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)
Coimbatore – 641 032

B.E. AERONAUTICAL ENGINEERING

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

Curriculum & Syllabus

2020-2021

CHOICE BASED CREDIT SYSTEM

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

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
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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-2016 and 2019

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

SEMESTER I

S.No.	Course Code	Course Title	Course category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2.	19MA1102	Calculus and linear algebra	BS	3	1	0	4	25	75	100
THEORY & LAB COMPONENT										
3.	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4.	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5.	19CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6.	19ME1152	Engineering Drawing	ES	1	0	4	3	25	75	100
PRACTICAL										
7.	19HE1071	Language Competency Enhancement Course-I	HS	0	0	2	1	100	0	100
8	19HE1072	Career Guidance Level-I	EEC	2	0	0	0	100	0	100
9	19HE1073	Entrepreneurship and Innovation	EEC	1	0	0	0	100	0	100
MANDATORY										
10	19MC1191	Induction Program	MC	0	0	0	0	0	0	0
Total:				**15**	**2**	**12**	**20**	**525**	**375**	**900**

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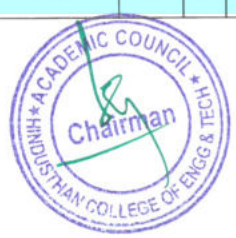
SEMESTER II

S.No.	Course Code	Course Title	Course category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2.	19MA2101	Differential equations and complex variables	BS	3	1	0	4	25	75	100
3.	19EE2103	Basic of Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
4.	19ME2101	Engineering Mechanics	ES	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5.	19PH2151	Material Science	BS	2	0	2	3	50	50	100
6.	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICAL										
7.	19HE2071	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100
8.	19ME2001	Engineering Practices Laboratory	ES	0	0	4	2	50	50	100
9.	19HE2072	Career Guidance Level-II	EEC	2	0	0	0	100	0	100
Total:				**17**	**2**	**10**	**22**	**450**	**450**	**900**

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

SEMESTER III

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	19MA3101	Fourier Series and Statistics	BS	3	1	0	4	25	75	100
2.	19AE3201	Elements of Aeronautics	PC	3	0	0	3	25	75	100
3.	19AE3202	Engineering Fluid Mechanics	PC	3	0	0	3	25	75	100
4.	19AE3203	Solid Mechanics	PC	3	0	0	3	25	75	100
THEORY WITH LAB										
5.	19AE3251	Aero Engineering Thermodynamics	PC	3	0	2	4	50	50	100
PRACTICAL										
6.	19AE3001	Aircraft Component Drawing Laboratory	PC	0	0	3	1.5	50	50	100



7.	19AE3002	Fluid mechanics and Solid mechanics Laboratory	PC	0	0	3	1.5	50	50	100
8.	19MC3191	Indian Constitution	MC	2	0	0	0	100	0	100
Total:				**17**	**1**	**8**	**20**	**350**	**450**	**800**

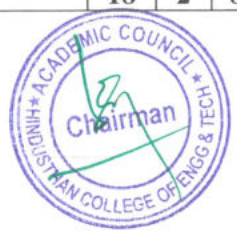
SEMESTER IV

	Course Code	Course Title	Course category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1.	19MA4113	Numerical Methods	BS	3	1	0	4	25	75	100
2.	19AE4201	Aerodynamics	PC	3	1	0	4	25	75	100
3.	19AE4202	Gas Turbine Propulsion	PC	3	0	0	3	25	75	100
4.	19AE4203	Mechanics of Machines	PC	3	0	0	3	25	75	100
THEORY WITH LAB										
5.	19AE4251	Aircraft Structures - I	PC	3	0	2	4	50	50	100
PRACTICAL										
6.	19AE4001	Aerodynamics Laboratory	PC	0	0	3	1.5	50	50	100
7.	19AE4002	Propulsion Laboratory	PC	0	0	3	1.5	50	50	100
8.	19MC4191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	100	0	100
Total:				**17**	**2**	**8**	**21**	**350**	**450**	**800**

For the students admitted during the academic year 2018-2019 and onwards

SEMESTER V

S.No	Course Code	Study Components and Course Title	L	T	P	C	CIA	ESE	Total
1.	16AE5201	Aircraft Performance	3	0	0	3	25	75	100
2.	16AE5202	High Speed Aerodynamics	3	1	0	4	25	75	100
3.	16AE5203	Aircraft Structures	3	1	0	4	25	75	100
4.	16AE5204	Advanced Propulsion	3	0	0	3	25	75	100
5.	16AE5205	Aircraft General Engineering Maintenance and practice	3	0	0	3	25	75	100
6.	16AE53XX	Professional Elective – I	3	0	0	3	25	75	100
7.	16AE5001	Aircraft Structures Laboratory	0	0	4	2	50	50	100
8.	16AE5002	Propulsion Laboratory	0	0	4	2	50	50	100
Total:			**18**	**2**	**8**	**24**	**250**	**550**	**800**



SEMESTER VI

S.No	Course Code	Study Components and Course Title	L	T	P	C	CIA	ESE	Total
1	16AE6201	Aircraft stability and control	3	0	0	3	25	75	100
2	16AE6202	Finite Element Methods in Engineering	3	1	0	4	25	75	100
3	16AE6203	Composite Materials and Structures	3	0	0	3	25	75	100
4	16AE63XX	Professional Elective – II	3	0	0	3	25	75	100
5	16XX64XX	Open Elective – I	3	0	0	3	25	75	100
6	16AE6001	Aircraft Design Project	0	0	4	2	50	50	100
7	16AE6002	Computer Aided Simulation Laboratory	0	0	4	2	50	50	100
8	16AE6003	Aircraft Systems Laboratory	0	0	4	2	50	50	100
9	16AE6801	Mini Project	0	0	6	3	50	50	100
Total:			**15**	**1**	**18**	**25**	**325**	**575**	**900**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE-I

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE5301	Aircraft materials and processes	3	0	0	3	25	75	100
2	16AE5302	Heat Transfer	3	0	0	3	25	75	100
3	16AE5303	Boundary layer Theory	3	0	0	3	25	75	100
4	16AE5304	Principles of Management	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE-II

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE6301	Theory of Elasticity	3	0	0	3	25	75	100
2	16AE6302	Introduction to Cryogenics	3	0	0	3	25	75	100
3	16AE6303	Wind tunnel techniques	3	0	0	3	25	75	100
4	16AE6304	Aero Engine Maintenance and Repair	3	0	0	3	25	75	100

OPEN ELECTIVE – I

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE6401	Introduction to flight	3	0	0	3	25	75	100

For the students admitted during the academic year 2017-2018 and onwards

SEMESTER VII

S.No	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE7201	Avionics	3	0	0	3	25	75	100
2	16AE7202	Computational Fluid Dynamics	3	0	0	3	25	75	100
3	16AE73XX	Professional Elective-III	3	0	0	3	25	75	100
4	16AE73XX	Professional Elective-IV	3	0	0	3	25	75	100
5	16XX74XX	Open Elective-II	3	0	0	3	25	75	100
PRACTICAL									
6	16AE7001	Aero Engine and Airframe Laboratory	0	0	4	2	50	50	100
7	16AE7002	Avionics Laboratory	0	0	4	2	50	50	100
8	**16AE7701**	**Internship / Industrial Training**	**0**	**0**	**0**	**2**	**0**	**100**	**100**
9	**16AE7702**	**Technical Publication**	**0**	**0**	**0**	**1**	**0**	**100**	**100**
		Total :	**15**	**0**	**8**	**22**	**225**	**675**	**900**

SEMESTER VIII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE83XX	Professional Elective-V	3	0	0	3	25	75	100
2	16AE83XX	Professional Elective-VI	3	0	0	3	25	75	100
PRACTICAL									
3	16AE8901	Project work	0	0	0	10	100	100	200
		Total	**6**	**0**	**0**	**16**	**150**	**250**	**400**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE-III

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE7301	Vibration and Elements of Aero Elasticity	3	0	0	3	25	75	100
2	16AE7302	Satellite Propulsion	3	0	0	3	25	75	100
3	16AE7303	Rockets and Missiles	3	0	0	3	25	75	100
4	16AE7304	Airframe Maintenance and Repair	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE-IV

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE7305	Experimental Stress analysis	3	0	0	3	25	75	100
2	16AE7306	Helicopter Theory	3	0	0	3	25	75	100
3	16AE7307	Aircraft Design	3	0	0	3	25	75	100
4	16AE7308	Engine system and control	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE-V

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE8301	Fatigue and Fracture	3	0	0	3	25	75	100
2	16AE8302	Professional Ethics	3	0	0	3	25	75	100
3	16AE8303	Space Mechanics	3	0	0	3	25	75	100
4	16AE8304	Aviation Management and Air safety	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE-VI

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE8305	Structural Dynamics	3	0	0	3	25	75	100
2	16AE8306	UAV Systems	3	0	0	3	25	75	100
3	16AE8307	Experimental Aerodynamics	3	0	0	3	25	75	100
4	16AE8308	Air Transportation control and Planning	3	0	0	3	25	75	100

OPEN ELECTIVE –II

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16AE7402	Aerodynamics for Industrial Applications	3	0	0	3	25	75	100
2	16AE7403	Introduction to Drones	3	0	0	3	25	75	100

CREDIT DISTRIBUTION

R-2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	27	25	23	25	24	25	22	16	187

R-2019

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

Chairman, Board of Studies

Dean – Academics

Principal

Chairman - BoS
AERO - HiCET

Dean (Academics)
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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1101	TECHNICAL ENGLISH	2	1	0	3

(COMMON TO ALL BRANCHES)

