: Identify various methods to perform numerical differentiation and integration.
CO4: Classify and solve ordinary differential equations by using single and multi step methods.
CO5: Illustrate various methods to find the solution of ordinary and partial differential equations.

TEXT BOOKS:

T1 - Sankara Rao K, "Numerical Methods for Scientists and Engineers", 3rd edition, Prentice Hall of India Private limited, New Delhi,2007..

T2 - M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Computation", Fifth Edition, New Age International publishers 2010.

REFERENCE BOOKS :

R1 - Kreyszig.E. "Advanced Engineering Mathematics", Eight Edition, John Wiley and sons (Asia) limited.

R2 - Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2015.

R3 - S.K.Gupta, Numerical Methods for Engineers" , New Age International Pvt.Ltd Publishers,2015.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	**21AE4201**	**Aerodynamics**	3	1	0	4

Course Objective

1. To provide accumulated knowledge of fluid mechanics.
2. To provide the mathematical understanding of basic flows and their combinations.
3. To demonstrate a fundamental understanding of fluid mechanics applicable to flight, the forces and moments on airfoil.
4. To apply the aerodynamic tools to develop the three dimensional wing and study aerodynamic behavior.
5. To understand the behavior of airflow over bodies with particular emphasis on airfoil sections in the incompressible flow regime.

Unit	Description	Instructional Hours
I	**REVIEW OF BASIC FLUID MECHANICS** Continuity, momentum and energy equations-Differential in Integral forms.	10
II	**TWO DIMENSIONAL FLOWS AND GENERATION OF LIFT** Introductory concepts - Elementary flows and their combinations, Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows - Kutta Joukowski's theorem, Kutta condition.	13
III	**AIRFOIL THEORY** Cauchy-riemann relations, complex potential, methodology of conformal transformation, kutta joukowski transformation and its applications - Airfoil characteristics, Point vortex-Vortex filament- Vortex sheet, kelvins circulation theorem and starting vortex - Thin airfoil theory and its applications.	12
IV	**SUBSONIC WING THEORY** Biot-Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations.	13
V	**INTRODUCTION TO VISCOUS FLOW** Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum , energy thickness, Flow over a flat plate, Blasius solution.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Apply governing equation to various fluid flow models
CO2: Apply the knowledge of basic flows to the various bodies in the atmosphere for the generation of lift.
CO3: Solve the aerodynamic problems associated with the airfoils.
CO4: Simulate wings with help of aerodynamic tools for various ambient conditions
CO5: Acquire knowledge on incompressible flow and viscous flow.

TEXT BOOKS:

T1 - Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", 7th edition., Edward Arnold Publishers Ltd., London, 2016.
T2 - Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 6th edition, 2016.

REFERENCE BOOKS:

R2 - Clancy, L J.," Aerodynamics", Sterling book house, 2006.
R3 - Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	**21AE4202**	**Gas Turbine Propulsion**	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**PRINCIPLES OF AIRBREATHING ENGINES** Operating principles of Piston engines - Illustration and working of gas turbine engines - Thrust equation - Factors affecting thrust - Methods of thrust augmentation – performance characteristics of turboprop, turbofan and turbojet engines - Numerical Problems.	9
II	**SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES** Internal flow and Stall in subsonic inlets - Boundary layer separation - Major features of external flow near a subsonic inlet - Relation between minimum area ratio and external deceleration ratio - Supersonic inlets - Starting problem in supersonic inlets - Shock swallowing by area variation – over speeding procedures - Modes of inlet operation.	9
III	**COMBUSTION CHAMBERS FOR JET ENGINES** Introduction to combustion Chemistry- Combustion process - Classification of Gas turbine combustion chambers - Important factors affecting combustion chamber design and performance - Flame tube cooling - Flame stabilization - Use of flame holders – Aircraft fuels.	8
IV	**COMPRESSORS FOR JET ENGINES** Euler's turbo machinery equation - Principle of operation of centrifugal compressor - Work done and pressure rise - Velocity diagrams - Diffuser vane design considerations - Concept of prewhirl - Elementary theory of axial flow compressor - Velocity triangles - Degree of reaction - Compressor blade design - Centrifugal and axial compressor performance characteristics – stage efficiency calculations.	10
V	**TURBINES FOR JET ENGINES** Principle of operation of axial flow turbines – Work done and pressure rise – Velocity diagrams – Degree of reaction –Limiting factors in blade design - Vortex theory - Free vortex and constant nozzle angle designs – Performance characteristics of axial flow turbine– Turbine blade cooling methods – Stage efficiency calculations – Basic blade profile design considerations – Matching of compressor and turbine.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Analyze thermodynamics of an aircraft jet engine and calculate the performance measures, such as thrust and specific fuel consumption in terms of design requirement.
CO2: Apply the knowledge to design suitable inlets for aircraft at different conditions
CO3: Ability to choose suitable combustion chamber for various aircraft.
CO4: Ability to determine the performance and design parameters of various compressors
CO5: Evaluate the operating characteristics of turbines in terms of given blade shapes, angles, and direction of rotation.

TEXT BOOKS:

T1 - Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion", Pearson Education., 2009.
T2 - Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman,6th edition, 2008.

REFERENCE BOOKS:

R1 - Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", 2nd edition, Standard Publishers & Distributors, Delhi, 2014.
R2 - Saeed Farokhi, Aircraft Propulsion, John Wiley & Sons, Inc ., 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	**21AE4203**	**Mechanics of Machines**	3	0	0	3

Course Objective

1. To learn about different types of inversions in the mechanisms.
2. To study about the working principle gear and gear applications.
3. To understand the frictional forces acting and how to resolve the friction.
4. To analyze the forces acting on various members in a mechanism.
5. To impart the knowledge about importance of balancing and vibration acting on systems.

Unit	Description	Instructional Hours
I	**KINEMATIC OF MECHANICS** Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain– cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion.	10
II	**GEARS AND GEAR TRAINS** Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – gear trains – parallel axis gears trains – Epicyclic gear trains.	9
III	**FRICTION** Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches – Belt and rope drives.	8
IV	**FORCE ANALYSIS** Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members. Dynamic Force Analysis – Inertia Forces and Inertia Torque – Alembert's principle – Superposition principle – Dynamic Force Analysis in simple machine members.	8
V	**BALANCING AND VIBRATION** Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing of multi cylinder inline engines, v engines – Governors and gyroscopic effects. Introduction to vibration - Torsional vibration of circular shafts.	10
	Total Instructional Hours	**45**

Course Outcome

CO1. Ability to design various mechanical components.
CO2. Acquire the knowledge on gears and gear trains.
CO3. Ability to utilize the frictional force into effect.
CO4. Analyze the forces acting on the mechanism.
CO5. ability to balance the forces and vibration in a machine.

TEXT BOOKS:

T1 - R S Khurmi., "Theory of Machines", Tata McGraw-Hill, New Delhi, 2008.
T2 – Ambekar A.G., "Mechanism and Machine Theory"., Prentice hall of India., New Delhi., 2007

REFERENCE BOOKS:

R1 –Robert L. Norton., "Design of Machinery". McGraw-Hill., 2012.
R2 – Thomas Bevan., "Theory of Machines", CBS Publishers and Distributors., 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE4251	Aircraft Structures I	3	0	2	4

Course Objective

1. To know the methodological approach to the static analysis of determinate aircraft structural components.
2. To know the theoretical approach to the static analysis of indeterminate aircraft structural components.
3. To analyze the beams and trusses using energy method.
4. To analyze the stability of column and determine critical buckling loads for various end conditions.
5. To know about the different failure criteria for engineering materials.

Unit	Description	Instructional Hours
I	**STATICALLY DETERMINATE STRUCTURES** Plane truss analysis – method of joints – method of sections – Maxwell's reciprocal theorem - principle of super position - **Verification of Maxwell's reciprocal theorem - Verification of superposition theorem**	11+2(P)
II	**STATICALLY INDETERMINATE STRUCTURES** Shear force and bending moment distribution diagram for statically indeterminate beams - Clapeyron's three moment equations - moment distribution method - **Determination of Elastic constants for a Composite Flexural Specimen.**	10 +2(P)
III	**ENERGY METHODS** 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 beams & trusses - **Stress analysis of Truss structure.**	10 + 2(P)
IV	**COLUMNS** Classification of columns – Euler buckling – columns with different end conditions - Euler's column curve – Rankine's Formula - effect of initial curvature – the Southwell plot – columns with eccentricity – beam columns – beam columns with different end conditions - **Construction of south well plot for Column.**	10 +2(P)
V	**FAILURE THEORIES AND INDUCED STRESSES** Maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – shear strain energy theory - Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation – **Fatigue test-Torque Test**	9 +2 (P)
	Total Instructional Hours	**60 hours**

Course Outcome

CO1: Analyze the forces on trusses under various types of loading and support conditions.
CO2: Calculate deflection and forces on statically indeterminate aircraft structural components.
CO3: Analyze the beams and trusses using energy method.
CO4: Understand the stability of the column used as aircraft component.
CO5: Design the aircraft structural component using different theories of failure.

TEXT BOOKS:

T1 - Timoshenko and Gere, "Mechanics of Materials", CBS Publishers and Distributors., 2nd edition., 2006.
T2 - Megson T M G, "Aircraft Structures for Engineering students" Elsevier Science and Technology, 2007

REFERENCE BOOKS:

R1 - Donaldson, B.K., "Analysis of Aircraft Structures - An Introduction", McGraw Hill, 2008.
R2 - Peery, D.J. and Azar,J.J., "Aircraft Structures", 2nd Edition, McGraw – Hill, N.Y, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE4001	Aerodynamics Laboratory	0	0	3	1.5

Course Objective

1. To study the pressure distribution around different profiles
2. To determine the aerodynamic forces around Airfoils
3. To visualize the fluid flow over various objects.

Expt. No.	Description of the Experiments
1.	Study of subsonic wind tunnel
2.	Calibration of a subsonic Wind tunnel.
3.	Pressure distribution over a rough circular cylinder.
4.	Pressure distribution over a smooth circular cylinder.
5.	Pressure distribution over symmetric airfoil.
6.	Pressure distribution over cambered airfoil.
7.	Determination of lift for the given airfoil section.
8.	Force measurement on an airfoil using blower balance for small aspect ratio models
9.	Water flow visualization studies in subsonic flows using water flow channels
10.	Smoke flow visualization studies in subsonic flows

Total Practical Hours 45

Course Outcome

)1: Exposure to the calibration of Wind Tunnel
)2: Ability to measure aerodynamic forces around Airfoils
)3: Ability to measure force for small Aspect ratio models
)4: Understand the pressure distribution of flow over different profiles
)5: Ability to visualize flow using Smoke and water channel

List of Equipment (for a batch of 30 students)

Sl. No.	Name of the Equipment	Quantity	Exp. No.
1	Subsonic Wind tunnel	1	All
2	Models (aerofoil, rough and smooth cylinder, small aspect ratio models)	1 each	3-10
3	Blower balance	1	8
4	Water flow channel	1	9

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21AE4002	**Propulsion Laboratory**	0	0	3	1.5

Course Objective

1. To familiarize students and to expose them practically about various aircraft engines and their performance.
2. To practically determine the flow behavior of jets and to understand the design of turbo machinery blade profile.
3. To impart the knowledge of characteristics of fuel and to determine the performance coefficients of various heat exchangers
4. To introduce the knowledge of inspection and maintenance procedures followed for overhaul of aero engines.
5. To impart knowledge on Nondestructive testing and starting procedures of aircraft Piston engine.

Expt. No.	Description of the Experiments
1.	dy of aircraft piston and Gas turbine engines
2.	formance test on a 4-stroke engine
3.	Study of subsonic Ramjet engine with Conical flame holder
4.	Velocity profiles of free jets and wall jets.
5.	Cascade testing of compressor and turbine blades
6.	Determination of heating value of a fuel.
7.	Determination of effectiveness of Parallel flow and counter flow heat exchangers.
8.	Dismantling and reassembly procedures for aircraft piston engines.
9.	Inspection procedures for various Aircraft Piston engine Components.
10.	Study of Camshaft operation, Fuel system, Ignition system and Lubrication system of Aircraft Piston engine.
11.	Non Destructive Testing methods used for Aircraft engine components.
12.	Aircraft Piston engine Starting Procedures.

Total Practical Hours 45

Course Outcome

O1: Identify the components and Understand the working principle of various aircraft engines.
O2: Ability to evaluate the velocity profile of jets and select the blade profile for compressors and turbines.
O3: Ability to determine the properties of fuel and Coefficient of performance of various heat exchangers.
O4: Understand the inspection and maintenance procedures followed in overhauling of Aircraft engines.
O5: Ability to find defects in engine components using various non-destructive methods and understand the starting procedures of aircraft engine.

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List of Equipment (for a batch of 30 students)

Sl. No.	Name of the Equipment	Quantity	Experiment No.
1.	Aircraft Piston engine	1	1,8,9,10,11,12
2.	Aircraft gas turbine engine	1	1
3.	Jet facility with compressor and storage tank	1	4
4.	Multitube manometer	2	4
5.	Ramjet facility	1	3
6.	Cascade Wind tunnel	1	5
7.	Compressor and turbine blade set	1 each	5
8.	4 stroke twin cylinder diesel engine	1	2
9.	Parallel and counter flow heat exchanger test rig	1	7
10.	Bomb Calorimeter	1	6
11.	Set of basic tools for dismantling and assembly	1set	8
12.	Micrometers, depth gauges, Vernier calipers	1set	9
13.	Valve timing disc	1	10
14.	NDT equipment	1 set	11

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Programme	Course Code	Name of the Course	L	T	P	C
BE	21MC4191	Essence of Indian Traditional Knowledge	2	0	0	0

Course Objective

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions,Indian linguistic tradition and Indian artistic tradition.