Course Objective

1. To facilitate students to communicate effectively with coherence.
2. To train the learners in descriptive communication.
3. To introduce professional communication.
4. To enhance knowledge and to provide the information on corporate environment.
5. To equip the trainers with the necessary skills on critical thinking.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – Opening a conversation, maintaining coherence, turn taking, closing a conversation (excuse, general wishes, positive comments and thanks) **Reading** –Reading articles from newspaper, reading comprehension **Writing** Chart analysis, process description, Writing instructions **Grammar and Vocabulary-** Tenses, Regular and irregular verb, technical vocabulary	9
II	**Listening and Speaking-** listening to product description, equipment & work place (purpose, appearance, function) **Reading-** Reading technical articles **Writing-** Letter phrases, writing personal letters, **Grammar and Vocabulary-**articles, Cause & effect, Prepositions.	9
III	**Listening and Speaking- -** listening to announcements **Reading-** Reading about technical inventions, research and development **Writing-** Letter inviting a candidate for intervie000000000000000w99, Job application and resume preparation **Grammar and Vocabulary-** Homophones and Homonyms.	9
IV	**Listening and Speaking- -** Practice telephone skills and telephone etiquette (listening and responding, asking questions).**Reading-** Reading short texts and memos **Writing-** invitation letters, accepting an invitation and declining an invitation **Grammar and Vocabulary-** Modal verbs, Collocation, Conditionals, Subject verb agreement and Pronoun-Antecedent agreement.	9
V	**Listening and Speaking-** listening to technical group discussions and participating in GDs **Reading-** reading biographical writing **- Writing-** Proposal writing, Writing definitions, **Grammar and Vocabulary-** Abbreviation and Acronym, Prefixes & suffixes, phrasal verbs.	9
Total Instructional Hours		**45**

Course Outcome

CO1- Trained to maintain coherence and communicate effectively.
CO2- Practiced to create and interpret descriptive communication.
CO3- Introduced to gain information of the professional world.
CO4- acquired various types of communication and etiquette.
CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2014
T2-Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, 2005.

REFERENCE BOOKS :

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication-Principles and Practice", Oxford University Press, 2009.
R2- Raymond Murphy, "English Grammar in Use"-4th edition, Cambridge University Press, 2004
R3- Kamalesh Sadanan "A Foundation Course for the Speakers of Tamil-Part-I &II", Orient Blackswan,2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA1102	CALCULUS AND LINEAR ALGEBRA	3	1	0	4

Course Objective

2. Understand the concept of differentiation.
3. Evaluate the functions of several variables which are needed in many branches of engineering.
4. Understand the concept of double integrals.
5. Understand the concept of triple integrals.
6. Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.

Unit	Description	Instructional Hours
I	**DIFFERENTIAL CALCULUS** Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem.	12
II	**MULTIVARIATE CALCULUS(DIFFERENTIATION)** Total derivatives - Jacobians– Maxima, Minima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
III	**DOUBLE INTEGRATION** Double integrals in Cartesian coordinates–Area enclosed by the plane curves (excluding surface area)– Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parellopiped.++	12
IV	**TRIPLE INTEGRATION** Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates. Gauss Divergence Theorem – Simple Application involving cubes and rectangular parellopiped.	12
V	**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
	Total Instructional Hours	**60**

Course Outcome

CO1: Apply the concept of differentiation in any curve.
CO2: Identify the maximum and minimum values of surfaces.
CO3: Apply double integrals to compute area of plane curves.
CO4: Evaluation of triple integrals to compute volume of solids.
CO5: Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies (or Eigen frequencies) of vibration and the shapes of these vibrational modes.

TEXT BOOKS:

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

T2 - Veerarajan T, "Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS :

R1- Thomas & Finney " Calculus and Analytic Geometry" , Sixth Edition.,Narosa Publishing House, New Delhi.

R2 - BaliN.P &ManishGoyal."ATextbookofEngineeringMathematics".8th Edition, Laxmi Pub. Pvt. Ltd. 2011.

R3 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH1151	APPLIED PHYSICS (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective
1. Enhance the fundamental knowledge in properties of matter
2. Analysis the oscillatory motions of particles
3. Extend the knowledge about wave optics
4. Gain knowledge about laser and their applications
5. Conversant with principles of optical fiber, types and applications of optical fiber

Unit	Description	Instructional Hours
I	**PROPERTIES OF MATTER** Elasticity – Hooke's law – Stress-strain diagram - 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. **Determination of Young's modulus by uniform bending method.**	6+3=9
II	**OSCILLATONS** Translation motion –Vibration motion – Simple Harmonic motion – Differential Equation of SHM and its solution –Damped harmonic oscillation - Torsion stress and deformations – Torsion pendulum: theory and experiment. **Determination of Rigidity modulus – Torsion pendulum.**	6+3=9
III	**WAVE OPTICS** Conditions for sustained Interference – air wedge and it's applications - Diffraction of light – Fresnel and 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. Determination of thickness of a thin wire – Air wedge method.**	6+6=12
IV	**LASER AND APPLICATIONS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Type of lasers – Nd:YAG laser and CO_2 laser- Laser Applications – Holography – Construction and reconstruction of images. **Determination of Wavelength and particle size using Laser.**	6+3=9
V	**FIBER OPTICS AND APPLICATIONS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors.	6
	Total Instructional Hours	**45**

Course Outcome
CO1: Illustrate the fundamental properties of matter
CO2: Discuss the Oscillatory motions of particles
CO3: Analyze the wavelength of different colors
CO4: Understand the advanced technology of LASER in the field of Engineering
CO5: Develop the technology of fiber optical communication 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 -Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015
R2 -M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi, 2016
R3 - Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
BE/B.Tech	19CY1151	Chemistry for Engineers (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. The boiler feed water requirements, related problems and water treatment techniques.
2. The principles of polymer chemistry and engineering applications of polymers and composites.
3. The principles of electrochemistry and with the mechanism of corrosion and its control.
4. The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
5. The important concepts of spectroscopy and its applications.

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, simple calculations, estimation of hardness of water – EDTA method – Boiler troubles - Conditioning methods of hard water – External conditioning - demineralization process - desalination: definition, reverse osmosis – Potable water treatment – breakpoint chlorination. **Estimation of total, permanent and temporary hardness of water by EDTA.**	6 +3=9
II	**POLYMER & COMPOSITES** Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, Polymerization – types Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite – moulding of plastics (extrusion and compression); Composites: definition, types of composites – polymer matrix composites (PMC) –FRP	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 – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions. **Conductometric titration of strong acid vs strong base (HCl vs NaOH).Conductometric titration (Mixture of strong acid and base).Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.** Estimation of Ferrous iron by Potentiometry.	6+9 =15
IV	**ENERGY SOURCES AND STORAGE DEVICES** Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	6
V	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. **Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).**	6+3

Total Instructional Hours : 45

Course Outcome

CO1: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life

CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance.

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 knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities.

CO5: Identify the structure and characteristics of unknown/new compound with the help spectroscopy.

TEXT BOOKS

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

REFERENCES

R1 - B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2012).

R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co. Ltd., New Delhi (2017).

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Programme	Course Code	Name of the Course	L	P	T	C
B.E.	19CS1151	PYTHON PROGRAMMING AND PRACTICES	2	0	2	3

Course Objective

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

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	9
II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments. *Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.*	7+2(P)
III	**CONTROL FLOW, FUNCTIONS** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. *Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.*	5+4(P)
IV	**LISTS, TUPLES, DICTIONARIES** 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: selection sort, insertion sort, merge sort, histogram.*	3+6(P)
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages. *Illustrative programs: word count, copying file contents.*	5+4(P)
	Total Instructional Hours	**(29 + 16) 45**

Course Outcome

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 andupdated 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 Pythonl, 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	COURSE CODE	NAME OF THE COURSE	L	T	P	C
B.E.	19ME1152	ENGINEERING DRAWING	1	0	4	3

Course Objective

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

UNIT	DESCRIPTION	TOTAL 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 to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as – Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	TOTAL INSTRUCTIONAL HOURS	**60**

Course Outcome

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

TEXT BOOK:

1. K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5th Edition New Age International Publishers, New delhi 2016.
2. K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai.

REFERENCES:

1. Basant Agrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited,New Delhi 2008.
2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- I	0	0	2	1

(COMMON TO ALL BRANCHES)

Course Objective

- ✓ To enhance student language competency
- ✓ To train the students in LSRW skills
- ✓ To develop student communication skills
- ✓ To empower the trainee in business writing skills.
- ✓ To train the students to react to different professional situations

Unit	Description	Instructional Hours
I	**Listening** Listening to technical group discussions and participating in GDs. listening to TED talks. Listen to Interviews & mock interview. Listening short texts and memos.	3
II	**Reading** Reading articles from newspaper, magazine. Reading comprehension. Reading about technical inventions, research and development. Reading short texts and memos.	3
III	**Writing** E-mail writing: Create and send email writing (to enquire about some details, to convey important message to all, to place an order, to share your joy and sad moment). Reply for an email writing.	3
IV	**Speaking** To present a seminar in a specific topic (what is important while choosing or deciding something to do). To respond or answer for general questions (answer for your personal details, about your family, education, your hobbies, your aim etc.,).	3
V	**Speaking** Participate in discussion or interactions (agree or disagree express your statement with a valid reason, involve in discussion to express your perspective on a particular topics).	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Trained to maintain coherence and communicate effectively.
CO2- Practiced to create and interpret descriptive communication.
CO3- Introduced to gain information of the professional world.
CO4- acquired various types of communication and etiquette.
CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

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

T2 Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019

REFERENCE BOOKS:

R1: Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

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Programme	Course code	Course title	L	T	P	C
B.E.	19HE1072	CAREER GUIDANCE – LEVEL I Personality, Aptitude and Career Development	2	0	0	0

Course Objectives:

- Introduce students to building blocks of Logical reasoning and Quantitative Aptitude [SLO 1]
- Train students on essential grammar for placements [SLO 2]
- Introduce students on scientific techniques to pick up skills [SLO 3]
- Provide an orientation for recruiter expectation in terms of non-verbal skills, and for how to build one's career with placements in mind [SLO 4]

Expected Course Outcome:
Enable students to approach learning Aptitude with ease, and understand recruiter expectation.

Student Learning Outcomes (SLO): 1, 2, 3 and 4

Module:1 Lessons on excellence **2hours** **SLO:**3
Skill introspection, Skill acquisition, consistent practice

Module:2 Logical Reasoning **11 hours** **SLO:**1
Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles
Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail
Picture and word driven Qs to develop attention to detail as a skill

Module:3 Quantitative Aptitude **11 hours** **SLO:**1
Speed Maths

- 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

Module:4 Recruitment Essentials **2hours** **SLO:**4
Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements

- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management
Getting it right for the interview:
- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5 Verbal Ability **4hours** **SLO:2**

Essential grammar for placements:
- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

Total Lecture hours: 30hours

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1073	ENTREPRENEURSHIP & INNOVATION	1	0	0	0

Course Objective`

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

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

Course Outcome

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 effectively and efficiently the potential of new business opportunities.
CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness..
CO5: Develop a business model for a new venture, including revenue. Margins, operations, working capital, and investment.

TEXT BOOKS:

T1: Arya Kumar "Entrepreneurship – Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).
T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition(2016).

REFERENCE BOOKS:

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

WEB RESOURCES:

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
W6:https://www.youtube.com/watch?v=8vEyL7uK&s&list=PLmP9QrmTNPqBEvKbMSXvwlwn7fdnXe6

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2101	BUSINESS ENGLISH FOR ENGINEERS	2	1	0	3

Course Objective

1. To introduce to business communication.
2. To train the students to react to different professional situations.
3. To make the learner familiar with the managerial skills
4. To empower the trainee in business writing skills.
5. To learn to interpret and expertise different content.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Business vocabulary, Adjectives & adverbs	9
II	**Listening and Speaking-** listening to TED talks **Reading-**Making and interpretation of posters **Writing-** Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success" **Grammar and Vocabulary-** Active & passive voice, Spotting errors (Tenses, Preposition, Articles)	9
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary-** Direct and Indirect speech,	9
IV	**Listening and Speaking-** Role play- **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors, Gerund & infinitive	9
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company - **Writing-** Descriptive writing (describing one's own experience) **Grammar and Vocabulary-** Editing a passage(punctuation, spelling& number rules)	9
	Total Instructional Hours	**45**

Course Outcome

CO1- Introduced to different modes and types of business communication.
CO2- Practiced to face and react to various professional situations efficiently.
CO3- learnt to practice managerial skills.
CO4- Familiarized with proper guidance to business writing.
CO5- Trained to analyze and respond to different types of communication.

TEXT BOOKS:

T1 - Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2014.

T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2013.

REFERENCE BOOKS :

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, 1986.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	19MA2101	Differential Equations and Complex Variables	3	1	0	4

Course Objectives

1. Describe some methods to solve different types of first order differential equations.
2. Solve ordinary differential equations of certain types using Wronskian technique.
3. Use the effective mathematical tools for the solutions of partial differential equations.
4. Describe the construction of analytic functions and conformal mapping.
5. Illustrate Cauchy's integral theorem and calculus of residues.

Unit	Description	Instructional Hours
I	**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** Equations of the first order and of the first degree – Homogeneous equations – Exact differential equations – Linear equations – Equations reducible to the linear form – Benoulli's equation .	12
II	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER** Second order linear differential equations with constant and variable co-efficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of paramers. Solution of ODE related to electric circuits, bending of beams.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by the elemination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the form f(p,q)=0, Clairaut's type : z = px+qy +f(p,q) – Lagrange's linear equation.	12
IV	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann's 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.	12
	Total Instructional Hours	**45+15**

Course Outcomes

CO1: Apply few methods to solve different types of first order differential equations.
CO2: Develop sound knowledge of techniques in solving ordinary differential equations.
CO3: Solve the Partial Differential Equations using various methods.
CO4: Infer the knowledge of construction of analytic functions and conformal mapping.
CO5: Evaluate real and complex integrals over suitable closed paths or contours.

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.
T2- Veerarajan T, "Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016

REFERENCE BOOKS :

R1-BaliN.P &ManishGoyal,"ATextbookofEngineeringMathematics",8th Edition, Laxmi Pub. Pvt. Ltd. 2011.
R2- Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
R3- Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012.
R4-Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons, 2006.
R5- Wylie & Barett, "Advanced Engineering Mathematics", McGraw Hill Education, 6th edition, 2003.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE2103	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3

Course Objectives

1 apply the basic laws used in Electrical circuits and the different components.
2 impart knowledge on construction and working of DC and AC machines.
3 provide knowledge on the fundamentals of semiconductor devices and their applications.
4 impart knowledge on digital electronics and its principles.
5 To develop block diagrams for TV, satellite and optical fiber communications.

Unit	Description	Instructional Hours
I	**ELECTRICAL CIRCUITS AND MEASUREMENTS** Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – RMS - Average Value for sine wave – Power and Power factor – Single Phase circuits. Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.	9
II	**FUNDAMENTALS OF ELECTRICAL MACHINES** Construction, Principle of Operation of DC Generators - EMF Equation - Construction, Principle of Operation of DC shunt and series Motors, Single Phase Transformer - EMF Equation, Single phase induction motor: capacitor start - capacitor run – Construction, Principle of Operation of Three Phase Induction Motor – Applications - (Qualitative Approach only).	9
III	**SEMICONDUCTOR DEVICES AND APPLICATIONS** Characteristics of PN Junction Diode – Zener Diode and its Characteristics – Zener Effect – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor (BJT) – CB, CE, CC Configurations and Characteristics – FET – Characteristics.	9
IV	**DIGITAL ELECTRONICS** Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops (RS, JK, T & D), A/D and D/A Conversion (Dual Slope, SAR, Binary-weighted and R-2R).	9
V	**FUNDAMENTALS OF COMMUNICATION ENGINEERING** Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations – TV, Satellite and Optical Fibre Communications (Block Diagram Approach only).	9
	Total Instructional Hours	**45**

Course Outcomes

CO1 Apply the KVL and KCL in Electrical circuits.
CO2 Explain the constructional features of AC and DC machines.
CO3 Identify electronics components and use of them to design circuits.
CO4 Use appropriate logic gates in circuit design.
CO5 Construct block diagram and explain TV, satellite and optical fibre communication systems.

TEXT BOOKS:

T1 Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Eighteenth Reprint, 2014.
T2 Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.

REFERENCE BOOKS:

R1 Premkumar N, "Basic Electrical and Electronics Engineering", Anuradha Publishers, 2018.
R2 Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
R3 Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.

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Programme	Course Code	Name Of The Course	L	T	P	C
B.E.	19ME2101	ENGINEERING MECHANICS	3	0	0	3

Course Objective

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	TOTAL 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 Curve linear 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

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", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
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, 1998.
3. P. Jaget Babu, "Engineering Mechanics", Pearson Publisher, India Ltd, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH2151	MATERIAL SCIENCE	2	0	2	3

Course Objective

1. Acquire fundamental knowledge of semiconducting materials which is related to the engineering program
2. Extend the knowledge about the magnetic materials
3. Explore the behavior of super conducting materials
4. Gain knowledge about Crystal systems
5. Understand the importance of ultrasonic waves

Unit	Description	Instructional Hours
I	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination. Optical properties of semiconductor – Light through optical fiber(Qualitative). **Determination of band gap of a semiconductor. Determination of acceptance angle and numerical aperature in an optical fiber**	6+6=12
II	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications. **B – H curve by Magnetic hysteresis experiment.**	6+3=9
III	**PERCONDUCTING MATERIALS** Superconductivity : properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors –High Tc superconductors – Applications of superconductors –Cryotron and magnetic levitation.	6
IV	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
V	**ULTRASONICS** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acousticgrating–Cavitations–Viscous force –co-efficient of viscosity. Industrial applications – Drilling and welding – Non destructive testing – Ultrasonic pulse echo system.**Determination of velocity of sound and compressibility of liquid – Ultrasonic wave. Determination of Coefficient of viscosity of a liquid –Poiseuille's method**.	6+6=12
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the purpose of acceptor or donor levels and the band gap of a semiconductor

CO2: Interpret the basic idea behind the process of magnetism and its applications in everyday

CO3: Discuss the behavior of super conducting materials

CO4: Illustrate the types and importance of crystal systems

CO5: Evaluate the production of ultrasonics and its applications in NDT

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 -Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015

R2 -M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016

R3 - Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY2151	ENVIRONMENTAL STUDIES	2	0	2	3

Course Objective

1. The natural resources, exploitation and its conservation
2. The importance of environmental education, ecosystem and biodiversity.
3. The knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
4. Scientific, technological, economic and political solutions to environmental problems.
5. An awareness of the national and international concern for environment and its protection.

Unit	Description	Instructional Hours
I	**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.	6
II	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem - 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.	6
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.**Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method.Determination of chloride content of water sample by argentometric method.**	6+9=15
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. **Determination of pH in beverages.**	6+3=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. **Estimation of heavy metal ion (copper) in effluents by EDTA.**	6+3=9
	Total Instructional Hours	**45**

Course Outcome

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

TEXT BOOKS:

T1- Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

T2 – S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2018

REFERENCES:

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	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2071	VALUE ADDED COURSE – II: LANGUAGE COMPETENCY ENHANCEMENT COURSE- II (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

- ✓ **To improve communication skills and Professional Grooming.**
- ✓ **To impart deeper knowledge of English Language and its practical application in different facets of life.**
- ✓ **To equip the techniques of GD, Public Speaking, debate etc.**

Unit	Description	Instructional Hours
I	**Listening** Listening for gist and respond – Listen for detail using key words to extract specific meaning – listen for phonological detail – Listen and identify the main points for short explanations and presentation.	3
II	**Reading** Strategies for effective reading – read and recognize different text types – Genre and Organization of Ideas – Quantifying reading – reading to comprehend – Interpreting sentences – contrasting, summarizing or approximating	3
III	**Speaking** Speak to communicate – Make requests and ask questions to obtain personal information – use stress and intonation – articulate the sounds of English to make the meaning understood – speaking to present & Interact – opening and closing of speech.	3
IV	**Writing** Plan before writing – develop a paragraph: topic sentences, supporting sentences – write a descriptive paragraph – elements of good essay – descriptive, narrative, argumentative – writing emails – drafting resumes – project writing – convincing proposals.	3
V	**Language Development** Demonstration at level understanding of application of grammar rules – revision of common errors : preposition, tenses, conditional sentences –reference words – pronouns and conjunctions.	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Introduced to different modes and types of communication.
CO2- Practiced to face and react to various professional situations efficiently.
CO3- learnt to practice managerial skills.
CO4- Familiarized with proper guidance to writing.
CO5- Trained to analyze and respond to different types of communication.