Unit	Description	Instructional Hours
I	**BASIC STRUCTURE OF INDIAN KNOWLEDGE SYSTEM**	4
II	**MODERN SCIENCE AND INDIAN KNOWLEDGE SYSTEM**	4
III	**YOGA AND HOLISTIC HEALTH CARE**	4
IV	**PHILOSOPHICAL TRADITION**	4
V	**INDIAN LINGUISTIC TRADITION (PHONOLOGY, MORPHOLOGY, SYNTAX AND SEMANTICS), INDIAN ARTISTIC TRADITION AND CASE STUDIES.**	4
	Total Instructional Hours	**20**

Course Outcome

CO1: Ability to understand the structure of Indian system of life.
CO2: Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.

TEXT BOOKS:

T1 - Timoshenko and Gere, "Mechanics of Materials", Tata McGraw Hill, 1993.

T2 - Megson T M G, "Aircraft Structures for Engineering students" Elsevier Science and Technology, 2007

REFERENCE BOOKS:

R1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan,Mumbai, 5th Edition, 2014

R2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan

R3. Fritzof Capra, Tao of Physics

R4. Fritzof Capra, The wave of Life.

R5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am

R6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.

R7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi,2016.

R8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi,2016.

R9. P R Sharma (English translation), Shodashang Hridayam.

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Course code	Course title	L	T	P	C
21HE4072	**Career Guidance – Level IV** Personality, Aptitude and Career Development	**2**	**0**	**0**	**0**
Pre-requisite	**None**				**Syllabus version** 1

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Crack mock interviews with ease [SLO 13]
- Be introduced to problem-solving techniques and algorithms [SLO 14]

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

Student Learning Outcomes (SLO): 6, 7, 8, 13, 14

Module:1 Logical Reasoning **3 hours** **SLO:**6
Logical connectives, Syllogism and Venn diagrams

- Logical Connectives
- Syllogisms
- Venn Diagrams – Interpretation
- Venn Diagrams - Solving

Module:2 Quantitative Aptitude **6 hours** **SLO:** 7
Logarithms, Progressions, Geometry and Quadratic equations

- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Permutation, Combination and Probability

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation
- Circular Permutations
- Computation of Combination
- Probability

Module:3 Verbal Ability **2 hours** **SLO:** 8
Critical Reasoning

- Argument – Identifying the Different Parts (Premise, assumption, conclusion)
- Strengthening statement
- Weakening statement
- Mimic the pattern

Module:4 Recruitment Essentials **1 hour** **SLO:** 12
Cracking interviews - demonstration through a few mocks
Sample mock interviews to demonstrate how to crack the:

- HR interview
- MR interview
- Technical interview

Cracking other kinds of interviews

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- Skype/ Telephonic interviews
- Panel interviews
- Stress interviews

Resume building – workshop
A workshop to make students write an accurate resume

Module:5 Problem solving and Algorithmic skills 8 hours **SLO:** 12

- Logical methods to solve problem statements in Programming
- Basic algorithms introduced

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, Mock interviews, 3 Assessments with End Semester (Computer Based Test)

Recommended by Board of Studies

Approved by Academic Council Date

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PROGRAMME	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	21HE4073	IDEATION SKILLS	1	0	0	0

Course Objective

- To study the importance of ideation.
- To learn about the various tools for Ideation.
- To provide an insight in Prototyping and its significance.

Unit	Description	Instructional Hours
	IDEATION: INTRODUCTION TO DESIGN THINKING METHODOLOGY	
I	Design Thinking Methodology and how it can be used as a powerful tool for developing new and innovative solutions - Inspiration – Implementation - Disruptive technology.	4
	IDEATION: TOOLS FOR IDEATION	
II	Various resources to kindle new ideas for innovation. Explore the types of ideas in the past – Effect of the ideas and innovation of past on the world – Innovation Thinking – Case studies.	4
	IDEATION: INTRODUCTION TO CUSTOMER DISCOVERY	
III	Intro to Customer Discovery - development of customer discovery plan that can lead to powerful business innovation - Customer Discovery Plan	4
	PROTOTYPING AND PRODUCT IDEATION	
IV	Introduction to Prototyping - minimum viable product - High fidelity prototype vs low fidelity prototype – Prototyping tools	3
	Total Instructional Hours	**15**

Course Outcome

Upon completion of the course, students will be able to
CO1: Develop a strong understanding and importance of ideation
CO2: Learn about the different kinds of tools for Ideation.
CO3: Learn the need and significance of prototyping and its significance.

TEXT BOOKS:

T1 - Mark Baskinger and William Bardel, “Drawing Ideas: A Hand-Drawn Approach for Better Design”,2013
T2 - Nigel Cross, “Design Thinking”, Kindle Edition

REFERENCE BOOKS:

R1 - Kurt Hanks and Larry Belliston, “Rapid Viz : A New Method for the Rapid Visualitzation of Ideas”, 2008.
R2 - Kathryn McElroy , “Prototyping for Designers: Developing the Best Digital and Physical Products”, 2017.

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SYLLABUS

SEMESTER V

Programme	Course Code	Name of the Course	L	T	P	C
B.E	19AE5201	Advanced Propulsion	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

T1 - Sutton, G.P., et al., “Rocket Propulsion Elements”, John Wiley & Sons Inc., 8th edition., New York, 2010.
T2 - Mathur,M., & Sharma, R.P.,“Gas Turbines,Jet and Rocket Propulsion”, Standard Publishers, New Delhi 2014.

REFERENCE BOOKS:

R1 - Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W., Freeman & Co. Ltd., London, 1982.
R2 - James Award, "Aerospace Propulsion System" ,Wiley,2010.
R3 - Hieter and Pratt, "Hypersonic Air Breathing Propulsion" AIAA Education Series, 1994

R4- Robert G.Jahn, “Physics of Electric Propulsion”, Dover Publications, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5202	Aircraft Structures-II	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**UNSYMMETRICAL BENDING** Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method, Advantages and Disadvantages of three methods.	9
II	**SHEAR FLOW IN OPEN SECTIONS** Thin walled beams – concept of shear flow – the shear centre and its determination – shear flow distribution in symmetrical and unsymmetrical thin-walled sections –shear flow variation in idealized sections.	9
III	**SHEAR FLOW IN CLOSED SECTIONS** Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single & multi-cell structures subject to bending – with walls effective and ineffective – shear centre of closed sections.	9
IV	**BUCKLING OF PLATES** Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength estimation – load carrying capacity of sheet stiffener panels – effective width-Integrally stiffened panels-cutouts- Lightly loaded beams.	9
V	**STRESS ANALYSIS OF WING AND FUSELAGE** Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: determine the Bending stress for wing and fuselage structural component.
CO2: analyze the shear flow distribution for open section.
CO3: analyze the shear flow distribution for closed section subjected to torsion and shear.
CO4: Construct the Aircraft skin with stiffener and their location.
CO5: identify design features of aircraft wing and fuselage structures, and to calculate load factors and margins of safety for various loading conditions.

TEXT BOOKS:

T1 - Bruhn. E.H., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985.
T2 - Megson T M G , "Aircraft Structures for Engineering Students", Elsevier Ltd, 2012

REFERENCE BOOKS:

R1 - Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997
R2 - Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw Hill, 1993.
R3 - Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw – Hill, N.Y., 1999
R4 - Michael Chun-Yung Niu, "Airframe structural Design ",Conmilit Press Ltd,1998.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5203	Flight Dynamics	3	1	0	4

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

Unit	Description	Instructional Hours
I	**CRUISING FLIGHT PERFORMANCE** Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag –estimation of parasite drag co-efficient by proper area method- Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines . Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required	9+3
II	**MANOEUVERING FLIGHT PERFORMANCE** Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) - Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.	10+3
III	**STATIC LONGITUDINAL STABILITY** Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes -Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic balancing.	10+3
IV	**LATERAL AND DIRECTIONAL STABILITY** Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.	8+3
V	**DYNAMIC STABILITY** Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional. Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.	8+3
	Total Instructional Hours	**45+15 = 60**

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

TEXT BOOKS:

T1: Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, NY, Fourth edition, 2017.

T2: John David Anderson, Jr., 'Aircraft Performance and Design', First Edition, Tata McGraw Hill, 2010.

REFERENCE BOOKS:

R1. Nelson, R.C., 'Flight Stability and Automatics Control', Second Edition, McGraw Hill,1997.

R2. E. L. Houghton, P. W. Carpenter, Steven H Collicott, and Daniel T Valentine, 'Aerodynamic for Engineering Students', Sixth Edition,Butterworth-Heinemann, 2012.

R3. L. J. Clancy, 'Aerodynamics', 6th edition, Sterling book house, 2006.

R4. Barnes W. McCormick, 'Aerodynamics, Aeronautics and Flight Mechanics', Second Edition, John Wiley, New York, 1994.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5204	High Speed Aerodynamics	3	0	0	3

Course Objective

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

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

Course Outcome

1: understand characteristics of compressible fluid flows.
2: estimate the properties across normal and oblique shocks.
3: identify the flow patterns across expansion waves.
4: compare the effect of compressible and incompressible flow.
5: handle wind tunnels for evaluating high speed flow behaviors.

TEXT BOOKS:

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

REFERENCE BOOKS:

R1 - Yahya, S. M., Fundamentals of Compressible flow with Aircraft and Rocket Propulsion, 3rd edition, New Age International Ltd. Publishers, 2003.
R2 - Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.
R3 - L J Clancy., "Aerodynamics", Sterling book house,2006.
R4 - Zucrow, M.J. and Anderson, J.D., "Elements of gas dynamics", McGraw-Hill Book Co.,New York, 1989.

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	19HE5071	Soft Skills - I	1	0	0	1

Course Objectives:

1.To employ soft skills to enhance employability and ensure workplace and career success.
2.To enrich students' numerical ability of an individual and is available in technical flavor.
3.To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	**Introduction to Soft Skills:** Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self Management-Critical Thinking-Reflective thinking and writing- p2p Interaction	3
II	**Art of Communication:** Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non-Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve nonverbal Communication - Importance of feelings in communication - dealing with feelings in communication.	4
III	**World of Teams:** Self Enhancement - importance of developing assertive skills- developing self-confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	3
IV	**Quantitative Aptitude:** Averages - Profit and loss - Partnerships - Time and work - Time, Speed and Distance - Problems based on trains - Problems based on boats and streams	3
V	**Logical Reasoning:** Clocks - Calendars - Direction Sense - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	2

Course Outcome:

CO1:	Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.
CO2:	Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others
CO3:	Students will understand how teamwork can support leadership skills
CO4:	Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.
CO5:	Students will demonstrate an enhanced ability to draw logical conclusions and implications to solve logical problems.

REFERENCE BOOKS:

R1: Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
R2: How to prepare for data interpretation for CAT by Arun Sharma.
R3: How to Crack TEST OF REASONING in all competitive examinations by Jaikishan and Premkishan.
R4: A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali
R5: Quantitative Aptitude for Competitive Examinations - Dr. R.S. Aggarwal, S. Chand

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Programme	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech.	19HE5072	**DESIGN THINKING**	1	0	0	1

Course Objective

OBJECTIVES:

- To expose students to the design process
- To develop and test innovative ideas through a rapid iteration cycle.
- To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
I	**DESIGN ABILITY** Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	**4**
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	**4**
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	**4**
IV	**DESIGN EXPERTISE** Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert	**3**
	Total Instructional Hours	**15**

Course Outcome

Upon completion of the course, students will be able to

CO1: Develop a strong understanding of the Design Process

CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.

CO3: Develop teamwork and leadership skills

TEXT BOOKS:

T1 - 1. Nigel Cross, “Design Thinking”, Kindle Edition.

REFERENCE BOOKS:

R1 - Tom Kelley, “Creative Confidence”, 2013.

R2 - 3. Tim Brown, “Change by Design”, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5251	Aircraft Systems and General Maintenance Practices	2	0	2	3

Course Objective

1. To impart the knowledge of hydraulic and pneumatic systems.
2. To understand the basic engine systems used in aircraft.
3. To understand the concepts of Air-conditioning and Pressurizing system.
4. To handle the aircraft ground support equipment.
5. To enumerate various safety and inspection procedures

Unit	Description	Instructional Hours
I	**AIRCRAFT SYSTEMS** Hydraulic systems – components – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system – Brake system – Components - Landing Gear Systems – Retractive mechanism - Instrument Landing system.	6
II	**ENGINE SYSTEMS** Fuel Systems for Piston and Jet Engines - Multi-engine fuel systems - Lubrication System for Reciprocating and Jet Engines – Starting and Ignition systems - Study of various types of engine instruments.	6
III	**HUMAN COMFORT SYSTEMS** Basic Air cycle systems - Vapor compression and absorption cycle systems, Cabin air pressure system, and Evaporative vapor cycle systems - Evaporative air cycle systems.	6
IV	**AIRCRAFT GROUND HANDLING AND SAFETY** Mooring, jacking, leveling and towing operations, Rigging – Preparation – Equipment – precautions – Ground power unit, Shop safety – Environmental cleanliness – Precautions	6
V	**SAFETY AND INSPECTION** Hand tools – Precision instruments – Special tools and equipment's in an airplane maintenance shop, Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – Type certificate Data sheets .	6
	Total Instructional Hours	**30**

S.No	Description of Experiments	Instructional Hours
1	Aircraft "Jacking Up" and "Leveling" procedure	3
2	Aircraft "Symmetry Check"	3
3	Inspection of aircraft instruments and its function in Cessna aircraft.	3
4	Study of Landing gear systems, classification and their components.	3
5	Maintenance and rectification of snags in hydraulic and fuel systems.	3
	Total Instructional Hours	**15**

S.No	Items	Quantity	Experiment No
1	Serviceable aircraft with all above systems	1	1,2,3,4,5
2	Hydraulic Jacks (Screw Jack)	5	1
3	Trestle adjustable	5	1,2
4	Levelling Boards	2	1,2

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Course Outcome

CO1: describe the principle and working of different aircraft systems.
C03: analyze the performance of various aircraft engine systems.
)3: understand the operating principle behind basic auxiliary systems.
)4 carry out ground servicing of critical aircraft systems.
)5: understand the FAA airworthiness regulations and the checklist involved in each inspection of aircraft

TEXT BOOKS:

T1 - Nagabhushana.Sand Sudha.L.K , "Aircraft Instrumentation and Systems", I.K..International Publishing House Pvt. Ltd, New Delhi,2010.