REFERENCE BOOKS :

1. Verbal Ability and Reading Comprehension by Arun Sharma,9th edition,Tata Mc graw Hill
2. Word Power Made Easy by Norman Lewis,– Print, 1 June 2011.
3. High School English Grammar by Wren and Martin,S.CHAND Publications, 1 January 2017.
4. Practical course in Spoken English by J.K. Gangal,PHI Learning , Second edition, 1 January 2018.

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Programme	COURSE CODE	Name of the Course	L	T	P	C
BE/B.Tech	19ME2001	Engineering Practices Laboratory	0	0	4	2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

S.No **Description of the Experiments**

CIVIL AND MECHANICAL ENGINEERING PRACTICES

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 1brick thick wall and 11/2 brick thick wall for right angle corner junction.
3. Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for 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)

S.No **Description of the Experiments**

ELECTRICAL ENGINEERING PRACTICES

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 Practical Hours 45

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 Circuits.

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Programme	Course code	Course title	L	T	P	C
B.E.	19HE2072	**Career Guidance – Level II** Personality, Aptitude and Career Development	2	0	0	0

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]

Expected Course Outcome:

Enable students to solve questions on Verbal, Logical and Quantitative Aptitude of placement level

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

Module:1 Logical Reasoning **5 hours** **SLO:** 6

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2 Quantitative Aptitude **8 hours** SLO: 7

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

Module:3 Verbal Ability **7 hours** SLO: 8

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

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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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA3101	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
B.E.	19AE3201	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
B.E.	19AE3202	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
B.E.	19AE3203	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
B.E.	19AE3251	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
B.E.	19AE3001	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
B.E.	19AE3002	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.
CO5: 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
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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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MC3191	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	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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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA4113	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
B.E.	19AE4201	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
B.E.	19AE4202	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.	19AE4203	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
B.E.	19AE4251	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
B.E.	19AE4001	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

CO1: Exposure to the calibration of Wind Tunnel
CO2: Ability to measure aerodynamic forces around Airfoils
CO3: Ability to measure force for small Aspect ratio models
CO4: Understand the pressure distribution of flow over different profiles
CO5: 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
B.E.	19AE4002	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

CO1: Identify the components and Understand the working principle of various aircraft engines.
CO2: Ability to evaluate the velocity profile of jets and select the blade profile for compressors and turbines.
CO3: Ability to determine the properties of fuel and Coefficient of performance of various heat exchangers.
CO4: Understand the inspection and maintenance procedures followed in overhauling of Aircraft engines.
CO5: Ability to find defects in engine components using various non-destructive methods and understand the starting procedures of aircraft engine.

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	19MC4191	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 and explain basics of Indian Traditional knowledge in modern scientific perspective.

TEXT BOOKS:

T1 -V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan,Mumbai, 5th Edition, 2014.
T2 - Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan

REFERENCE BOOKS:

R1. Fritzof Capra, Tao of Physics
R2. Fritzof Capra, The wave of Life.
R3.V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
R4. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
R5. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016.
R6. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi. 2016.
R7. P R Sharma (English translation), Shodashang Hridayam.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5201	AIRCRAFT PERFORMANCE	3	0	0	3

Course Objective

1. To familiarize students with the lift, drag and wing performance.
2. To familiarize students with the cruising flight performance
3. To understand the performance characteristics of climbing and gliding flight.
4. To describe the performance of flight under different maneuvering conditions
5. To familiarize the students with various special performance characteristics of aircraft.

Unit	Description	Instructional Hours
I	**LIFT AND DRAG ON FLIGHT PERFORMANCE** International Standard Atmosphere - Measurement of speed-Forces and moments acting on a flight vehicle -Equation of motion of a rigid flight vehicle - Different types of drag – Methods of drag reduction in airplanes- Drag polar of vehicles from low speed to high speeds - Effects of Reynold's number on skin friction and pressure drag. Variation of thrust, power with velocity and altitudes for air breathing engines.	10
II	**CRUISING FLIGHT PERFORMANCE** Performance of airplane in level flight - Power available and power required curves-Maximum speed in level flight - Conditions for minimum drag and power required.	10
III	**CLIMBING AND GLIDING PERFORMANCE** Climbing Flight- Rate of climb, time to climb - Service and absolute ceiling-Maximum rate of climb and Maximum climb angle -steepest angle of climb-climb hodograph-Gliding flight-minimum rate of sink and shallowest angle of glide- Glide Hodograph	10
IV	**MANEUVERING PERFORMANCE** Turning performance (Turning rate & turn radius)-Bank angle and load factor – limitations on turn - Pull up and push over -V-n diagram, maneuvering envelope.	7
V	**SPECIAL PERFORMANCE** Range and Endurance of jet and propeller type of airplanes, Estimation of take-off and landing distance, High lift devices, Up gust and down gust maneuvering.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Predict the aerodynamic characteristics of the airplane, the engine performance and how flight altitude affects the airplane performance.
CO2: Calculate the performance of an airplane, mainly for non-accelerating flight states, but also in some simple accelerating cases such as take-off and landing.
CO3: Calculate the aerodynamic and engine data that is needed to perform a performance analysis.
CO4: Design aircraft parameters according to the mission requirement.
CO5:Identify, formulate, and solve engineering problems. This will be accomplished by discussing some open-ended problems in estimating the aircraft performance.

TEXT BOOKS:

T1 - John David Anderson, Jr., 'Aircraft Performance and Design', First Edition, Tata McGraw Hill, 2010.
T2 - Houghton, E. L., and Caruthers, N. B., 'Aerodynamics for Engineering Students', Edward Arnold Publishers, 1988

REFERENCE BOOKS:

R1 - L. J. Clancy, 'Aerodynamics', Pitman, 1986.
R2 - E. L. Houghton, P. W. Carpenter, Steven H Collicott, and Daniel T Valentine, 'Aerodynamic for Engineering Students', Sixth Edition,Butterworth-Heinemann, 2012.
R3 - 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
B.E.	16AE5202	HIGH SPEED AERODYNAMICS	3	1	0	4

Course Objective

1. To impart knowledge on the basic concepts of compressible flow.
2. To understand about the formation of normal and oblique shocks.
3. To gain knowledge in low speed real flows.
4. To understand the concept of nozzle design.
5. To gain knowledge about the high speed wind tunnels.

Unit	Description	Instructional Hours
I	**FUNDAMENTAL CONCEPTS OF COMPRESSIBLE FLOW** Introduction to isentropic flow-Scope of compressible flow-Review of continuity, momentum and steady flow energy equations and entropy considerations- Energy and momentum equations for compressible fluid flow reference velocities-stagnation states-velocity of sound-critical states-mach number-critical Mach number. Types of waves- mach cones mach angle-effect of Mach number on compressibility flow regimes.	12
II	**SHOCK AND EXPANSION WAVES** Development of normal shocks-governing equations-Stationery and moving normal shock waves-applications, Shock polars, supersonic pitot probes. Oblique shock - Reflection of flow- Prandtl-Meyer expansion flow. Under and over expanded nozzles, shock expansion method for flow over airfoils.	13
III	**FLOW WITH FRICTION AND HEAT TRANSFER** Fanno flow and Rayleigh flow - flow equations and solutions- variation of flow properties-variation of Mach number with duct length-tables and charts for Fanno flow and Rayleigh flow.	11
IV	**TWO DIMENSIONAL COMPRESSIBLE FLOW AND AEROFOIL THEORY** Method of characteristics – Prandtl - Glauert and Goethert rules - Ackeret's supersonic airfoil theory. Small perturbation equations for subsonic, transonic, supersonic and hypersonic flow. Experimental characteristics of Airfoils in compressible flow.	13
V	**EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS** 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.	11
	Total Instructional Hours	**60**

Course Outcome

CO1: Understanding characteristics of compressible fluid flows.
CO2: Capable of identification of shock patterns at different scenario.
CO3: Manipulating the effect caused by real flows.
CO4: Ability to design shock free nozzle.
CO5: Capable of handling wind tunnels for evaluating flow behaviors.

TEXT BOOKS:

T1 - Radhakrishnan, Ethirajan., Gas Dynamics, John Wiley & Sons,2010
T2 - Yahya, S. M., Fundamentals of Compressible flow with Aircraft and Rocket Propulsion, 3rd edition, New Age International Ltd. Publishers, 2003

REFERENCE BOOKS:

R1 - Shapiro, Ascher. H., The Dynamics and Thermodynamics of Compressible Fluid Flow (Vol I & II), Ronald Press, 1954.
R2 - Anderson J. D., Jr., Modern Compressible Flow with Historical Perspective, McGraw Hill Publishing Co., 2004
R3 - Anderson J. D., Jr., Fundamentals to Aerodynamics, McGraw Hill Publishing Co., 3rd edition, 2001

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5203	AIRCRAFT STRUCTURES	3	1	0	4

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.	12
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.	12
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.	12
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.	11
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.	13
	Total Instructional Hours	**60**

Course Outcome

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

TEXT BOOKS:

T1 - Megson T M G , "Aircraft Structures for Engineering Students", Elsevier Ltd, 2007
T2 - Bruhn. E.H., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985.