T2 - Michael J.Kroes, William A.Watkins ad Frank Delp, "Aircraft Maintenance and Repair", Seventh Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2013.

REFERENCE BOOKS:

R1 - "Aviation Maintenance Technician Handbook - Airframe", Vol.2, U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012..

R2 - Aviation Maintenance Technician Handbook-Power plant, FAA, Vol.2., Aviation Supplies & Academics, 2012,

R3 - McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 2013.

R4 - Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5001	UAV design and Aeromodelling Laboratory	0	0	3	1.5

Course Objective

1. To impart hands on experience in making a UAV.
2. To enhance the basic knowledge in aircraft design and material selection.
3. To provide the knowledge about RC aircraft parts and its control.

Expt. No.	Description of the Experiments
1.	Study of UAVs, its classification and scope.
2.	Study of Components of Fixed wing UAVs.
3.	Design and Fabrication of non-powered Glider using Balsa Wood.
4.	Selection of Wing parameters, design and Fabrication of wing for an RC model aircraft. (using suitable materials)
5.	Selection of Fuselage parameters, design and Fabrication of Fuselage for an RC model aircraft. (using suitable materials)
6.	Power plant selection, Weight estimation and C.G calculations.
7.	Assembly of Wings, Fuselage and Landing gear.
8.	Study of Components of Multirotor UAVs.
9.	Selection of Motors, Propeller, Flight controller, Frame and Batteries.
10.	Assembly of various components and Fabrication of a Quadcopter.
11.	Flying practice using simulator.
12.	Real time Flying practice with Nano and Micro models.
13.	Study of aircraft maneuvering using FLIGHT GEAR

Total Practical Hours 45

Course Outcome

Upon completion students will be able to,
CO1: build a R.C. Aircraft with given Material.
CO2: carryout Performance test on various aspects.
CO3: design all the parts in a R.C. Aircraft.

List of Equipment (for a batch of 30 students)

Sl.No.	Name of the Equipment	Qty.
1.	RC Model Aircraft (three models : delta wing type, swept back wing and X rotor)	each 1
2	RC Helicopter model (M series)	1
3	Screw Driver (small/big)	each 1
4	Hammer (small/big)	each 1
5	Cutting Player (small/big)	each 11
6	Soldering Iron	1
7	Scissor (Small/Big)	each 1
8	Hellen Key Set	1
9	Glue Gun	1
10	Hot Air Gun	1
11	Fevicol SH 250 GRM	10
12	Fevibond SR Tube 100 ML	10
13	Nylon Rubber Band Kg	1
14	Other basic tools – set	1
15	Simulator Software (FLIGHT GEAR)	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5002	Aircraft Structures Laboratory - II	0	0	3	1.5

Course Objective

1. To enable to understand the behavior of aircraft structural components under different loading conditions.
2. To provide the Principle involved in photo elasticity and its applications in stress analysis.
3. To study about vibration of beams.

Expt. No.	Description of the Experiments
1.	Unsymmetrical Bending of a Cantilever Beam
2.	Constant strength Beam
3.	Combined bending and Torsion of a Hollow Circular Tube
4.	terial Fringe Constant of a Photo elastic Models
5.	Shear Centre of an open Channel Section
6.	Shear Centre of a Closed Section
7.	Vibration of a Cantilever Beam
8.	Fabrication of a Composite Laminate.
9.	Tension field beam.
10.	Influence line study on beams

Total Practical Hours 45

Course Outcome

CO1: perform test on beam with unsymmetrical Bending, torsion and vibration.
CO2: locate the Shear center for the various cross sections.
CO3: fabricate composite specimen

List of Equipment (for a batch of 30 students)

S.No.	Name of the Equipment	Quantity	Experiment No.
1	Unsymmetrical bending set up	1	1
2	Constant strength beam	1	2
3	Set up for combined bending and torsion	1	3
4	Photo elasticity set up	1	4
5	Beams with weight hangers and dial gauges	3	5,6,10
6	Vibration set up with accessories	1	7
7	Wagner beam	1	9

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SEMESTER VI

Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6181	Total Quality Management	3	0	0	3

Course Objective

1. To introduce about the evolution and history of management.
2. To understand the leadership qualities.
3. To learn about the basic tools used in management.
4. To learn about the basic tools for predicting quality loss.
5. To know about the concept of ISO and documentation.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention.	9
II	**TQM PRINCIPLES** Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.	9
III	**TQM TOOLS AND TECHNIQUES I** The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.	9
IV	**TQM TOOLS AND TECHNIQUES II** Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.	9
V	**QUALITY SYSTEMS** Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000– ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: understand the evolution of management in different eras.
CO2: apply the leadership skills.
CO3: implement the basic tools in management.
CO4: understand the implication of quality in business.
CO5: implement the concept of documentation.

TEXT BOOKS:

T1 - Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2013.
T2 - Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

REFERENCE BOOKS:

R1 - James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
R2 - Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
R3 - Michael A. Milgate "Transforming Corporate Performance: Measuring and Managing the Drivers of Business Success", Praeger Publisher, 2004.
R4 - ISO 9001-2015 standards

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6201	Finite Element Methods in Engineering	3	0	0	3

Course Objective

1. To give exposure to the formulation and procedure of the finite element method.
2. To provide the mathematical foundations of the finite element formulation for engineering applications and solve the same.
3. To study about the various structural elements and their properties.
4. To enumerate the loads acting on various structural elements.
5. To analyze the field variable problems like heat transfer and fluid flow problems.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction To Finite Element Method – Basic Concepts And Steps In Fem – Overview Of Approximate Methods For The Solution Of The Mathematical Models: Rayleigh-Ritz Methods, Methods Of Weighted Residuals (Galerkin, Least-Squares & Collocation Methods).	8
II	**DISCRETE ELEMENTS** Bar Elements - Uniform Section, Varying Sections - Mechanical and Thermal Loading– Introduction to boundary condition - Plane Truss Analysis: Formulation of Truss Element - Stiffness Matrix and Force Vector – Element Stress. Beam Bending-Governing Differential Equation for Beam Bending - Two Node Beam Element - Calculation of Stresses In Beams.	12
III	**CONTINUUM ELEMENTS** Triangular (CST): Plane Stress and Plane Strain Problems - Shape Function - Strain Displacement Matrix – Stress Strain Relationship Matrix - Force Vector – Nodal Displacements – Element Stress. Axisymmetric Elasticity Problems: Axisymmetric Triangular Element – Stress In Cylinders Subjected To Internal Pressure.	10
IV	**ISOPARAMETRIC ELEMENTS** Isoparametric Elements: Shape Functions for Quadrilateral Elements – Four Node Quadrilateral Elements – Serendipity Elements – Numerical Integration for Quadrilateral and Triangular Element Problems - Matrix Solution Techniques.	8
V	**DYNAMIC AND FIELD VARIABLE PROBLEMS** Longitudinal Vibration Of Bars, Lateral Vibration Of Beams, Steady State Heat Transfer: Element Formulations, Treatment To Boundary Conditions With Application To 1-D Heat Conduction, Heat Transfer Through Thin Fins, Fluid Flow Problems, Potential Flow Problems.	7
	Total Instructional Hours	**45**

Course Outcome

CO1. Understand different mathematical techniques used in FEM analysis and use them for solving structural and thermal problems.
CO2. Calculate the stresses in one dimensional structures.
CO3. Calculate the stresses in two dimensional and axi-symmetric structures
CO4. Evaluate the stresses in non-uniform higher order structures.
CO5. Solve fluid flow and field variable problems.

TEXT BOOKS:

T1 - Tirupathi.R. Chandrapatla and Ashok D. Belegundu., “Introduction to Finite Elements in Engineering", Prentice Hall India, Fourth Edition, 2012.
T2 - Rao.S.S., “Finite Element Method in Engineering", 3rd Ed., Butterworth-Heinemann, 2001.

REFERENCE BOOKS:

R1 - Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000.
R2 - Daryl L. Logan., “A First Course in the Finite Element Method”, Seventh Edition, Cengage Learning, 2017.
R3 - Bathe, K.J. and Wilson, E.L., “Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
R4 - Reddy J.N., "An Introduction to Finite Element Method", McGraw Hill, third edition, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6202	Composite Materials and Structures	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**MICROMECHANICS** Introduction - advantages and application of composite materials – types of reinforcements and matrices - micro mechanics – mechanics of materials approach, elasticity approach- fiber volume ratio – mass fraction – effect of voids in composites.	10
II	**MACROMECHANICS** Generalized Hooke's Law - elastic constants for anisotropic, orthotropic and isotropic materials - macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina - Failure theories of a lamina.	10
III	**LAMINATED PLATE THEORY** Governing differential equation for a laminate. Stress – strain relations for laminate - Different types of laminates - In plane and flexural constants of a laminate. Hygrothermal stresses and strains in a laminate. Impact resistance and interlaminar stresses. Netting analysis	11
IV	**FABRICATION PROCESS AND REPAIR METHODS** Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.	7
V	**SANDWICH CONSTRUCTIONS** Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels - bending stress and shear flow in composite beams.	7
	Total Instructional Hours	**45**

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6203	Heat Transfer	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**HEAT CONDUCTION** Basic Modes of Heat Transfer – One dimensional steady state heat conduction, Composite Medium – Critical thickness – Effect of variation of thermal Conductivity –Extended Surfaces – Unsteady state, Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and infinite solids – Use of Transient – Temperature charts – Application of numerical techniques.	11
II	**CONVECTIVE HEAT TRANSFER** Introduction – Free convection in atmosphere free convection on a vertical flat plate –Empirical relation in free convection – Forced convection – Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations, application of numerical techniques in problem solving.	10
III	**HEAT EXCHANGERS** Classification – Temperature Distribution – Overall heat transfer coefficient, Heat Exchange Analysis – LMTD Method and E-NTU Method.	8
IV	**RADIATIVE HEAT TRANSFER** Basic definitions – concept of black body - laws of black body radiation-radiation between black surfaces – radiation heat exchange between grey surfaces – radiation shielding – shape factor-electrical network analogy in thermal radiation systems - Solar heat Pipe.	8
V	**HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING** High-Speed flow Heat Transfer, Heat Transfer problems in gas turbine combustion chambers – Rocket thrust chambers – Aerodynamic heating – Ablative heat transfer.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: understand different modes of heat transfer and the resistance concept used in heat conduction
CO2: apply various correlation used in Convective Heat Transfer problems
CO3: design different types of heat exchangers.
CO4: understand the concepts of Black Body, Grey Body, View factor, Radiation shielding and solar heat pipe.
CO5: describe various heat transfer problems in aerospace engineering.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	19HE6071	Soft Skill-II	1	0	0	1

Course Objectives:

1. To make the students aware of the importance, the role and the content of softskills through instruction, knowledge acquisition, demonstration and practice.
2. To learn everything from equations to probability with a completely different approach.
3. To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	**Group Discussion & Presentation Skills:** GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback. - Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback	4
II	**Interview Skills and Personality Skills:** Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Interpersonal skills-creative thinking-problem solving-analytical skills	3
III	**Business Etiquette & Ethics:** Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress. Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	3
IV	**Quantitative Aptitude:** Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	3
V	**Logical Reasoning:** Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	2

Course Outcome:

CO1: Students will have learnt to keep going according to plan, coping with the unfamiliar, managing disappointment and dealing with conflict.

CO2: Students will Actively participate meetings, Group Discussions / interviews and prepare & deliver presentations

CO3: Students will define professional behavior and suggest standards for appearance, actions and attitude in a Business environment

CO4: Students will be able to apply quantitative reasoning and mathematical analysis methodologies to understand and solve problems.

CO5: Students will excel in complex reasoning.

REFERENCE BOOKS:

R1: Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young Talent- Bruce Tulgan

R2: Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha

R3: How to crack test of Reasoning - Jaikishan and Premkishan

R4: The hand on guide to Analytical Reasoning and Logical Reasoning - Peeyush Bhardwaj

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	19HE6072	**Intellectual Property Rights (IPR)**	1	0	0	1

Course Objectives:

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. To disseminate knowledge on copyrights and its related rights and registration aspects.
4. To disseminate knowledge on trademarks and registration aspects.
5. To disseminate knowledge on Design, Geographical Indication (GI) and their registration aspects.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTELLECTUAL PROPERTY** Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	3
II	**PATENTS** Patents -Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application -Non -Patentable Subject Matter -Registration Procedure, Rights and Duties of Patentee, Assignment and license.	3
III	**COPYRIGHTS** Purpose And Function of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	3
IV	**TRADEMARKS** Concept of Trademarks -Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) -Non-Registrable Trademarks -Registration of Trademarks.	3
V	**DESIGN AND GEOGRAPHICAL INDICATION** Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks -Procedure for registration.	3

Course Outcome:

CO1 : Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.

CO2 : Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.

CO3 : Identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing.

CO4 : Identify different types of trademarks and procedure for registration

CO5 : Recognize the concept of design, geographical indication and procedure for registration

TEXT BOOKS:

T1- Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
T2- V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt. Ltd, 2012.

REFERENCE BOOKS:

R1- Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
R2- Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6001	Structural Simulation Laboratory	0	0	3	1.5

Course Objective

1. To train the students for structural analysis using FEM based software packages
2. To introduce the problems and modern calculation methods in stress analysis of aircraft structures, as well as their application to solving real problems.
3. To the modern computational methods for stress analysis related to airframe structures..

Expt. No.	Description of the Experiments
1.	Stress analysis of beams with different loading conditions.
2.	Stress analysis of a plate with circular hole.
3.	Finding the member force in truss structure.
4.	Vibration analysis of cantilever beam.
5.	Model analysis of wing.
6.	Structural analysis of a tapered wing.
7.	Structural analysis of a fuselage structure.
8.	Analysis of a composite laminate structure.
9.	Structural analysis of a landing gear.
10.	Thermo-structural analysis of a composite laminate structure.

Total Practical Hours 45

Course Outcome

CO1: Execute design and analysis of various components.
CO2: Simulate flow behavior and perform structural analysis.
CO3: excel in structural and flow analysis so as to meet the industry requirements.

List of Equipment (for a batch of 30 students)

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6002	Aero Engine and Airframe Laboratory	0	0	3	1.5

Course Objective

1. To introduce the knowledge of the maintenance procedures followed for aircraft engine overhaul.
2. To impart the knowledge of the repair procedures followed in Airframe maintenance.
3. To study about welding of aircraft components.

Expt. No.	Description of the Experiments
1.	Piston engine dismantling and reassembly procedures.
2.	Engine (Piston Engine) - cleaning, visual inspection, NDT checks.
3.	Engine starting procedures.
4.	Study of Camshaft operation, firing order and magneto, study of carburetor and valve timing.
5.	Study of lubrication and cooling system Piston Engine.
6.	Riveted patch repairs.
7.	Tube bending and flaring
8.	eet metal forming
9.	Study on MIG, TIG & PLASMA welding of aircraft components- Welded patch repair
10.	Aircraft wood gluing-Single scarf joint and Double scarf joint
	Total Practical Hours : 45

Course Outcome

CO1: perform repair and maintenance procedures of aircraft engine overhaul.
CO2: execute repair and maintenance of airframe structures.
CO3: perform welding of aircraft components.

List of Equipment (for a batch of 30 students)

Sl. No.	Equipments	Qty.
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	2 sets
5	Valve timing disc	1
6	Shear cutter pedestal type	1
7	Drilling Machine	1
8	Bench Vices	1
9	Radius Bend bars	1
10	Pipe Flaring Tools	1
11	Welding machine	1

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EI5331	Control Engineering	3	0	0	3

Course Objective

1. State the basic elements of control systems and their transfer function models.
2. Describe the methods of representing and construction of control system components.
3. Discuss time response system analysis.
4. Establish methods of stability analysis and Frequency domain specifications.
5. Outline discrete and sampled data control systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CONTROL SYSTEMS** Historical review of control system – Basic elements in control system – Simple Pneumatic, Hydraulic and Thermal systems – Transfer Function models – Mechanical Translational, Rotational systems – Analogies –mechanical and electrical analogous systems – Development of flight control systems, AFCS.	9
II	**OPEN AND CLOSED LOOP SYSTEMS** Feedback control systems – Control system components – Open and Closed loop system – Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs – Construction–Mason's Gain Formula.	9
III	**TIME RESPONSE ANALYSIS** Laplace transformation – Standard test signals – Order and Type of a system – impulse, step response of first order systems – second order system (under damped and critically damped) –Time domain specifications – Controllers: P,PI,PID– steady state errors and error constants.	9
IV	**STABILITY AND FREQUENCY RESPONSE ANALYSIS** Necessary and sufficient conditions, Routh Array, Routh – Hurwitz criteria –relative stability, Frequency response – advantages – Frequency domain specifications, Types – Root locus and Bode techniques.	9
V	**SAMPLED AND DIGITAL CONTROL SYSTEMS** Z-Transforms, properties– sampled data control systems – sampling process – ZOH and First order Hold – mapping between S and Z planes. Introduction to digital control system, Digital Controllers and Discrete PID controllers – Positional and Velocity Algorithm.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the knowledge for modeling of mechanical and electrical control systems.
CO2: Represent the control system components and reduce them.
CO3: Deduct the different order systems with various inputs and their response.
CO4: Investigate the open and closed loop control systems stability and frequency specifications.
CO5: Analyze sampled and discrete control systems for Aircraft control.

TEXT BOOKS:

T1 - Katsuhiko Ogata, "Modern Control Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
T2 - M.Gopal, "Control Systems: Principles and Design", Tata McGraw-Hill Education, 2002.

REFERENCE BOOKS:

R1 - Houpis, C.H. and Lamont, G.B. "Digital Control Systems", McGraw Hill Book Co.,New York,U.S.A.1995.
R2 – A.NagoorKani, "Control Systems Engineerig", RBA Publications,Second Edition, 2012.
R3 - Pallet, E.H.J. "Automatic Flight Control", Shroff Publishers, India, 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5301	Aircraft Materials and Processes	3	0	0	3

Course Objective

1. To study the various types of materials and its structure
2. To analyze mechanical behavior of materials
3. To understand various types of corrosion in the materials
4. To identify the various types of composite materials and its uses
5. To understand Heat treatment processes of aircraft materials

Unit	Description	Instructional Hours
I	**ELEMENTS OF AEROSPACE MATERIALS** Structure of solid materials – Atomic structure of materials – crystal structure – miller indices – density – packing factor – space lattices – x-ray diffraction – imperfection in crystals – physical metallurgy - general requirements of materials for aerospace applications - Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect.	8
II	**CORROSION AND HEAT TREATMENT** Types of corrosion – effect of corrosion on mechanical properties – stress corrosion cracking – corrosion resistance materials used for space vehicles heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys.	8
III	**CERAMICS AND COMPOSITES** Introduction – powder metallurgy - modern ceramic materials – cermets - cutting tools – glass ceramic –production of semi-fabricated forms - plastics and rubber – carbon/carbon composites, fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design	8
IV	**HIGH TEMPERATURE MATERIALS CHARACTERIZATION** Classification, production and characteristics – methods and testing – determination of mechanical and thermal properties of materials at elevated temperatures – application of these materials in thermal protection systems of aerospace vehicles – super alloys – high temperature material characterization.	10
V	**MANUFACTURING PROCESSES** Introduction-Metal casting processes- Metal die casting, Stir casting processes. Powder metallurgy and its applications. Manufacturing of plastics- compression moulding process- Injection moulding process. Fabrication of composite materials – Open mould and Close mould processes.	11
	Total Instructional Hours	**45**

Course Outcome

1: gain knowledge in evolution of aerospace materials and its mechanical behavior.
2: understand corrosion of materials and its treatment.
3: acquire knowledge about ceramics and composites in aviation.
4: identify different types of high temperature materials for aerospace application.
5: understand various manufacturing processes of aircraft materials.

TEXT BOOKS:

T1 - Titterton.G., "Aircraft Materials and Processes", 5th Edition, Pitman Publishing Co., 1995.
T2 - Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2004.

REFERENCE BOOKS:

R1 - Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications(London) Ltd., 1987.
R2 - Popov., "Engineering Mechanics of Solids", Prentice Hall of India,2003.
R3- Van Vlack.L.H., "Materials Science for Engineers", Addison Wesley, 1985
R4 - Raghavan.V., "Materials Science and Engineering", Prentice Hall of India, New Delhi, 1993

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5302	Wind Tunnel Techniques	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5303	UAV and MAV design	3	0	0	3

Course Objective

1. To study the basic terminologies to develop the UAV systems
2. To impart knowledge about airframe design
3. To learn about the flight propulsion and navigation systems.
4. To study about various subsystems equipped in UAV and MAV.
5. To understand the performance calculation of UAV and MAV.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO UAV AND MAV WITH REGULATIONS** Historical Background of UAVs and MAVs -classifications based on range and Endurance -basic Terminology-models and prototypes - Preliminary, Conceptual and Detailed design stages, DGCA rules and Regulation for UAVs.	9
II	**AIRFRAME DESIGN** Fixed wing -Rotor -VTOL-STOL- Blimb wing Airframe - flapping wing - dynamics –modeling fuselage structures -Airfoil selection - Propeller Selection-Empennage design -Flight control surfaces specifications- Airframe maintenance.	9
III	**HARDWARE SUPPORT** Propulsion unit - Selection of motors and Battery-UAV and MAV airframe weight calculations - Payloads -Autopilot sensors-servos-accelerometer -gyros-actuators- power supply processor, integration, installation, configuration.	9
IV	**SUBSYSTEMS** Onboard Flight computer sensor-displays-Fully Autonomous takeoff and Landing system analysis - Payloads-Telemetry-tracking- -control Loops-Sensor data transmission and Encoding systems-Light weight full motion and Angle video systems.	9
V	**PATH PLANNING** Path planning - Trajectory generations-Obstacles avoidance - Endurance -Way points navigation ground control software-Flight Endurance and Range -analysis of existing UAVs and MAVs..	9
	Total Instructional Hours	**45**

Course Outcome

CO1. understand the advanced concept of UAV and MAV system design to the engineers.
CO2. acquire the importance of payload integration with UAV airframe.
CO3. design avionics hardware
CO4. perform analysis of UAVs and MAVs subsystems for stable fly
CO5. acquire knowledge of the development of UAV systems

TEXT BOOKS:

T1 - Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.
T2 - Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

REFERENCE BOOKS:

R1 - Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007.
R2 - Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001.
R3 - Mirosaw Adamski, "Power units and power supply systems in UAV", New Edition, Taylor and Francis Group publishers, 2014.
R4 - Paul Fahlstrom, Thomas Gleason., “Introduction to UAV systems”, John Wiley and sons,4th edition,2006.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE5304	Non Destructive Evaluation	3	0	0	3

Course Objective

1. To study the basic concepts involved in Non destructive testing methods
2. To understand the principles of various types of NDT methods
3. To learn about the procedures involved in thermography and eddy current testing.
4. To familiarize about the principle of Ultrasonic testing and Acoustic emission testing
5. To acquire the knowledge of Radiography.

Unit	Description	Instructional Hours
I	**OVERVIEW OF NDT** 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.	9
II	**SURFACE NDE METHODS** 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.	9
III	**THERMOGRAPHY AND EDDY CURRENT TESTING (ET)** 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.	9
IV	**ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)** 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.	9
V	**RADIOGRAPHY** 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- X RAY-Radiography, Computed Radiography, Computed Tomography	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Explain the fundamental concepts of NDT
CO2	Discuss the different methods of NDE
CO3	Explain the concept of Thermography and Eddy current testing
CO4	interpret the concept of Ultrasonic Testing and Acoustic Emission
CO5	understand 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

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REFERENCES:

1. ASM Metals Handbook,"Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 2001, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1,2015, 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

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PROFESSIONAL ELECTIVE – II

Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6301	Theory of Elasticity	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6302	Introduction to Cryogenics	3	0	0	3

Course Objective

1. To impart knowledge on the cryogenic fluids
2. To predict the storage problems of cryogenic fluids
3. To understand the thermodynamics of cryogenics
4. To analyze the operating cycles
5. To enumerate the applications of cryogenics

Unit	Description	Instructional Hours
I	**INTRODUCTION** Historical Background - Introduction to cryogenic propellants - Liquid hydrogen, liquid helium, liquid nitrogen and liquid oxygen and their properties	7
II	**LOW TEMPERATURE PRODUCTION** Theory behind the production of low temperature - Expansion engine heat exchangers - Cascade process Joule Thompson Effect - Magnetic effect - Ortho and H2 - Helium4 and Helium 3 – Metals for low temperature application	10
III	**EFFICIENCY OF CRYOGENIC SYSTEMS** Types of losses and efficiency of cycles - specific amount of cooling - The fraction liquified – Cooling coefficient of performance - Thermodynamic efficiency – The energy balance Method	10
IV	**OPERATION CYCLES OF CRYOGENIC PLANTS** Classification of cryogenic cycles - The structure of cycles - Throttle expansion cycles - Expander cycles - Thermodynamic analysis - Numerical problems	10
V	**CRYOGENIC IN AEROSPACE APPLICATIONS** Cryogenic liquids in missile launching and space simulation Storage of cryogenic liquids - Effect of cryogenic liquids on properties of aerospace materials – Cryogenic loading problems - Zero gravity problems associated with cryogenic propellants - Phenomenon of tank collapse – Storage vessel, thermal shield and insulation - Elimination of Geysering effect in missiles	8
	Total Instructional Hours	**45**

Course Outcome

CO1: understand the evolution of cryogenic fluids
CO2: understand the storage problems of cryogenic fluids
CO3: predict the heat transfer characteristics
CO4: identify various operating cycles for cryogenics
CO5: enumerate the application of cryogenics

TEXT BOOKS:

T1 - Haseldom, G., “Cryogenic Fundamentals”, Academic Press, 1971
T2 - Barron, R. F., “Cryogenic Systems”, Oxford University, 1985

REFERENCE BOOKS:

R1 - Parner, S. F., “Propellant Chemistry”, Reinhold Publishing Corporation., New York 1985
R2 - Randall Barron., Gregory Nellis., “ Cryogenic Heat Transfer” 2nd edition, CRC Press.1999.
R3 - Valery V. Kostionk., “A Text Book Of Cryogenics”, Discovery Publishing House, 2003.
R4 – S S Thipse.,”Cryogenics-A Text book”, Alpha science International Publisher, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6303	Boundary Layer Theory	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Course Title	L	T	P	C
BE	19AE6304	AI & IoT for aviation	3	0	0	3

Course Objectives:

1. Learn the fundamental knowledge about artificial intelligence.
2. Describe about the image perception and modelling of real time systems.
3. Outline the basic concepts of Internet of Things.
4. Gain knowledge about IoT devices.
5. Know the applications of AI and IoT in aerospace industry.

Unit	Description	Instructional Hours
I	**Basics and Evolution of Artificial Intelligence:** Introduction- Foundation –History of Artificial intelligence – The state of the art- Weak AI Vs Strong AI-Ethics and Risks of developing Artificial intelligence-Present and Future of AI- Intelligent agents and its structures.	8
II	**Perception and Modelling:** Image formation – Early image Processing Operations – Extracting Three-Dimensional Information –Object Recognition - Using Vision for Manipulation and Navigation – Introduction to Robotics – Robot Hardware- Robotic Perception- Planning to move – Uncertain movements – Moving –Robotic software architectures– Application Domains.	10
III	**Fundamentals of Internet of Things:** Definition – Characteristics of IoT- Its Physical design– Logical design – Enabling Technologies – Levels and Deployment Templates.	9
IV	**Design and Development of IoT Devices:** Domain Specific IoTs – IoT Vs M2M – IoT Design Methodology – Motivation for using Python – Basic building blocks of an IoT device – Exemplary Device-Raspberry Pi board – Other IoT devices.	9
V	**Applications of AI and IoT in Aerospace industry :** AI applications: Predictive Maintenance and Machinery Inspection – Modernized Airport and Runway Construction – Flight Performance and Crisis Management – Auto-pilot and Training. IoT applications: Smart factory adopted by Airbus, Weather Forecasting, Space Navigation System, IoT use case in Mars Exploration - Marsbees.	9
	Total Instructional Hours	**45**

Course Outcome:

CO1: Understand about the basics of Artificial intelligence.
CO2: Identify image processing operations and robotic operations.
CO3: Understand the fundamental of IoT.
CO4: Familiarize about the IoT devices.
CO5: Apply the AI and IoT knowledge in their domain specification.