REFERENCE BOOKS:

R1- Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw Hill, 1993.
R2 - Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997.
R3- Michael Chun-Yung Niu, "Airframe Structural Design: Practical Design Information and Data on Aircraft Structures", 2nd edition, Adaso/Adastra Engineering Center, 2006

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5204	ADVANCED PROPULSION	3	0	0	3

Course Objective

1. To impart knowledge in hypersonic propulsion
2. To know the basics of rocket propulsion
3. To understand the working of solid rockets
4. To analyze the performance of liquid propellant engines
5. To understand various propulsion technologies associated with space launch vehicles, missiles and space probes.

Unit	Description	Instructional Hours
I	**RAMJET AND SCRAMJET PROPULSON** Operating principle of ramjet engine – Various components of ramjet engines and their efficiencies – Combustion in ramjet engine –Modes of operation -Ramjet engine and its performance characteristics – Sample ramjet design calculations – Flame stability problems in ramjet combustors. Introduction to hypersonic air breathing propulsion, need for supersonic combustion for hypersonic propulsion – Scramjet engine and its applications for hypersonic vehicles – Problems associated with supersonic combustion - Various types scramjet combustors – Fuel injection schemes in scramjet combustors	10
II	**INTRODUCTION TO CHEMICAL ROCKET PROPULSION AND NOZZLES** Operating principle of a rocket – Specific impulse of a rocket – Internal ballistics – Types of igniters – Air augmented rockets – Pulse rocket motors - Nozzles - Isentropic flow through nozzles - Convergent nozzles and nozzle choking - Nozzle throat conditions. Effect of back pressure in nozzles- Classification of rocket nozzles	9
III	**SOLID ROCKET PROPULSION** Selection criteria of solid propellants – Estimation of solid propellant adiabatic flame temperature - Propellant grain design considerations – Erosive burning in solid propellant rockets – Combustion instability – Strand burner and T-burner – Applications and advantages of solid propellant rockets.	9
IV	**LIQUID ROCKET PROPULSION** Selection of liquid propellants – Various feed systems and injectors for liquid propellant rockets - Thrust control and cooling in liquid propellant rockets and the associated heat transfer problems – Combustion instability in liquid propellant rockets – Peculiar problems associated with operation of cryogenic engines - Introduction to hybrid rocket propulsion	9
V	**ADVANCED PROPULSION TECHNIQUES** Electric rocket propulsion– Types of electric propulsion techniques - Ion propulsion – Nuclear rocket – Future applications of electric propulsion systems - Solar sail	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Knowledge on hypersonic propulsion
CO2: Ability to classify rocket engines
CO3: Ability to calculate various performance parameters
CO4: Knowledge in rocket propulsion systems
CO5: Application of nuclear propulsion in rocketry

TEXT BOOKS:

T1 - Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.
T2 - B. Mathur, M.L., and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", 2nd edition, Standard Publishers and Distributors, Delhi, 2008.

REFERENCE BOOKS:

R1 - Gorden, C. V., "Aerothermodynamics of Gas Turbine & Rocket Propulsion", AIAA Education Series, New York, 1997
R2 - Philip Hill, and Carl Peterson, "Mechanics and Thermodynamics of Propulsion", 2nd edition, Pearson Education Ltd, 2009.
R3 - K Ramamurthi., " Rocket Propulsion", Macmillan, 2010

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5205	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICE	3	0	0	3

Course Objective

1. To handle the aircraft ground support equipment.
2. To examine the various sub systems of an aircraft.
3. To enumerate various safety procedures
4. To know various types of inspection procedures
5. To identify the various types of aircraft hardware and fluid line fittings.

Unit	Description	Instructional Hours
I	**AIRCRAFT GROUND HANDLING** Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions– Engine starting procedures – Piston engine, turboprops and turbojets – Ground power unit.	10
II	**GROUND SERVICING OF VARIOUS SUB SYSTEMS** Air conditioning and pressurization – Oxygen and oil systems and their Maintenance – Engine mount and supercharger check	7
III	**MAINTENANCE OF SAFETY** Shop safety – Environmental cleanliness – Precautions – Preservation and De-preservation procedure	8
IV	**INSPECTION** Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection – Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications	10
V	**AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES** Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identifiation terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws etc) – American and British systems of specifications – Threads, gears, bearings, etc – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.	10
	Total Instructional Hours	**45**

Course Outcome

CO1: Ability to carry out ground servicing of critical aircraft systems.
CO2: Understand various subsystems and the safety precautions in maintenance.
CO3: Identify the various safety procedures.
CO4: Knowledge on various inspection procedures
CO5: Knowledge in specifications standards of aircraft hardware systems.

TEXT BOOKS:

T1 - Kroes Watkins Delp, Aircraft Maintenance and Repair, McGraw Hill, New York, 1993.
T2 - Larry Reithmaier, Lawrence .W. Reithmaier, Standard Aircraft Handbook for Mechanics and Technicians, McGraw Hill Professional, 6th Edition, 1999.

REFERENCE BOOKS:

R1 - A&P Mechanics, Aircraft Hand Book, FAA Himalayan Book House, New Delhi, 1996.
R2 - A&P Mechanics, General Hand Book, FAA Himalayan Bok House, New Delhi, 1996.
R3 - 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
B.E.	16AE5001	AIRCRAFT STRUCTURES LABORATORY	0	0	4	2

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.	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.	Study of non-destructive testing procedures
11.	Shear failure of bolted and riveted Joints
12.	Influence line study on beams

Total Practical Hours 45

Course Outcome

CO1: To perform Bending and Torsion test on beams.
CO2: Capability to locate the Shear center for the various cross section.
CO5: Ability to conduct Vibration test on beams.
CO4: Capability to fabricate composite specimen
CO5: Ability to perform non-destructive testing to predict the properties of metabolic materials used in aircraft application.

List of Equipment (for a batch of 30 students)

S.No.	Name of the Equipment	Quantity	Experiment No.
1	400 kN Universal Testing Machine	1	10
2	Photo elasticity set up	1	4
3	Vibration set up with accessories	1	7
4	Wagner beam	1	9
5	Unsymmetrical bending set up	1	1
6	Set up for combined bending and torsion	1	3
7	Constant strength beam	1	2
8	Beams with weight hangers and dial gauges	1	12

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5002	PROPULSION LABORATORY	0	0	4	2

Course Objective

6. To familiarize students and to expose them practically to various aircraft piston and gas turbine engines
7. To practically determine the flow behavior of jets
8. To impart the knowledge of characteristics of fuel

Expt. No.	Description of the Experiments
13.	dy of aircraft piston engines
14.	Study of aircraft gas turbine engines
15.	Velocity profiles of free jets.
16.	Velocity profiles of wall jets.
17.	Study of Subsonic Ramjet engine
18.	Cascade testing of compressor and turbine blades
19.	Performance test on a 4-stroke engine
20.	Determination of effectiveness of a parallel flow heat exchanger
21.	Determination of effectiveness of a counter flow heat exchanger
22.	Determination of heating value of a fuel

Total Practical Hours 45

Course Outcome

CO1: Understand details of piston and gas turbine engine
CO2: Perform various testing on ducts, propellants, jet engine components
CO3: Perform test on diesel/petrol engine
CO4: Explain the characteristics of the diesel/Petrol engine
CO5: Determine the properties of the fuels.

List of Equipment (for a batch of 30 students)

Sl.No.	Name of the Equipment	Quantity	Experiment No.
15.	Aircraft Piston engine	1	1
16.	Aircraft gas turbine engine	1	2
17.	Jet facility with compressor and storage tank	1	3,4
18.	Multitube manometer	2	3,4
19.	Ramjet facility	1	5
20.	Cascade Wind tunnel	1	6
21.	Compressor and turbine blade set	1 each	6
22.	4 stroke twin cylinder diesel engine	1	7
23.	Parallel and counter flow heat exchanger test rig	1	8,9
24.	Bomb Calorimeter	1	10

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SEMESTER VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6201	AIRCRAFT STABILITY AND CONTROL	3	0	0	3

Course Objective

1. To understand the static and dynamic response and controls.
2. To familiarize with the concept of Stability and control of Aircraft.
3. To familiarize with various Aircraft motions and related stability.
4. To familiarize with the concept of dynamic stability of Aircraft.
5. To analyze the longitudinal, lateral, directional stability modes of an aircraft.(static & dynamic)

Unit	Description	Instructional Hours
I	**GENERAL** Degrees of freedom of a system, Static and dynamic stability, Need for stability in an airplane, purpose of controls, Inherently and marginally stable airplanes.	6
II	**STATIC LONGITUDINAL STABILITY** Stick fixed: Basic equations of equilibrium, Stability criterion, Wing and tail moments, Effect of fuselage and nacelles, Effect of c.g. location, Power effects, Stabilizer setting and c.g. location, Elevator effects, stick fixed neutral point. Stick free: Hinge moment coefficients, Stick free neutral point symmetric maneuvers, stick force gradients and stick force per cg. Aerodynamic balancing of control surfaces.	14
III	**STATIC LATERAL STABILITY** Dihedral effect, coupling between rolling moment and yawing moment, Adverse yaw, Aileron power, Aileron reversal.	8
IV	**SATATIC DIRECTIONAL STABILITY** Weather cocking effect, rudder requirements. One engine inoperative conditions, rudder lock.	7
V	**DYNAMIC STABILITY** Equation of motion, Stability derivatives, Routh's discriminant, solving the stability quadratic, Phugoid motion, factors affecting the period and damping- Dutch roll and spiral instability Auto rotation, spin and spin recovery, Two control airplane.	10
	Total Instructional Hours	**45**

Course Outcome

CO1: Calculate aircraft trim and static stability characteristics.
CO2: Perform preliminary design computations to meet static stability and trim requirements.
CO3: Identify the lateral and longitudinal modes and relate the important physical influences of aircraft properties on these modes.
CO4: Determine the stability of the aircraft from the linearized equations of motion.
CO5: Design the control surfaces according to the stability requirements.