TEXT BOOKS:

T1 - V. Scople Vinod, “Managing Intellectual Property”, Prentice Hall of India pvt Ltd, 2012
T2 - S. V. Satakar, “Intellectual Property Rights and Copy Rights”, EssEss Publications, New Delhi, 2002.

REFERENCE BOOKS:

R1 - Deborah E. Bouchoux, —Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.
R2 - PrabuddhaGanguli,Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
R3 - Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
R4 – P.Merges., C.Ginsburg., “Foundation on Intellectual property”, Foundation press,2019.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	19AE6305	Airframe Maintenance and Repair	3	0	0	3

Course Objective

1. To make the students to understand the working of Airframe components.
2. To make use of the tools used for maintaining the various components.
3. To study about the positioning of aircraft while maintenance.
4. To analyze and evaluate various investigation on maintenance.
5. To troubleshoot the detailed safety practices in hanger.

Unit	Description	Instructional Hours
I	**MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS** Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding. **SHEET METAL REPAIR AND MAINTENANCE** Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing. Riveted repair design - Damage investigation - Reverse engineering.	10
II	**PLASTICS AND COMPOSITES IN AIRCRAFT** Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Cleaning of fiber reinforced plastic materials prior to repair- Break test - Repair Schemes- FRP/honeycomb sandwich materials- laminated FRP structural members and skin panels; Tools/equipment- Vacuum-bag process- Special precautions - Autoclaves	9
III	**AIRCRAFT JACKING, ASSEMBLY AND RIGGING** Airplane jacking and weighing and C.G. Location - Balancing of control surfaces - Inspection maintenance - Helicopter flight controls - Tracking and balancing of main rotor.	9
IV	**REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM** Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).	10
V	**SAFETY PRACTICES** Hazardous materials storage and handling - Aircraft furnishing practices – equipment's used - Trouble shooting - Theory and practices.	7
	Total Instructional Hours	**45**

Course Outcome

CO1: know the working of airframe components.
CO2: use their knowledge on tools for plastic maintenance practices.
CO3: position the aircraft while maintenance in hanger.
CO4: handle the pneumatic and hydraulic systems used in aircraft.
CO5: perform the safety practices inside the hanger.

TEXT BOOKS:

T1 - Kroes, Watkins, Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, March 2013.
T2 - Delp. Bent and Mckinely "Aircraft Maintenance Repair", McGraw Hill, New York, 1987.

REFERENCE BOOKS:

R1 - Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 2008.
R2 - Brimm D.J. Bogges H.E., "Aircraft Maintenance", Pitman Publishing corp., New York, 1995.
R3 - "Aviation Maintenance Technician Handbook - Airframe", Vol.2, ", U.S.Dept. of Transportation, Federal Aviation Administration, Flight Standards Service, 2012..
R4 - Aviation Maintenance Technician Handbook-Power plant, FAA, Aviation Supplies & Academics, 2012, Vol. 2

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6401	Introduction to Flight	3	0	0	3

Course Objective

1. To introduce the concept of flying and evolution of flight.
2. To gain knowledge about the basic design and contol components of aircraft.
3. To provide the basic idea about the atmosphere and aerodynamic forces.
4. To understand the concept of powerplants.
5. To learn the basic construction and structrures of an aircraft.

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

Course Outcome

CO1: Learn the history of various flight over the years.
CO2: understand the functions of various control components.
CO3: understand about the aerodynamic behavior of an aircraft.
CO4: understand about the basic science of aircraft engines.
CO5: implement structural properties of materials.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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SYLLABUS

SEMESTER VII

Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7201	Computational Fluid Dynamics	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7202	Vibration and Elements of Aero Elasticity	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**SINGLE DEGREE OF FREEDOM SYSTEMS** Introduction to simple harmonic motion, D'Alembert's principle, free vibrations – damped vibrations – forced vibrations, with and without damping – support excitation – transmissibility - vibration measuring instruments – Introduction to helicopter vibration and methods for measurement and control	10
II	**MULTI DEGREE OF FREEDOM SYSTEMS** Two degrees of freedom systems - static and dynamic couplings - vibration absorber- Multi degree of freedom systems - principal co-ordinates - principal modes and orthogonal conditions - Eigen value problems - Hamilton's principle - Lagrangean equations and application.	10
III	**CONTINUOUS SYSTEMS** Vibration of elastic bodies - vibration of strings – longitudinal, lateral and torsional vibrations	8
IV	**APPROXIMATE METHODS** Approximate methods - Rayleigh's method - Dunkerley's method – Rayleigh-Ritz method	9
V	**ELEMENTS OF AERO-ELASTICITY** Concepts- Coupling - Aero elastic instabilities and their prevention- Collars triangle - Basic ideas on wing divergence, loss and reversal of aileron control- Flutter and its prevention.	8
	Total Instructional Hours	**45**

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7251	**Avionics**	2	0	2	3

Course Objective

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

Unit	Description	Instructional Hours
I	**INTRODUCTION TO AVIONICS** Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, Design, technologies.	5
II	**DIGITAL AVIONICS ARCHITECTURE** Avionics Bus architecture–Data buses MIL–RS 232- RS422- MIL STD 1553 B–ARINC 429–ARINC 629- Aircraft system Interface, Development and integration-Use of simulation tools, stand alone and integrated Verification and Validation. **Sorting of Data in Ascending & Descending order for voting mechanism-Addition/Subtraction of 8 bit and 16 bit data for control surface deflection.**	6
III	**FLIGHT DECKS AND COCKPITS** Control and display technologies: CRT, LED, LCD, EL and plasma panel – Direct voice input (DVI) – ARINC 818- Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS. **Sum of a given series with and without carry for identifying flap data.**	6
IV	**INTRODUCTION TO NAVIGATION SYSTEMS AND AUTOPILOT SYSTEMS** Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS– Inertial Navigation Systems (INS) – Satellite navigation systems. Auto pilot – Basic principles, Longitudinal and lateral auto pilot**. Greatest in a given series & Multi-byte addition in BCD mode- Addition/Subtraction of binary numbers using adder and Subtractor circuits.**	8
V	**MAINTENANCE AND COST OF AVIONICS** Built in Test equipments, speed maintenance ATLAS, Remote diagnostics, Maintenance support-life cycle cost for Military and civil avionics systems, Cash flow analysis and software cost- Establishing spare levels.	5
	Total Instructional Hours	**45**

Course Outcome

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

CO2: Ability to build Digital avionics architecture

CO3: Ability to design flight decks and cockpits

CO4: Ability to design Navigation system

CO5: Ability to design and perform analysis on air system

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

List of Equipment (for a batch of 30 students)

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7001	Aircraft Design Project	0	0	3	1.5

Course Objective

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

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

Total Practical Hours 45

Course Outcome

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7002	Flow Simulation Laboratory	0	0	3	1.5

Course Objective

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

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

Total Practical Hours 45

Course Outcome

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

List of Equipment (for a batch of 30 students)

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

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PROFESSIONAL ELECTIVE-III

Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7301	Nano Science and Technology	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

R1 - Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.
R2 - G Timp, "Nanotechnology", AIP press/Springer, 1999.

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R3- Brenner D W, Lyshevski S E, and Goddard W A, ―Handbook of Nanoscience Engineering and Technology‖, CRC Press, 2009.
R4-Ramachandra Rao M S and Shubra Singh, ―Nanoscience and Nanotechnology: Fundamentals to Frontiers‖, Wiley, Delhi, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7302	Satellite Technology	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	19AE7303	Fatigue and Fracture Mechanics	3	0	0	3

Course Objective

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

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

Course Outcome

1. Understand how fatigue occurs in structures.
2. Analyze the type of various aspects of fatigue behavior.
3. Access the different types of cracks on components.
4. Ability to analyze the fracture due to fatigue.
5. Skill to perform on fatigue design.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7304	Aero Engine Maintenance And Repair	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

R1 - Turbomeca, “Gas Turbine Engines ", The English Book Store ", New Delhi, 1993.
R2 - United Technologies’ Pratt & Whitney, "The Aircraft Gas turbine Engine and its Operation”, The English Book Store, New Delhi.2001.
R3 – “Aircraft Engine log book” Graphyco publishing,Volume.3., 2019
R4 – Varsha Arora., “Planner 2020-AME” Wiley publisher.,Germany,2019.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	19AE7305	Space Mechanics	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

T1 - Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 1984.
T2 - Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982.

REFERENCE BOOKS:

R1 - Thomas A Ward, "Aerospace Propulsion systems", John Wiley, 2010.
R2 - Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1993.
R3 - Van de Kamp, P., "Elements of Astromechanics", Pitman, 1979.
R4 – Tom Logdson "Orbital Mechanics-Theory and Application", John Wiley and Sons, New York,1998.

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PROFESSIONAL ELECTIVE-IV

Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8301	Experimental Stress Analysis	3	0	0	3

Course Objective

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

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

Course Outcome

1. Understand the strain measurement techniques in structures using mechanical and other means.
2. Determine strain in structures using electrical strain gauges.
3. Acquire knowledge in testing and evaluation of stress in photoelastic materials.
4. Calculate of failure stress in coatings using different failure theories.
5. Use extensive knowledge in using non-destructive testing for testing purpose.

TEXT BOOKS:

T1 - Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., “Experimental Stress Analysis”, Tata McGraw-Hill, New Delhi, 1984.

T2 - Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 1996.

REFERENCE BOOKS:

R1 - Dally, J.W., and Riley, W.F., “Experimental Stress Analysis”, McGraw-Hill Inc., NewYork,IV edition,2005.

R2 - Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall,1993.

R3 - Durelli. A.J., "Applied Stress Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1970.

R4 - Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8302	Aviation Management And Air Safety Engineering	3	0	0	3

Course Objective

1. To familiarize the Civil aviation, Airport terminologies, airport planning, management and operations
2. To provide the knowledge of infrastructure, condition monitoring and control aids.
3. To provide knowledge on Safety Regulations and Aviation Security.
4. To study and understand the technologies in Air Safety Maintenance.
5. To learn about technological advancement in aviation security.

Unit	Description	Instructional Hours
I	**INTRODUCTION** History of Aviation- Development of Air transportation in India- Major players in Airline Industry- Market potential of Indian Airline Industry— Current challenges in Airline Industry-Competition in Airline Industry –Role of ICAO and IATA in Air transportation – Airport terminology - Classification of aerodromes -Classification of airports.	9
II	**AIRPORT MANAGEMENT AND AIRLINE OPERATIONS** **Airport Management**- Airport planning- Airport Operations - Organization structure of Airports Sectors - Global and Indian scenario of Airport management –DGCA –AAI. **Airline Operations** -Airline Terminal Management- Flight Information Counter/Reservation and Ticketing-Check In/Issue of Boarding pass-Customs and Immigration formalities -Security Clearance-Baggage-Handling -Handling of CIP,VIP & VVIP– Introduction to Airport cargo management.	9
III	**INSTITUTIONAL FRAMEWORK AND CONTROLLING** Role of DGCA – Slot allocation – Methodology followed by ATC and DGCA – Role of Air Traffic Control - Importance of Air Traffic Control - Flight rules - Automation in Air Traffic Control aids - GPS Air Traffic Control - Aerodrome standards and Air Traffic Services -Air Safety -Design standards and type certification - Flight crew standards, training and licensing	10
IV	**AIR SAFETY** Rules of air avoidance of collision – lights to be displayed by aircraft – Visual and instrument flight rules – Distress urgency and safety signals - Hijacking – Security Measures - Screening- Metal Detectors –X-ray Inspections, Trace- Detection Techniques - Aviation regulations -threat warnings - Civil Aviation Security - Airborne Aircraft Security.	10
V	**TECHNOLOGICAL IMPROVEMENTS ON AVIATION SAFETY AND SECURITY** Technological Improvements on Aviation Safety and Security Introduction- Microwave Holographic Imaging - Body or Fire Security Scanner - New Generation of video Security Systems –Bio simmer – Biometric Systems.	7
	Total Instructional Hours	**45**

Course Outcome

CO1: understand Aviation and Airport Management.
CO2: know the Airport Infrastructure and its maintenance procedures.
CO3: gain knowledge about Air traffic control and GPS systems.
CO4: understand the requirement of Air Safety and the supporting systems.
CO5: get familiarity in technologies in Aircraft maintenance.

TEXT BOOKS:

T1 – Rangwala. "Airport Engineering", Charotar Publishing House Pvt., 15th edition 2015.
T2 – Wells .A-Airport Planning and Management, 4th Edition-McGraw-hill, London-2000..

REFERENCE BOOKS:

R1 – Alexender.T. Wells, Seth young, principles of airport management, excel books, 2007.
R2 – P.S. Senguttuvan –Fundamentals of Airport Transport Management –McGraw Hill 2003
R3 – Richard H.Wood ,"Aviation Safety Programs-A management hand book"–Jeppesen Sanderson Inc, 1991.
R4 -Aviation and Airport Security –Kathleen M. Sweet –Pearson Education Inc., Second edition, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8303	Helicopter Theory	3	0	0	3

Course Objective

1. To make the student familiarize with the principle involved in helicopters.
2. To understand the aerodynamics of helicopter rotor blade
3. To gain knowledge in various power plants equipped in helicopter
4. To study the performance and stability aspects of Helicopter under different operating conditions
5. To understand the source and control of helicopter transmission.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Helicopter as an aircraft, Layout, Configuration based on antitorque system, Generation of lift, lead-lag, flapping and feathering motion, Rotor controls and various types of rotor, Blade loading, Effect of solidity , Rotor efficiency.	11
II	**AERODYNAMICS OF ROTOR BLADE** Aerofoil characteristics in vertical flight, Hovering and forward flight. Vortex ring state, Blade stall, High speed limitations; Induced, profile and parasite drag , power loading, ground effect	10
III	**POWER PLANTS** Piston engines, Gas turbine engines, Ramjet principle, Comparative performance, Power requirements, Autorotation.	7
IV	**STABILITY AND VIBRATION** Stability and control response. Properties of vibrating system, phenomenon of vibration, vibration absorbers, Measurement of vibration in flight.	8
V	**ROTOR AND TRANSMISSION SYSTEMS** Blade construction, Materials, Factors affecting weight and cost. Blade alignment - Tracking. Static main rotor balance. Drive shaft, freewheeling unit, rotor brake, sprag clutch. Tail rotor system.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Perform the Aerodynamics calculation of Rotor blade
CO2. Calculate the power components of helicopter blade
CO3. Compare the performance of power plants
CO4. Perform stability and control characteristics of Helicopter
CO5. Apply the knowledge in rotor and transmission system of a helicopter.

TEXT BOOKS:

T1 - John Fay, "The Helicopter and How It Flies", Himalayan Books 1995
T2 - Lalit Gupta, "Helicopter Engineering", Himalayan Books New Delhi 1996

REFERENCE BOOKS:

R1 - Jeppesen, " Helicopter Maintenance", 2nd edition , Jeppesen and sons Inc., 2000
R2 - R W Prouty, Helicopter Aerodynamics, Phillips Pub Co, 1993.
R3 – Ryan Dale.,"Helicopters Maneuvers manual., Aviation Supplies & Academics Inc.2011.
R4 - W.J. Wagtendonk, "Principles of Helicopter Flight",2nd edition,ASA Newyork,2019.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8304	Hypersonic Aerodynamics	3	0	0	3

Course Objective

1. To introduce the fundamentals of hypersonic aerodynamics
2. To determine flow properties for hypersonic inviscid flows.
3. To understand hypersonic viscous flow theory
4. To determine flow properties for hypersonic viscous interactions.
5. To understand the temperature effects in hypersonic flows.

Unit	Description	Instructional Hours
I	**INTRODUCTION** 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.	9
II	**SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS** 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.	9
III	**VISCOUS HYPERSONIC FLOW THEORY** 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.	9
IV	**VISCOUS INTERACTIONS IN HYPERSONIC FLOWS** 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..	9
V	**HIGH TEMPERATURE EFFECTS in HYPERSONIC FLOWS** 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.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Knowledge in basics of hypersonic and supersonic aerodynamics
CO2: Acquiring knowledge in theory of hypersonic flow.
CO3: Understanding of boundary layers of hypersonic flow
CO4: Understanding viscous interactions in hypersonic flows.
CO5: Role of chemical and temperature effects in hypersonic flow.

TEXT BOOKS:

T1 - John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", Mc.Graw hill Series, New York, 1996.
T2 - Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press, 1982.

REFERENCE BOOKS:

R1 - John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", Mc.Graw Hill Publishing Company, New York, 1996.
R2 – John T. Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington.D.C.,1994.
R-3-Vinh, N.X, A. Busemann, and R. D Culp, 'Hypersonic and Planetary Entry Flight Mechanics', University of Michigan Press, Ann Arbor, 1980. 5.
R-4-Hayes, W.D, and R.F Probstein, 'Hypersonic Flow Theory', Second Edition, Academic Press, New York, 19.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8305	Additive Manufacturing and Tooling	3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION 9

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

UNIT II REVERSE ENGINEERING & CAD MODELING 9

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

UNIT III ADDITIVE MANUFACTURING SYSTEMS 9

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

UNIT IV SINTERING BASED ADDITIVE MANUFACTURING SYSTEMS 9

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

UNIT V TOOLING 9

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications, Case studies- aerospace industries.

TOTAL: 45 Hours

COURSE OUTCOME

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

Text Books

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

Reference Books

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

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PROFESSIONAL ELECTIVE-V

Programme	Course Code	Name of the Course	L	T	P	C
B.E	19AE8306	Rockets and Missiles	3	0	0	3

Course Objective

1. To understand the basic concepts of rocket and missiles in current scenario.
2. To give the relations in motion in space and gravitational field.
3. To study about the rocket aerodynamics in the region of rockets and missile flight.
4. To augment their knowledge staging & control of rockets.
5. To know the materials and propulsion systems of rockets and missiles.

Unit	Description	Instructional Hours
I	**CLASSIFICATION OF ROCKETS AND MISSILES** 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.	8
II	**MOTION IN SPACE AND GRAVITATIONAL FIELS** 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.	10
III	**AERODYNAMICS OF ROCKETS AND MISSILES** Airframe components of rockets and missiles – forces acting on a missile while passing through atmosphere – 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.	10
IV	**STAGING AND CONTROL OF ROCKETS** Multi-staging 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.	9
V	**PROPULSION SYSTEMS AND MATERIALS** 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 slosh and propellant hammer – elimination of geysering effect in missiles – selection of materials – special requirements of materials to perform under adverse conditions.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: know about the current scenario and classification of rockets and missiles.
CO2: gain knowledge about the trajectory motion of rockets in gravitational field and in space.
CO3: find the aerodynamic characteristics of rockets and missiles.
CO4: design the staging and control of the rockets.
CO5: get basic knowledge about the propulsion systems and materials used.

TEXT BOOKS:

T1 - Sutton, G.P., et al., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 2016.
T2 - Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W., Freeman & Co. Ltd., London, 1982.

REFERENCE BOOKS:

R1 - Mathur,M., & Sharma, R.P.,“Gas Turbines,Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1998.
R2 - Parker, E.R., “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co. Inc., 1982.
R3 - A. Bowdoin Van Riper,”Rockets and Missiles”.,Greenwood Publication,2004.
R4 - Vinh, N.X, A. Busemann, and R. D Culp, ‘Hypersonic and Planetary Entry Flight Mechanics’, University of Michigan Press, Ann Arbor, 1980. 5.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8307	Aircraft Rules and Regulations	3	0	0	3

Course Objective

1. To teach the civil air rules and regulations which are being followed by Directorate General of Civil Aviation
2. To familiarize the students in Airworthiness
3. To ensure design levels of reliability and operating safety of civil registered aircraft through promulgation.
4. To enforce the highest achievable standards of airworthiness
5. To gain knowledge about approval of aviation organizations.

Unit	Description	Instructional Hours
I	**C.A.R SERIES'A'-PROCEDURE FOR CIVIL AIR WORTHINESS REQU AND RESPONSIBILITY OPERATORS VIS-À-VIS AIRWORTHINESS DIRECTORA** Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Obje and targets of airworthiness directorate; Airworthiness regulations and safety oversight c activities of operators.	8
II	**C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, M** Deficiency list (MEL & CDL); Preparation and use of cockpit check list and emergency **C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATIO REPORTING** Defect recording, reporting, investigation, rectification and analysis; Flight report; Rep rectification of defects observed on aircraft; Analytical study of in-fight readings & rec Maintenance control by reliability Method. **C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES** Reliability Programme (Engines); Aircraft maintenance programme& their approval; O maintenance of reciprocating engines; TBO - Revision programme - Maintenance of fue and consumption records - Light aircraft engines; Fixing routine maintenance periods a TBOs - Initial & revisions.	7
III	**C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS** Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrast stations other than parent base. C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Req renewal of Certificate of Airworthiness.	10
IV	**C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER - LICENSING** Issue of AME Licence, its classification and experience requirements, Complete Series C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: Mandatory Modifications / Inspections.	8
V	**C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT** Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which been previously issued. C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; Weight and balance control of an aircraft; Provision & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Ai books; Document to be carried on board on Indian registered aircraft; Procedure for permit; Procedure for issue of type approval of aircraft components and equipment including in **C.A.R. SERIES 'X' – AIRTRANSPORT OF DRONES** Unique identification number (UIN), Unmanned Aircraft Operator Permit (UAOP), op requirements.	12
	Total Instructional	**45**

Course Outcome

CO1: acquire knowledge of Airworthiness requirements for transport, military, gliders and micro light aircrafts.
CO2: understand the Defect recording, reporting, investigation, rectification and analysis
CO3: understand the procedure for holding examinations, proficiency checks etc. for Defense personnel to fulfill the requirements for grant of civil licenses.
CO4: explain the procedure relating to registration of aircraft

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CO5: gain knowledge of Issue/validation and renewal of Certificate of Airworthiness

TEXT BOOKS:

T1 - Aeronautical Information Circulars (relating to Airworthiness) from DGCA 2000

T2 - Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.

REFERENCE BOOKS:

R1 - Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 17-1,Connaught Circus, New Delhi.

R2 -"Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. Advisory Circulars ", form DGCA.

R3 – "Aviation Handbook and Manual" FAA,Volume 2.,New Delhi 2014.

R4 – "FAR/AIM 2019: Federal Aviation Regulations / Aeronautical Information Manual (FAR/AIM Series)" FAA Hand book, ASA Publisher,2018.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8308	Product Design and Development	3	0	0	3

Course Objective

1. To introduce the basic concept of engineering design and product development.
2. To impart the knowledge on product development with the focus on front end process.
3. To understand the overview of all the product development process
4. To acquire the knowledge of concept generation and selection tools.
5. To understand the concept of design and cost analysis

Unit	Description	Instructional Hours
I	**INTRODUCTION** Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research	9
II	**CUSTOMER NEEDS** Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies	10
III	**CREATIVE THINKING** Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods-TRIZ- axiomatic design	6
IV	**DECISION MAKING AND PRODUCT ARCHITECTURE** Decision making –decision theory –utility theory –decision trees –concept evaluation methods – Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture	10
V	**DESIGN AND COST ANALYSIS** Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing	10
	Total Instructional Hours	**45**

Course Outcome

CO1. Understand the basic concept of engineering product design and development
CO2. Identify the customer needs in new product development
CO3. Understand the importance of creative thinking new design.
CO4. Knowledge on product architecture and decision making
CO5. Evaluate the design feasibility and cost effectiveness.

TEXT BOOKS:

T1 - Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9

T2 - Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2015, Pearson Education,ISBN 9788177588197

REFERENCE BOOKS:

R1 - Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.

R2 - George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9.

R3 - Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8309	Air Traffic Control and Airport Planning	3	0	0	3

Course Objective

1. To acquire knowledge about basic concepts of air traffic system
2. To study and understand about the air traffic control, procedure and air traffic service
3. To learn about various instruments used for air traffic control
4. To study the procedure of the formation of aerodrome and its design.
5. To know the various emergency services providing in the air traffic control system

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS** Objective of Air Traffic Control systems – Parts of ATC services – VFR & IFR operations – Classification of ATS air spaces – Varies kinds of separation – Altimeter setting procedures –Division of responsibility of control.	9
II	**AIR TRAFFIC SERVICES** Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report.	9
III	**FLIGHT INFORMATION ALERTING SERVICES, COORDINATION, EMERGENCY PROCEDURES AND RULES OF THE AIR** Basic radar terminology – Classification of radars– Identification procedures using primary /secondary radar – performance checks – use of radar in area and approach control services – co-ordination between radar / non radar control – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures.	10
IV	**AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION** 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 etc. – obstacles restriction.	9
V	**VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES** 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.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: acquire the concept of air traffic rules and clearance procedures for airline operation.
CO2: analyze the various air traffic data for air traffic services.
CO3: explore the emergency procedure and air rules followed by air traffic control systems.
CO4: understand the influence of aerodrome design factors for service establishments.
CO5: gain the information of navigation and emergency procedures in the air traffic control systems.

TEXT BOOKS:

T1 - AIP (India) Vol. I & II, "The English Book Store", 17-1, Connaught Circus, New Delhi.
T2 - "Aircraft Manual (India) Volume I", latest Edition – The English Book Store, 17-1, Connaught Circus, New Delhi.

REFERENCE BOOKS:

R1 - "PANS – RAC – ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Circus, NewDelhi.
R2 - Michael S. Nolan., "Fundamentals of Air Traffic Control", Cengage Learning.
R3 - Wells .A-Airport Planning and Management, 4th Edition-McGraw-Hill, London-2000.
R4 – P S Senguttuvaan., "Fundamentals of Air Transport Management", McGraw-Hill, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE8310	Industrial Aerodynamics	3	0	0	3

Course Objective

1. To understand the application of various types of wind tunnels in the field of aerodynamics.
2. To understand about the wind energy conversion systems and wind turbine design.
3. To learn and understand the road vehicles aerodynamics.
4. To acquire the knowledge about building aerodynamics and problems associated with tall & small building design
5. To learn the concept of effect of wake formation and special vibration issues.

Unit	Description	Instructional Hours
I	**UNIT I ATMOSPHERE** Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.	9
II	**WIND ENERGY COLLECTORS** Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.	9
III	**VEHICLE AERODYNAMICS** Power requirements and drag coefficients of automobiles, Effects of cut back angle, basic shape factors and bluff body Aerodynamics of trains and Hovercraft.	9
IV	**BUILDING AERODYNAMICS** Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation, architectural aerodynamics and application of tower and bridge aerodynamics.	9
V	**FLOW INDUCED VIBRATIONS** Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter-Introduction to industrial gas turbines.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: understand the concepts of tunnels.
CO2: analyze the design concept of wind turbines & power efficiency.
CO3. understand the road vehicles aerodynamics in terms of drag reduction.
CO4: understand the wind forces on buildings and architectural design parameters.
CO5: apply the knowledge to bluff body aerodynamics and flow induced vibrations.

TEXT BOOKS:

T1 - Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRC Press – Taylor & v Francis, 2007.
T2 - M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and Road vehicles", Plenum press, New York, 1978.

REFERENCE BOOKS:

R1 - Blevins. R.D., "Flow Induced Vibrations", Van Nostrand, 1990.
R2 - Calvent. N.G., "Wind Power Principles", Charles Griffin & Co., London, 1979
R3 – Tony Burton, Nick Jenkins, David Sharpe and Ervin Bossanyi, "Aerodynamics of Horizontal Axis Wind Turbines"John Wiley & Sons, Ltd, 2011
R4 - Sachs. P., "Winds forces in Engineering", Pergamon Press, 1978.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE6401	Introduction to Flight	3	0	0	3

Course Objective

6. To introduce the concept of flying and evolution of flight.
7. To gain knowledge about the basic design and contol components of aircraft.
8. To provide the basic idea about the atmosphere and aerodynamic forces.
9. To understand the concept of powerplants.
10. To learn the basic construction and structrures of an aircraft.