TEXT BOOKS:

T1 -Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, New York, 1988.
T2 - Nelson, R.C., 'Flight Stability and Automatics Control', Second Edition, McGraw Hill, 1997.

REFERENCE BOOKS:

R1 - Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, New York, 1982.
R2 - L. J. Clancy, 'Aerodynamics', Pitman, 1986.
R3 -Houghton, E. L., and Caruthers, N. B., 'Aerodynamics for Engineering Students', Edward Arnold Publishers, 1988

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6202	FINITE ELEMENT METHODS IN ENGINEERING	3	1	0	4

Course Objective

1. To give exposure to the formulation and the 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, fluid 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).	11
II	**DISCRETE ELEMENTS** Bar Elements - Uniform Section, Varying Sections - Mechanical And Thermal Loading – Linear And Quadratic Elements, Elimination And Penalty Approach. 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.	15
III	**CONTINUUM ELEMENTS** Triangular (CST, LST): 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.	13
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.	11
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.	10
	Total Instructional Hours	**60**

Course Outcome

CO1. Can 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. Solving the field variable problems.

TEXT BOOKS:

T1 - Tirupathi.R. Chandrapatla and Ashok D. Belegundu., "Introduction to Finite Elements in Engineering", Prentice Hall India, Third Edition, 2003.
T2 - Rao.S.S., "Finite Element Method in Engineering", 3rd Ed., Butterworth-Heinemann, 1998.

REFERENCE BOOKS:

R1 - Larry J Segerlind., "Applied Finite Element Analysis", Second Edition, John Wiley and Sons, Inc.1984.
R2 - Daryl L. Logan., "A First Course in the Finite Element Method", Cengage Learning, 2011.
R3 - Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6203	COMPOSITE MATERIALS AND STRUCTURES	3	0	0	3

Course Objective

1. To make the student understand the analysis of composite laminates under different loading conditions.
2. To gain knowledge in failure theories of lamina.
3. To provide the mathematical foundations of laminated plates.
4. To give exposure in various methods of fabrication of composite laminates.
5. To Apply 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 – density of 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 - experimental characterization of 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: Understanding 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 gained in manufacturing and repair of composites.
CO5: Solve the structural problems of sandwich panels.

TEXT BOOKS:

T1 - Dam Ishai., "Mechanics of Composite Materials,"
T2 - Autar K Kaw, „Mechanics of Composite Materials", CRC Press, 1997..

REFERENCE BOOKS:

R1 - Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
R2 - Madhuji Mukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004.
R3 - Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, II Edition, 1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6001	AIRCRAFT DESIGN PROJECT	0	0	4	2

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 and their specifications an 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.	Power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces
5.	Drag Estimation
6.	Detailed performance calculations and stability estimates.
7.	V-n diagram.
8.	Landing gear selection & design
9.	Preliminary design of an aircraft wing – Shrenck's curve, structural load distribution, shear force, bending moment and torque diagrams
10.	Detailed design of an aircraft wing – design of spars and stringers, bending stress and shear flow calculations
11.	Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
12.	tailed design of an aircraft fuselage – design of bulkheads and longerons –bending stress and shear flow calculations.
13.	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 angle the design in terms of structural point of view.
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
B.E.	16AE6002	COMPUTER AIDED SIMULATION LABORATORY	0	0	4	2

Course Objective

1. To make the students familiarize with computational fluid dynamics.
2. To practice on structural analysis software tools.
3. By employing these tools for Aerospace applications students will have an opportunity to expose themselves to simulation software.

Expt. No.	Description of the Experiments
1.	Simulation of flow through a Converging-diverging nozzle
2.	Simulation of flow through an axial flow compressor blade passage
3.	Simulation of supersonic flow over a wing of biconvex cross section
4.	Hot flow simulation through an axial flow turbine blade passage
5.	Simulation of flow through subsonic and supersonic diffusers
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. Explore different simulation and analysis software tools.
CO2. Execute design and analysis of various components.
CO3. Simulate flow behavior and perform structural analysis.
CO4. Analyze the problems for the better solution.
CO5. Students can meet the industry requirement excel in structural and flow analysis

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	30 licenses
4	UPS	1
5	Printer	1

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6003	AIRCRAFT SYSTEMS LABORATORY	0	0	4	2

Course Objective

1. To train the students "ON HAND" experience in maintenance of various air frame systems in aircraft and rectification of common snags.
2. To impart knowledge on various checks of aircraft.
3. To gain knowledge about various trouble shooting methods.

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

Total Practical Hours 45

Course Outcome

CO1: Ability to carry out basic maintenance activities involved in aircraft.
CO2: Capable of carrying out symmetry checks.
CO3: Ability to conduct various pressure and functional tests.
CO4: Enable to rectify the snags in aircraft hydraulic & pneumatic systems.
CO5: Identification of reasons involved at the time of malfunctioning.

List of Equipment (for a batch of 30 students)

Sl. No.	Item	Quantity	Experiment No.
1	Serviceable aircraft with all above systems	1	1,2,3,4,5,6,7,8,9,10
2	Hydraulic Jacks (Screw Jack)	5	1,2,4,8
3	Trestle adjustable	5	1,2,4,8
4	Spirit Level	2	8
5	Levelling Boards	2	8
6	Cable Tensiometer	1	8
7	Adjustable Spirit Level	1	8
8	Plumb Bob	1	8

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PROFESSIONAL ELECTIVE-I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5301	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.	9
II	**MECHANICAL BEHAVIOUR OF MATERIALS** Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect – Notch effect testing and flaw detection of materials and components – creep - fatigue – fracture mechanics.	9
III	**HEAT TREATMENT AND CORROSION** 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 – Corrosion Resistant materials used in aircraft	10
IV	**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 – wood and fabric in aircraft construction	9
V	**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 – Emerging trends in aerospace application	8
	Total Instructional Hours	**45**

Course Outcome

CO1. Knowledge in evolution of materials and its structure.
CO2. Ability to understand various material behaviour.
CO3. Understand the role of corrosion and heat treatment processes of aircraft materials.
CO4. Knowledge in usage of composite materials in aircraft component design.
CO5. Exposure to high temperature materials for space applications.

TEXT BOOKS:

T1 - Titterton.G., "Aircraft Materials and Processes", V Edition, Pitman Publishing Co., 1995.
T2 - Raghavan.V., "Materials Science and Engineering", Prentice Hall of India, New Delhi, 1993

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5302	HEAT TRANSFER	3	0	0	3

Course Objective

1. To introduce the concepts of heat transfer to enable the students understand the thermal systems and conduction behavior of various solids.
2. To give mathematical knowledge of convection heat transfer for various ambience.
3. To give analytical knowledge to the Radiation heat transfer.
4. To give exposure to numerical methods employed to solve heat transfer problems.
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** Introduction to Physical mechanism – Radiation properties – Radiation shape factors – Heat exchange between non – black bodies – Radiation shields.	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: Able to do basic calculations involving conduction heat transfer in various solids.
CO2: Able to perform the convection phenomenon to the varied environment conditions and the equipment's
CO3: Able to understand the radiation heat transfer in the ambient conditions of the various equipment's
CO4: Able to solve the heat transfer problems with help of numerical methods
CO5: Able to predict heat transfer problems in the propulsive device.

TEXT BOOKS:

T1-Yunus A.Cengel.,"Heat Transfer – A practical approach", Second Edition, Tata McGraw-Hill, 2002.
T2-Sachdeva, S.C., "Fundamentals of Engineering Heat & Mass Transfer", Wiley Eastern Ltd., New Delhi, 1981.

REFERENCE BOOKS:

R1- Mathur, M. and Sharma, R.P. "Gas Turbine and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1988.
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, Prentice Hall Inc., 1981.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5303	BOUNDARY LAYER THEORY	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

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

REFERENCE BOOKS:

R1 - Schlicting, H., Boundary Layer Theory, McGraw-Hill, New York, 1979.
R2 - Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.
R3 - Stephen B.Pope,Turbulent flows, Cambridge University Press, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE5304	PRINCIPLES OF MANAGEMENT (Only for AERO)	3	0	0	3

Course Objective

1. To introduce the basic of management.
2. To impart knowledge about planning
3. To gain more knowledge on organizing and staffing
4. To impart knowledge about directing
5. Students will also gain some basic knowledge on controlling

Unit	Description	Instructional Hours
I	**INTRODUCTION TO MANAGEMENT** Definition of Management - Science or Art - Manager Vs Entrepreneur- Management and Administration - Development of Management Thought - Contribution of Taylor and Fayol – Functions of Management - Types of Business Organisation.	9
II	**PLANNING** Nature & Purpose - Steps involved in Planning - Objectives – Setting Objectives - Process of Managing by Objectives - Strategies, Policies & Planning Premises- Forecasting - Decision-making.	8
III	**ORGANISING AND STAFFING** Nature and Purpose - Types of Organization - Organization Chart - Structure and Process – Departmentalization by difference strategies - Line and Staff authority - Benefits and Limitations - Difference between authority and power- Centralization , De-Centralization and Delegation of Authority - Staffing - Selection Process - Techniques – Human Recourse management .	10
IV	**DIRECTING** Scope - Human Factors - Creativity and Innovation - Leadership - Types of Leadership Motivation - Hierarchy of needs - Motivation theories - Motivational Techniques - Job Enrichment - Communication - Process of Communication - Barriers and Breakdown - Effective Communication - Electronic media in Communication.	9
V	**CONTROLLING** System and process of Controlling - Requirements for effective control - budgetary and non-budgetary control techniques - Information Technology in Controlling - Use of computers in handling the information - Productivity - Problems and Management - Direct and Preventive Control - Reporting - The Global Environment - Globalization and Liberalization.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Knowledge of management
CO2. Ability to have clear understanding of planning
CO3. Ability to have clear understanding of organizing and staffing
CO4. Ability to have clear understanding of staffing
CO5. Have some basic knowledge on international aspect of management.

TEXT BOOKS:

T1 - Harold Kooritz & Heinz Weihrich "Essentials of Management", Tata McGraw-Hill, 1998
T2 - Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999.

REFERENCE BOOKS:

R1 - Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill.
R2 - Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003.
R3 - Stephen P. Robbins & Mary Coulter, "Management", 10th Edition, Prentice Hall (India) Pvt. Ltd., 2009.

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PROFESSIONAL ELECTIVE-II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6301	THEORY OF ELASTICITY	3	0	0	3

Course Objective

1. Ability to analyze some real problem and to formulate the conditions of theory of elasticity application
2. To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions.
3. Students can able 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: Understand the fundamental equations used for forming the equilibrium equations.
CO2: Able to find stress in two dimensional structures using Cartesian co-ordinates
CO3: Able to find stress in polar co-ordinates and axi-symmetric structures.
CO4: Able to solve stress in cylindrical structures.
CO5: Introduction to methods used for solving plate and shell structures.

TEXT BOOKS:

T1 - Timoshenko, S., and Goodier, T.N., "Theory of Elasticity", McGraw – Hill Ltd., Tokyo, 1990.
T2 - Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.

REFERENCE BOOKS:

R1 - Volterra & J.H. Caines, "Advanced Strength of Materials", Prentice Hall, New Jersey, 1991
R2 - Sokolnikoff, I. S., "Mathematical Theory of Elasticity", McGraw – Hill, New York, 1978.
R3 - 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
B.E.	16AE6302	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 analyze the operating cycles
4. To understand the thermodynamics of cryogenics
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	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 - 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.	Ability to predict the heat transfer characteristics
CO4.	Identification of operating cycles
CO5.	Knowing 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 Corpn., New York 1985
R2 - Randall Barron., Cryogenics systems , Mc Graw Hill Book Co
R3 - Valery V. Kostionk., "A Text Book Of Cryogenics", Discovery Publishing House, 2003

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6303	WIND TUNNEL TECHNIQUES	3	0	0	3

Course Objective

1. To interpret the basic concepts of measurement of forces and moments on models during the wind tunnel testing.
2. To understand the application of various types of wind tunnels.
3. To know the calibration techniques used in wind 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	**PRINCIPLES OF MODEL TESTING** Buckingham Theorem – Non-Dimensional Numbers –Scale Effect Types of Similartes.	6
II	**WIND TUNNELS** Introduction to wind tunnels - Classification – Special problems of Testing in Subsonic, Transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.	8
III	**CALIBRATION OF WIND TUNNELS** Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.	11
IV	**WIND TUNNEL MEASUREMENTS** Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances	12
V	**FLOW VISUALIZATION** Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.	8
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the principles and opretion of windtunnels
CO2: Analyse the different components in wind tunnel
CO3: Calibrate the wind tunnel
CO4: Ability to measure various flow parameters
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.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6304	AERO ENGINE MAINTENANCE AND REPAIR	3	0	0	3

Course Objective

1. To make the students understand about the piston engine and its operation.
2. To interpret the basic concepts of inspections of piston engines
3. To learn the fundamentals of propeller and its inspection methods.
4. To make the students to familiarize with the Aircraft engine maintenance procedure and practice.
5. To study the basic concepts of the maintenance and repair of both piston and jet aero engines and the procedures followed for overhaul of aero engines.

Unit	Description	Instructional Hours
I	**PISTON ENGINE** Types of piston engines – Principles of operation – Function of components – Materials used – Details of starting the engines – Details of carburetion and injection systems for small and large engines – Ignition system components – Spark plug details – Engine operating conditions at various altitudes – Lubrication system, Maintenance and inspection checks to be carried out.	8
II	**INSPECTIONS OF PISTON ENGINES** 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. Methods and instruments for non-destructive testing techniques – Equipment for replacement of part and their repair	8
III	**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.	10
IV	**JET ENGINES , TESTING AND INSPECTION** 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 . Maintenance procedures of gas turbine engines – Trouble shooting and rectification procedures.	12
V	**OVERHAULING** Engine overhaul – Overhaul procedures- inspection and cleaning of the components – repair schedules for overhaul- balancing of gas turbine components Trouble shooting: procedures for trouble shooting – condition monitoring of the engine on ground and at flight – engine health monitoring and corrective methods.	7
	Total Instructional Hours	**45**

Course Outcome

CO1:Apply maintenance procedure to Aircraft Engines
CO2: Identify the engine components and faults
CO3:Knowing the fundamentals of propellers.
CO4:Apply non-destructive testing procedures to identify the defects
CO5: Apply overhauling procedure to new engines

TEXT BOOKS:

T1 - KROES & WILD, "Aircraft Power plants", 7th Edition – McGraw Hill, New York, 1994.
T2 - Brimm D.J. Bogges H.E., "Aircraft Maintenance", Pitman Publishing corp., New York, 1940.

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.
R3 - Mekinly, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw Hill, 1993.

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OPEN ELECTIVE - I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE6401	INTRODUCTION TO FLIGHT	3	0	0	3

Course Objective

1. To understand the concept of flying and instruments associated with it.
2. To gain knowledge about the structural design and material of aircraft components.
3. To provide the basic idea about the working principle of aircraft power plants.
4. To understand the concept of space vehicles.
5. To gain knowledge on helicopter flight mechanism.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO AIRPLANES** Introduction, historical background, Different types of flight vehicles, Components of an airplane and their functions. Conventional control, Basic instruments for flying. Physical properties and structure of the atmosphere, (Temperature, Pressure and altitude relationships), Evolution of lift, Drag and moment. Aero foils, Avionics: Flight deck and cockpit.	9
II	**AIRPLANE STRUCTURES AND MATERIALS** Introduction to structural design of Aircraft and spacecraft, flight loads, general types of construction, Monocoque, Semi-monocoque and composite structure construction, Typical wing and fuselage structure, Metallic and Non metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials in aerospace.	9
III	**AIRCRAFT ENGINES** Selection of power plants: piston, turbo-propeller, turbofan, and jet engines with after burner / thrust augmentation thrust vector control, FADEC. Use of propeller and jets for thrust production, Comparative merits. Theory of Propellers.	9
IV	**SPACE SYSTEM DESIGN** Overview on space environment, introduction to space debris, Launch site selection, Brief introduction to rockets, ramjet, and SCRAMJET, Thrust vector control mechanisms, staging of rockets, space mission, re-entry vehicles, life support systems for manned space missions, Fuel cells, Introduction to space mechanics to satellites, Interplanetary missions, Space exploration.	9
V	**ROTORCRAFT, UAVs, AND AIRCRAFT SYSTEMS** Introduction to Helicopters and Micro-lights. Introduction to UAVs and MAVs. Types and applications, Maintenance, safety and operations. Basic principles and lay out of various aircraft systems: Hydraulic system, Aircraft Fuel system, Engine fuel system, Air conditioning and Pressurization system Flight control system, Navigation and Weapon control system, Under carriage and Brake system, High lift devices.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Understand about the fundamentals of various flight configurations.
CO2. Capable of choosing the correct material for specified components.
CO3. Understand about the basic science of aircraft engines.
CO4. Ability to understand about the space vehicles behavior.
CO5. Capable of implementing the ideas on helicopter aerodynamics.

TEXT BOOKS:

T1 - Anderson J.D., Introduction to Flight, McGraw-Hill 7th edition, 2013.
T2 - Austin R., Unmanned Aircraft Systems, AIAA Education Series, 2010.

REFERENCE BOOKS:

R1 - Dava Newman, Interactive Aerospace Engineering and Design, McGraw-Hill. 2nd edition., 2002.
R2 - Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997
R3 - Kermode A.C, " Flight without formulae", Pearson Education,, Fifth edition,1989.

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SYLLABUS

SEMESTER VII

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7201	AVIONICS	3	0	0	3

Course Objective

1. To introduce the basic of avionics and its need for civil and military aircrafts
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.	9
II	**DIGITAL AVIONICS ARCHITECTURE** Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 429 – ARINC – 629.	9
III	**FLIGHT DECKS AND COCKPITS** Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.	9
IV	**INTRODUCTION TO NAVIGATION SYSTEMS** Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.	9
V	**AIR DATA SYSTEMS AND AUTO PILOT** Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.	9
	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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7202	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3

Course Objective

1. To introduce Governing Equations of viscous fluid flows
2. To introduce the grid generation techniques
3. To enable the students to understand the various discretization methods.
4. To enable the students to understand the solution procedures and turbulence modeling
5. To create confidence to solve the complex problems using finite volume techniques

Unit	Description	Instructional Hours
I	**FUNDAMENTAL CONCEPTS** Introduction – Governing equations of Fluid Dynamics - Incompressible In viscid Flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations -_ Elliptic, Parabolic and Hyperbolic equations - Well posed problems - discretization of partial Differential Equations.	10
II	**GRID GENERATION** Grids- Classification of grids and transformations. Generation of structured grids. Unstructured grids. Delany triangulation, Advanced front technique.	7
III	**DISCRETIZATION** Discretization and its importance, Boundary layer Equations and methods of solution -Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation – Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems - Further advantages of upwind differencing. Explicit and implicit method for subsonic and supersonic flows.	8
IV	**FINITE ELEMENT TECHNIQUES** Overview of Finite Element Techniques in Computational Fluid Dynamics. History of finite element techniques. Strong and Weak Formulations of a Boundary Value Problem.	6
V	**FINITE VOLUME TECHNIQUES** Finite Volume Techniques - Cell Centered Formulation - Lax - Vendoroff Time Stepping - Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy - Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques – Central and Up-wind Type Discretizations - Treatment of Derivatives. Flux – splitting schemes. Pressure correction solvers – SIMPLE, PESO.	14
	Total Instructional Hours	**45**

Course Outcome

CO1: To create numerical modeling and its role in the field of fluid flow and heat transfer
CO2: To learn the various grid generating techniques.
CO3: To use the various discretization methods and boundary layer equations.
CO4: To learn the various solution methods used in finite element techniques.
CO5: To learn the solution procedures and turbulence modeling to solve flow and heat transfer problems

TEXT BOOKS:

T1 - Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Vols. I and II, Springer - Verlag, Berlin, 1988.
T2 - John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer – Verlag, Berlin, 1992

REFERENCE BOOKS:

R1 - Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II.John Wiley & Sons, New York, 1988.
R2 - Klaus A Hoffmann and Steve T. Chiang. "Computational Fluid Dynamics for Engineers", Vols. I & II Engineering Education System, P.O. Box 20078, W. Wichita,K.S., 67208 - 1078 USA, 1993.
R3 - Anderson, Jr.D., "Fundamentals of Aerodynamics", McGraw-Hill, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7001	AERO ENGINE AND AIRFRAME LABORATORY	0	0	4	2

Course Objective

1. To introduce the knowledge of the maintenance procedures followed for overhaul of aero engines.
2. To introduce the knowledge of the repair procedures followed for overhaul of aero engines.
3. To study about welding of aircraft components.