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

Course Outcome

CO1: Learn the history of various flight over the years.
CO2: understand the functions of various control components.
CO3: understand about the aerodynamic behavior of an aircraft.
CO4: understand about the basic science of aircraft engines.
CO5: implement structural properties of materials.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19AE7401	Introduction to Drones	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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MAPPING OF COURSE OUTCOMES (COs), PROGRAM OUTCOMES (POs) AND PROGRAM SPECIFIC OUTCOME (PSOs)

B. E. AERONAUTICAL ENGINEERING (UG)

Academic Year 2022-2023

REGULATION-2019, 2019 (Amendment) & 2022

SEMESTER-I														
22MA1101/ MATRICES AND CALCULUS														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2	2	2
C04	3	3	3	3	3	-	-	-	-	-	-	2	2	3
C05	3	3	3	3	3	-	-	-	-	-	-	2	1	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2
22ME1201 - Engineering Drawing														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	1	-	1	-	-	1	1	1	1	2
CO2	3	3	2	1	1	-	1	-	-	1	1	1	1	2
CO3	3	3	3	-	1	1	1	-	-	1	1	-	1	1
C04	3	3	3	1	1	2	1	-	-	1	1	1	1	1
C05	3	3	3	1	1	3	1	-	-	1	1	1	1	1
AVG	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4
22PH1151/ PHYSICS FOR NON CIRCUIT ENGINEERING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	-	1	-	2	3	3	2
CO2	3	3	2	2	1	1	1	-	1	-	2	2	3	1
CO3	3	3	2	2	2	1	1	-	1	-	1	2	2	2
CO4	3	2	3	1	3	1	1	-	1	-	1	2	2	1
CO5	3	2	3	1	2	1	1	-	1	-	2	2	2	1
Avg	3	2.6	2.6	1.6	2.2	1	1	-	1	-	1.6	2.2	2.4	1.4
22HE1151 / ENGLISH FOR ENGINEERS														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	2	-	-	-	-	1	2	2	2	3	1	1	1	2
CO2	2	1	-	-	1	1	1	2	2	3	-	2	-	2
CO3	2	1	-	-	1	1	2	3	3	3	-	1	1	2
CO4	2	1	-	-	-	1	2	2	2	3	1	1	-	-
CO5	2		-	-	-	1	1	2	3	3	-	1	1	2
Avg	2	1	-	-	1	1	1.6	2.2	2.4	3	1	1.2	1	2
22IT1151 - Python Programming and practices														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
C04	2	3	3	-	2	-	-	-	2	-	-	2	2	2
C05	2	3	3	-	2	-	-	-	2	-	-	2	2	2
AVG	2	3	3	-	2	-	-	-	2	-	-	2	2	2
SEMESTER-II														
22MA2101 - Differential Equations and Complex Analysis														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	2	2.2
22CY2101 - Environmental Studies														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	1	1	-	-	-	-	1	1	-
CO2	3	2	2	-	2	1	-	-	-	-	-	1	-	-
CO3	3	2	2	-	2	1	1	-	-	-	-	1	-	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	-	1
CO5	3	2	2	-	2	1	-	-	-	-	-	1	-	1
Avg	3	2	2	2	2	1	1	-	-	-	-	1	1	1
22PH2101 - Basics Of Material Science														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	-	-	-	1	2	-	-
CO2	3	3	1	1	2	-	-	-	-	-	1	2	-	-
CO3	3	2	1	2	2	-	-	-	-	-	1	2	-	-
CO4	3	3	1	2	2	1		-	-	-	1	2	-	-
CO5	3	2	2	3	2	1	2	-	-	-	1	2	-	-
Avg	3	2.4	1.2	1.8	1.8	1	1.5	-	-	-	1	2	-	-
22ME2101 - Engineering Mechanics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	1	-	-	-	1	1	1	2

CO2	3	3	2	1	-	-	1	-	-	-	1	1	1	2
CO3	3	3	1	-	-	1	1	-	-	1	1	-	1	1
C04	3	3	2	1	-	2	1	-	-	1	1	1	1	1
C05	3	3	2	1	-	3	1	-	-	1	1	1	1	1
AVG	3	3	1.6	1	-	2	1	-	-	1	1	1	1	1.4
22CY2152 - Applied Chemistry														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	-	1	-	1	2	-	-
CO2	2	3	2	1	1	1	1	-	1	-	1	2	-	-
CO3	2	2	2	2	1	1	1	-	1	-	1	2	-	-
CO4	2	2	3	1	2	1	1	-	1	-	2	2	-	1
CO5	2	3	3	2	2	1	1	-	1	-	1	2	-	-
Avg	2	2.6	2.6	1.4	1.4	1	1		1		1.2	2		1
22HE2151 - Effective Technical Communication														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	_	2	_	_	1	_	1	3	_	1	_	2	1
CO2	2	1	_	_	_	2	2	2	3	_	2	_	1	1
CO3	2	_	1	_	_	2	_	1	3	_	2	_	1	1
CO4	1	2	_	_	_	1	_	1	3	_	1	_	1	1
CO5	1	_	_	2	_	1	_	1	3	_	2	_	1	1
Avg	1.4	1.5	1.5	2	_	1.4	2		3	_	1.6	_	1.2	1
22ME2001- Engineering Practices														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO2	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO3	3	-	3	-	3	-	1	-	1	-	-	-	1	2
AVG	3	-	3	-	3	-	-	-	1	-	-	-	1	2
SEMESTER-III														
21MA3101 & Fourier Series and Statistics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	1
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	3
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2
C04	3	3	3	1	2	2	-	-	-	-	-	2	2	2
C05	3	3	3	2	1	1	-	-	-	-	-	2	2	3
AVG	3	2.8	3	1.4	1.4	2	-	-	-	-	-	2.2	2.2	2.2
21AE3201 & Elements of Aeronautics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	1

CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	1
C04	3	-	-	-	-	-	-	-	-	-	-	-	2	1
C05	3	-	-	-	-	-	-	-	-	-	-	-	2	1
AVG	3	-	-	-	-	-	-	-	-	-	-	-	2	1
21AE3202 & Engineering Fluid Mechanics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	1
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	1
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	1
C04	3	3	2	3	-	-	-	-	-	-	-	2	2	2
C05	3	3	2	3	-	-	-	-	-	-	-	2	2	2
AVG	3.0	2.8	2.0	2.7	-	-	-	-	-	-	-	2.0	2.6	1.4
21AE3203 & Solid Mechanics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C04	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C05	3	1	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	1.6	1.2	-	-	-	-	-	-	-	-	-	3	2
21AE3251 & Aero Engineering Thermodynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	2	2	1	-	-	-	-	-	-	-	-	3	2
C05	3	1	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2.2	1.6	1	-	-	-	-	-	-	-	-	3	2
21AE3001 & Aircraft Component Drawing Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	-	-	-	-	2	3	2	3
CO2	3	3	2	3	3	2	-	-	-	-	2	3	2	3
CO3	3	2	1	2	3	2	-	-	-	-	2	2	1	3
AVG	3	2.7	1.7	2.7	3.0	2.0	-	-	-	-	2.0	2.7	1.7	3
21AE3002 & Fluid mechanics and Solid mechanics Laboratory														

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

SEMESTER-IV

21MA4101 & Numerical Methods

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	2	2	1
C04	3	3	3	3	3	-	-	-	-	-	-	2	2	1
C05	3	3	3	3	3	-	-	-	-	-	-	2	2	1
AVG	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2

21AE4201 & Aerodynamics

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

21AE4202 & Gas Turbine Propulsion

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	1	2	-	-	1	-	-	-	-	2	3	2
C04	3	2	1	3	-	-	-	-	-	-	-	-	3	2
C05	3	2	2	3	-	-	-	-	-	-	-	2	3	2
AVG	3.0	2.0	1.3	2.4	-	-	1.0	-	-	-	-	2.0	3.0	2.0

21AE4203 & Mechanics of Machines

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2

CO2	3	2	1	-	1	-	-	-	-	-	-	-	2	1
CO3	3	2	-	1	-	-	-	-	-	-	-	-	2	1
C04	3	2	-	-	-	-	-	-	-	-	-	-	2	1
C05	3	2	-	1	-	-	-	-	-	-	-	-	2	2
AVG	3	2	1	1	1	-	-	-	-	-	-	-	2.2	1.4
21AE4251 & Aircraft Structures - I														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
C04	3	2	-	-	-	-	-	-	-	-	-	1	3	2
C05	3	2	2	2	-	-	-	-	-	-	-	1	3	2
AVG	3	2.4	2	2	-	-	-	-	-	-	-	1	3	2
21AE4001 & Aerodynamics Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	3
CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	3
C04	3	2	2	2	-	-	-	-	-	-	-	-	3	3
C05	3	2	2	1	-	-	-	-	-	-	-	-	3	3
AVG	3	1.8	1.8	1.6	-	-	-	-	-	-	-	-	3	3
21AE4002 & Propulsion Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	2	2	3	2
CO2	3	3	-	2	2	-	-	-	-	-	2	2	3	3
CO3	3	3	-	2	-	-	-	-	-	-	2	2	3	3
C04	3	2	-		-	-	-	-	-	-	2	2	3	3
C05	3	3	-	2	-	-	-	-	-	-	2	2	3	3
AVG	3.0	2.8	-	2.0	2.0	-	-	-	-	-	2.0	-	3.0	2.8
SEMESTER-V														
19AE5201 & Advanced Propulsion														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	2	-	-	-	-	2	3	2
C04	3	3	2	2	-	-	2	-	-	-	-	2	3	2

C05	3	-	-	-	-	-	2	-	-	-	-	2	3	2
AVG	3.0	3.0	2.3	2.0	-	-	2.0	-	-	-	-	2.0	3.0	2.0
19AE5202 & Aircraft Structures - II														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	2
CO2	3	3	-	-	-	-	-	-	-	-	-	1	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	1	3	2
C04	3	3	2	2	-	-	-	-	-	-	-	1	3	2
C05	3	3	3	3	-	-	-	-	-	-	-	1	3	2
AVG	3	2.8	2.5	2.5	-	-	-	-	-	-	-	1	3	2
19AE5203 & Flight Dynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	2	1	1	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	1	-	-	-	-	-	-	-	-	3	2
AVG	3	2	1.4	1.2	-	-	-	-	-	-	-	-	3	2
19AE5204 & High Speed Aerodynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	1
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	1
CO3	3	3	-	2	2	-	-	-	-	-	-	-	3	1
C04	3	3	3	2	2	-	-	-	-	-	-	-	3	-
C05	3	-	2	-	2	-	-	-	-	1	-	2	3	3
AVG	3.0	3.0	2.3	2.0	2.0	-	-	-	-	1.0	-	2.0	3.0	1.5
19AE5251 & Aircraft Systems and General Maintenance Practices														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	-	2	-	-	2	1	1
CO2	-	-	-	-	2	3	3	-	3	-	-	-	1	1
CO3	-	-	-	-	-	3	3	-	3	2	-	-	1	1
C04	-	-	-	-	-	3	3	-	3	2	-	-	1	1
C05	-	-	-	-	2	-	-	-	-	-	-	-	1	1
AVG	-	-	-	-	2.0	3.0	3.0	-	2.8	2.0	-	2.0	1.0	1.0
19AE5001 & UAV design and Aeromodelling Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	2	2	1
CO2	3	2	2	2	1	-	-	-	-	-	-	2	2	1
CO3	3	2	2	2	2	-	-	-	-	-	-	2	2	1
AVG	3	2	2	2	1.3	-	-	-	-	-	-	2	2	1
19AE5002 & Aircraft Structures Laboratory -II														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	-	2	-	-	-	-	-	2	-	-	2	3	3
CO2	3	-	2	-	-	-	-	-	2	-	-	2	3	3
CO3	3	-	2	-	2	-	-	-	2	-	-	2	3	3
AVG	3	-	2	-	2	-	-	-	2	-	-	2	3	3
SEMESTER-VI														
19AE6181 & Total Quality Management														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	2	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	3	-	3	-	-	-
C04	2	-	-	-	-	-	-	-	3	-	3	-	-	-
C05	2	-	-	-	-	-	2	-	3	-	3	-	-	-
AVG	2	-	-	-	-	-	2	3	3	-	3	-	-	-
19AE6201 & Finite Element Methods in Engineering														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1	-	-	-	-	-	-	-	2	2
CO2	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO3	3	2	2	1	1	-	-	-	-	-	-	-	2	2
C04	3	2	2	1	1	-	-	-	-	-	-	-	2	2
C05	3	3	2	1	2	-	-	-	-	-	-	-	2	2
AVG	3	2.2	2.2	1.2	1.2	-	-	-	-	-	-	-	2	2
19AE6202 & Composite Materials and Structures														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	3	3
CO2	3	3	3	2	1	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	1	-	-	-	-	-	-	1	3	3
C04	3	2	2	2	1	-	-	-	-	-	-	1	3	3
C05	3	3	3	2	1	-	-	-	-	-	-	1	3	3
AVG	3	2.4	2.2	2	1	-	-	-	-	-	-	-	3	3
19AE6203 & Heat Transfer														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	1.8	1.4	1	-	-	-	-	-	-	-	-	3	2
19AE6001 & Structural Simulation Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	3	-	-	-	-	-	1	2	3	2
CO2	3	2	2	2	3	-	-	-	-	-	-	2	3	2
CO3	3	3	2	1	2	-	-	-	-	-	1	2	3	1

AVG	3.0	2.7	2.0	1.3	2.7	-	-	-	-	-	1.0	2.0	3.0	1.7
19AE6002 & Aero Engine and Airframe Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	-	3	-	-	2	2	-	2	3	1
CO2	3	2	2	2	-	-	-	-	2	2	-	-	3	2
CO3	3	3	3	2	-	-	-	-	2	2	-	-	3	3
AVG	3.0	2.3	2.3	2.3	-	3.0	-	-	2.0	2.0	-	2.0	3.0	2.0
SEMESTER-VII														
19AE7201 & Computational Fluid Dynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
C04	2	2	2	2	2	-	-	-	-	-	-	-	2	2
C05	3	3	3	2	2	-	-	-	-	-	-	-	2	2
AVG	2.4	2.2	2.2	2	2	-	-	-	-	-	-	-	2	2
19AE7202 & Vibrations and Elements of Aero Elasticity														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	-	-	-	-	-	-	-	-	-	3	2
C05	2	2	2	-	-	-	-	-	-	-	-	-	2	2
AVG	2.8	2.8	2	-	-	-	-	-	-	-	-	-	2.8	2
19AE7251 & Avionics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	2	2	-	-	-	1	3	3	2
CO2	3	1	3	3	3	1	-	-	-	-	-	-	3	2
CO3	3	2	3	3	3	1	-	-	-	-	-	3	3	3
C04	3	3	3	-	3	3	2	-	-	-	-	2	3	2
C05	3	3	1	2	3	-	-	-	-	-	-	3	3	2
AVG	3.0	2.2	2.4	2.7	3.0	1.8	2.0	-	-	-	1.0	2.8	3.0	2.2
19AE7001 & Aircraft Design Project														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	2	3	2	2	2	3	3
CO2	3	3	3	3	2	-	1	1	3	2	2	2	3	3
CO3	3	3	3	3	1	1	-	1	3	2	2	2	3	3
C04	3	3	3	3	2	-	2	1	3	2	2	2	3	3
C05	3	2	3	3	3	2	-	-	3	2	2	2	3	3
AVG	3.0	2.8	3.0	3.0	2.2	1.3	1.3	1.3	3.0	2.0	2.0	2.0	3.0	3.0
19AE7002 & Flow Simulation Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	3	2	3	2	-	-	-	-	-	1	2	3	3
CO2	3	3	2	2	1	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	1	-	-	-	-	-	-	2	3	3
AVG	3.0	3.0	2.3	2.7	1.3	-	-	-	-	-	1.0	2.0	2.7	2.7
19AE7901 & Project Phase I														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO5	3	3	3	3	3	2	2	3	3	3	3	2	3	3
AVG	3	3	3	3	3	2	2	3	3	3	3	2	3	3
SEMESTER-VIII														
19AE8901 & Project Work – Phase II														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	2	3	3
CO5	3	3	3	3	3	2	2	3	3	3	3	2	3	3
AVG	3	3	3	3	3	2	2	3	3	3	3	2	3	3

PROFESSIONAL ELECTIVES

19EI5331 & Control Engineering														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	1	-	1	-	-	-	-	-	-	-	1	1	-
CO3	3	1	2	1	2	-	-	-	-	-	-	1	1	-
C04	3	1	2	1	2	-	-	-	-	-	-	1	1	-
C05	3	1	-	-	-	-	-	-	-	-	-	1	1	-
AVG	3	1	2	1	2	-	-	-	-	-	-	1	1	-
19AE5301 & Aircraft Materials and Process														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	-
C04	3	2	2	-	-	-	-	-	-	-	-	-	3	-
C05	3	2	1	-	-	-	-	-	-	-	-	-	3	-
AVG	3	2	1.3	-	-	-	-	-	-	-	-	-	3	-
19AE5302 & Wind tunnel techniques														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	3	1	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	1	2	2	1	-	-	-	-	-	-	-	-
CO3	3	3	1	2	2	1	-	-	-	-	-	-	-	-
C04	3	3	1	2	2	1	-	-	-	-	-	-	-	-
C05	3	2	1	2	2	1	-	-	-	-	-	-	-	-
AVG	3	2.8	1	2	2	1	-	-	-	-	-	-	-	-
19AE5303 & UAV and MAV design														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	2	-	-	-	-	-	-	-	-	3	2
C05	3	2	2	1	-	-	-	-	-	-	-	-	3	2
AVG	3	2.4	2	1.6	1	-	-	-	-	-	-	-	3	2
19AE5304 & Non Destructive Evaluation														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	1	1	2	2	2	2	2	3	2
CO2	3	2	2	1	2	1	1	2	2	2	2	2	3	2
CO3	3	2	2	1	2	1	1	2	3	2	2	2	3	2
C04	2	2	2	1	2	1	1	2	3	2	2	2	3	1
C05	3	2	2	1	2	1	1	2	3	1	1	2	3	2
AVG	2.8	2	2	1	2	1	1	2	2.6	1.8	1.8	2	3	1.8
19AE6301 & Theory of Elasticity														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	3	1
CO2	3	3	1	1	-	-	-	-	-	-	-	-	3	1
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1
C04	3	3	3	2	-	-	-	-	-	-	-	-	3	1
C05	3	3	3	2	-	-	-	-	-	-	-	-	3	1
AVG	3	3	2.2	1.8	-	-	-	-	-	-	-	-	3	1
19AE6302 & Introduction to cryogenics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO2	3	2	1	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	3
C04	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2.2	1.2	1	-	-	-	-	-	-	-	-	3	2.2
19AE6303 & Boundary Layer Theory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	1	-	2	-	3
CO2	3	3	1	2	1	-	-	-	-	1	-	2	-	3

CO3	3	2	2	1	2	1	1	-	-	-	1	1	2	2
C04	3	2	1	-	1	-	-	2	-	-	1	1	2	1
C05	3	3	2	1	2	1	-	2	1	1	2	2	2	2
AVG	3	2.6	1.6	1.5	1.6	1	1	2	1	1	1.3	1.6	2	2.2
19AE6304 & AI & IoT for aviation														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	1	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	1
C04	3	1	-	-	-	-	-	-	-	-	-	-	3	1
C05	3	1	1	-	-	-	-	-	-	-	-	-	3	2
AVG	3	1.6	1	-	-	-	-	-	-	-	-	-	3	1.6
19AE6305 & Airframe Maintenance and Repair														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	-	-	-	-	-	-	-	2	3	2
CO2	3	2	3	1	1	-	1	-	-	-	-	1	3	2
CO3	3	2	2	3	2	-	-	-	-	-	-	1	2	3
C04	3	1	3	2	2	-	-	-	-	-	-	2	2	2
C05	2	2	2	2	-	-	-	-	-	-	-	1	2	2
AVG	2.8	1.8	2.6	2	1.7	-	1	-	-	-	-	1.4	2.4	2.2
19AE7301 & Nano Science and Technology														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	1	1	-	-	-	-	-	-	-	-	-	3	2
C04	3	1	1	1	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	1	1	-	-	-	-	-	-	-	3	2
AVG	3	1.6	1.4	1.3	1	-	-	-	-	-	-	-	3	2
19AE7302 & Satellite Technology														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	-	-	-	-	-	-	-	3	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	3	1
CO3	3	2	2	1	-	-	-	-	-	-	-	-	3	1
C04	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C05	3	2	1	-	-	-	-	-	-	-	-	-	3	1
AVG	3	1	1	1	1	-	-	-	-	-	-	-	3	1
19AE7303 & Fatigue and Fracture Mechanics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.00	2.00	2.00	3.00	-	-	-	-	-	-	-	2.00	3.00	1.00
CO2	3.00	2.00	3.00	2.00	-	-	-	-	-	-	-	2.00	3.00	2.00
CO3	3.00	2.00	3.00	3.00	2.00	-	-	-	-	-	-	2.00	2.00	3.00
C04	3.00	2.00	3.00	3.00	3.00	-	-	-	-	-	-	2.00	3.00	2.00

C05	3.00	2.00	3.00	3.00	2.00	-	-	-	-	-	-	2.00	3.00	2.00
AVG	3.00	2.00	2.80	2.80	2.33	-	-	-	-	-	-	2.0	2.80	2.00
19AE7304 & Aero Engine Maintenance and Repair														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	2
C04	2	3	2	-	-	-	-	-	-	-	-	-	3	2
C05	2	3	2	-	-	-	-	-	-	-	-	-	3	2
AVG	2.6	2.4	1.6	-	-	-	-	-	-	-	-	-	3	2.2
19AE7305 & Space Mechanics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C04	3	3	2	1	-	-	-	-	-	-	-	-	3	2
C05	3	3	2	1	-	-	-	-	-	-	-	-	3	2
AVG	3	3	2	1	-	-	-	-	-	-	-	-	3	2
19AE8301 & Experimental Stress analysis														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	-	-	2	3	3
CO2	3	2	2	2	3	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	3	-	-	-	-	-	-	2	3	3
C04	3	2	2	2	3	-	-	-	-	-	-	2	3	3
C05	3	2	2	2	3	-	-	-	-	-	-	2	3	3
AVG	3	2	2	2	3	-	-	-	-	-	-	2	3	3
19AE8302 & Aviation management and Air safety Engineering														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1.00	1.00	1.00	-	-	-	-	-	-	-	-	2.00	-
CO2	-	1.00	1.00	1.00	-		-	-	-	-	-	-	2.00	-
CO3	-	2.00	2.00	2.00	-	2.00	-	-	-	-	-	-	2.00	-
C04	-	2.00	2.00	2.00	-	2.00	-	-	2.00	-	-	-	2.00	-
C05	-	-	-	-	3.00	-	-	-	-	-	-	-	2.00	-
AVG	-	1.50	1.50	1.50	3.00	2.00	-	-	2.00	-	-	-	2.00	-
19AE8303 & Helicopter Theory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.00	-	2.00	-	-	-	-	-	-	-	-	-	3.00	1.00
CO2	3.00	-	2.00	-	-	-	-	-	-	-	-	-	3.00	2.00
CO3	3.00	-	2.00	-	-	-	-	-	-	-	-	2.00	3.00	1.00
C04	3.00	-	3.00	2.00	-	-	-	-	-	-	-	-	3.00	2.00
C05	3.00	-	3.00	2.00	3.00	2.00	-	-	-	-	-	3.00	3.00	3.00
AVG	3.00	-	2.40	2.00	3.00	2.00	-	-	-	-	-	2.50	3.00	1.80

19AE8304 & Hypersonic Aerodynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	1	1	1	3	2
CO2	3	2	1	1	2	-	-	-	-	1	1	1	3	2
CO3	3	3	2	-	2	-	-	-	-	1	1	2	3	1
C04	3	2	1	1	2	-	-	-	-	1	1	1	3	1
C05	3	2	1	1	2	-	-	-	-	1	1	1	3	2
AVG	3	2.2	1.2	1	1.8	-	-	-	-	1	1	1.2	3	1.6
19AE8305 & Additive Manufacturing and Tooling														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	1	-	-	-	-	-	2	2
CO2	3	2	2	2	2	-	1	-	-	-	-	-	2	2
CO3	3	2	2	2	2	-	1	-	-	-	-	-	2	2
C04	3	2	3	2	2	-	1	-	-	-	1	-	2	3
C05	3	2	2	1	2	-	1	-	-	-	2	-	2	2
AVG	3	2	2.2	1.8	2	-	1	-	-	-	1.5	-	2	2.2
19AE8306 & Rockets and Missiles														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3.00	-	-	-	-	-	-	-	-	-	-	1.00	3.00	1.00
CO2	3.00	2.00	-	2.00	-	-	-	-	-	-	-	1.00	3.00	1.00
CO3	3.00	3.00	-	3.00	-	-	-	-	-	-	-	1.00	3.00	1.00
C04	3.00	2.00	-	3.00	-	-	-	-	-	-	-	1.00	3.00	1.00
C05	3.00	-	-	-	-	-	2.00	-	-	-	-	1.00	3.00	1.00
AVG	3.00	2.33	-	2.67	-	-	2.00	-	-	-	-	1.00	3.00	1.00
19AE8307 & Aircraft Rules and Regulations														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	1
CO2	3	2	2	1	-	-	-	-	-	-	-	-	3	1
CO3	3	1	1	1	-	-	-	-	-	-	-	-	3	1
C04	3	1	1	-	-	-	-	-	-	-	-	-	3	1
C05	3	1	-	-	-	-	-	-	-	-	-	-	3	1
AVG	3	1.4	1.25	1	-	-	-	-	-	-	-	-	3	1
19AE8308 & Product Design and Development														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	2
CO2	3	2	1	1	-	-	-	-	-	-	-	-	3	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	3	1
C04	3	2	1	1	-	-	-	-	-	-	-	-	3	1
C05	3	2	2	1	-	-	-	-	-	-	-	-	3	2
AVG	3	2	1.4	1	-	-	-	-	-	-	-	-	3	1.4
19AE8309 & Air traffic control and Airport planning														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
C04	3	2	2	-	-	-	-	-	-	-	-	-	-	-
C05	3	2	2	-	-	-	-	-	-	-	-	-	-	-
AVG	3	2	2	-	-	-	-	-	-	-	-	-	-	-
19AE8310 & Industrial Aerodynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	2	-	-	-	-	-	-	-	2	1
CO2	1	2	2	2	2	-	-	-	-	-	-	-	2	1
CO3	1	2	2	2	2	-	-	-	-	-	-	-	2	1
C04	1	2	2	2	2	-	-	-	-	-	-	-	2	1
C05	1	2	2	2	2	-	-	-	-	-	-	-	2	1
AVG	1	2	2	2	2	-	-	-	-	-	-	-	2	1

OPEN ELECTIVES

19AE6401-Introduction to Flight														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	-
C04	3	-	-	-	-	-	-	-	-	-	-	-	2	-
C05	3	-	-	-	-	-	-	-	-	-	-	-	2	-
AVG	2.6	-	-	-	-	-	-	-	-	-	-	-	1.8	-
19AE7401-Introduction to Drones														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	1	2	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
C04	3	3	2	2	2	-	-	-	-	-	-	3	2	2
C05	2	2	1	2	-	-	-	-	-	-	-	3	1	2
AVG	2.8	2.2	1.8	2	1.3	-	-	-	-	-	-	1.8	1.8	2

Chairman - BoS
AERO - HiCET

Chairman

Dean (Academics)
HiCET