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

Total Practical Hours 45

Course Outcome

CO1: Ability to maintain the aero engines.
CO2: Ability to repair the aero engines.
CO3: Knowledge in overhaul of aero engines.
CO4: Ability to perform welding of aircraft components.
CO5: Knowledge of the aircraft joints.

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
B.E.	16AE7002	AVIONICS LABORATORY	0	0	4	2

Course Objective

1. This laboratory is to train students, to study about basic digital electronics circuits, various microprocessor applications in Control surface.
2. To study about displays fault tolerant computers.
3. To study the stability analysis and design using MATLAB.

Expt. No.	Description of the Experiments
1.	Addition/Subtraction of 8 bit and 16 bit data for control surface deflection.
2.	Sorting of Data in Ascending & Descending order for voting mechanism.
3.	Sum of a given series with and without carry for identifying flap data
4.	Greatest in a given series & Multi-byte addition in BCD mode.
5.	Addition/Subtraction of binary numbers using adder and Subtractor circuits.
6.	Multiplexer & Demultiplexer Circuits
7.	Encoder and Decoder circuits.
8.	Stability analysis using Root locus, Bode plot techniques.
9.	Design of lead, lag and lead –lag compensator for aircraft dynamics
10.	Performance Improvement of Aircraft Dynamics by Pole placement technique.
	Total Practical Hours 45

Course Outcome

CO1: Ability to write the programme for control surface deflection.
CO2: Ability to use microprocessor in Flight control.
CO3: Ability to understand digital electronics circuits.
CO4: Ability to perform stability analysis
CO5: Knowledge of the design of avionic systems using MATLAB

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
2.	Adder/Subtractor Binary bits Kit	10	5
3.	Encoder Kit	10	7
4.	Decoder Kit	10	7
5.	Multiplexer Kit	10	6
6.	Demultiplexer Kit	10	6
7.	computers	10	8,9,10
8.	Regulated power supply*	10	5,6,7
9.	MATLAB software	-	8,9,10

*Is not needed when regulated power supply is in built.

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PROFESSIONAL ELECTIVE-III

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7301	VIBRATIONS AND ELEMENTS OF AEROELASTICITY	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 get the natural characteristics of continuous system.
4. To Familiarize with the Approximate Methods
5. To study the Aeroelastic 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, forced vibrations – with and without damping – support excitation – transmissibility – vibration measuring instruments.	10
II	**MULTI DEGREES OF FREEDOM SYSTEMS** Two degrees of freedom systems - static and dynamic couplings - vibration absorber- principal co-ordinates - principal modes and orthogonal conditions - Eigen value problems - 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 - Dunkerlay's method – Rayleigh-Ritz method, Holzer method, matrix iteration method.	9
V	**ELEMENTS OF AEROELASTICITY** Vibration due to coupling of bending and torsion - Aeroelastic problems - Collars triangle - wing divergence - aileron control reversal – flutter – buffeting. – elements of servo elasticity	8
	Total Instructional Hours	**45**

Course Outcome

CO1.	Gaining understanding of single
CO2.	Ability to solve multi-degree vibrating systems
CO3.	Blast to continuous systems
CO4.	Ability to use numerical techniques for vibration problems
CO5.	Knowledge acquired in aero elasticity and fluttering

TEXT BOOKS:

T1 - Timoshenko S., "Vibration Problems in Engineering"– John Wiley and Sons, New York, 1993.
T2 - V. P. Singh, 'Mechanical Vibrations', Fourth Edition, Dhanpat Rai and Co., 2014.

REFERENCE BOOKS:

R1 - Grover. G.K., "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India, 2003
R2 - Bisplinghoff R.L., Ashely H and Hogman R.L., "Aeroelasticity", Addision Wesley Publication, New Tork, 1983.
R3 - Singiresu S. Rao, 'Mechanical Vibrations', Fifth Edition, Prentice Hall, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7302	SATELLITE PROPULSION	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 SATELLITE** Selection of Materials - Special Requirements of Materials to Perform under Adverse Conditions.	7
	Total Instructional Hours	**45**

Course Outcome

CO1.	Understanding evolution of satellite propulsion
CO2.	Understanding separation techniques of satellite
CO3.	Identify suitable thrusters for satellites
CO4.	Knowledge on control of satellites
CO5.	Ability to 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.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7303	ROCKETS AND MISSILES	3	0	0	3

Course Objective

1. To know types of rockets and missiles with respect to Indian & international scenario
2. To enrich their knowledge in the area of missile and rocket flight.
3. To understand space and gravity
4. To know the staging of rockets
5. To select materials for the rockets

Unit	Description	Instructional Hours
I	**CLASSIFICATION 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 programme with respect to international scenario	10
II	**AERODYNAMICS OF ROCKETS AND MISSILES** Airframe Components of Rockets and Missiles - Forces Acting on a Missile While Passing Through Atmosphere Classification of Missiles - methods of Describing Aerodynamic Forces and Moments - Lateral Aerodynamic Moment - Lateral Damping Moment and Longitudinal Moment of a Rocket - lift and Drag Forces - Drag Estimation - Body Upwash and Downwash in Missiles - Rocket Dispersion - Numerical Problems.	10
III	**ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD** Introduction – Kepler's laws of planetary motion - 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.	10
IV	**STAGING AND CONTROL OF ROCKETS AND MISSILES** Rocket Vector Control – Methods, SITVC termination, Thrust determination, Multi staging of rockets - Vehicle Optimization - Stage Separation Dynamics - Separation Techniques, Types of aerodynamics control in missiles	10
V	**MATERIALS FOR ROCKETS AND MISSILES** Selection of Materials - Special Requirements of Materials to Perform under Adverse Conditions.	5
	Total Instructional Hours	**45**

Course Outcome

CO1: Knowledge to classify rockets and missiles
CO2: Understanding aerodynamics of rocket and missiles
CO3: Abilty to analyse the motion of rockets
CO4: Knowledge on stages and control of rockets & missiles
CO5: Select suitable materials for various systems

TEXT BOOKS:

T1 - Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 1993.
T2 - Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W., Freeman & Co. Ltd., London, 1982.

REFERENCE BOOKS:

R1 - Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket Propulsion", Standard Publishers, New Delhi 1998.
R2 - Parket, E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc., 1982
R3 - J. Ras.,"Design of Space and Missile Rocket Engines", CreateSpace Independent Publishing Platform, 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7304	AIRFRAME MAINTENANCE AND REPAIR	3	0	0	3

Course Objective

1. To make the students to understand the Airframe components and the tools used to maintain the components.
2. Understanding on plastics used in aircrafts.
3. To know how to jack, rig and assembles the aircrafts' components.
4. To know the various components used in hydraulic and pneumatic system.
5. To identify the methods to carry out investigation and the detailed maintenance and practice procedures.

Unit	Description	Instructional Hours
I	**WELDING AND SHEET METAL REPAIR AND MAINTENANCE** Equipments used in welding shop and their maintenance – Ensuring quality welds –Welding jigs and fixtures – Soldering and brazing- Inspection of damage – Classification – Repair or replacement – Sheet metal inspection –N.D.T. Testing – Riveted repair design. Damage investigation – reverse technology.	10
II	**PLASTICS AND COMPOSITES IN AIRCRAFT** Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., and various repair schemes – Scopes.Inspection and Repair of composite components – Special precautions – Autoclaves.	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 – Fire protection systems – Ice protection system – Rain removal system –Position and warning system – Auxiliary Power Units (APUs)	10
V	**SAFETY PRACTICES** Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble shooting - Theory and practices.	7
	Total Instructional Hours	**45**

Course Outcome

CO1. Ability to identify the airframe components
CO2. Skill to repair the plastic components in aircraft.
CO3. Capability to do jack, rig the aircraft
CO4. Analyze the system for defect investigation and repair it.
CO5. Ability to perform investigation skill to maintain the airframe with safety.

TEXT BOOKS:

T1 - Kroes, Watkins, Delp, "Aircraft Maintenance and Repair", McGraw-Hill, New York, 1992.
T2 - Delp. Bent and McKinley "Aircraft Maintenance Repair", McGraw Hill, New York, 1987.

REFERENCE BOOKS:

R1 - Larry Reithmeir, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.
R2 - Brimm D.J. Bogges H.E., "Aircraft Maintenance", Pitman Publishing corp. New York,1940
R3 - A&P Mechanics, "Aircraft Hand Book", F A A Himalayan Book House, New Delhi, 1996.

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PROFESSIONAL ELECTIVE-IV

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7305	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. Ability to analyze experimental data and develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.
3. Detailed knowledge about the photo elastic materials and their testing.
4. Use of failure theories 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	10
III	**PHOTOELASTICITY** Two Dimensional Photo Elasticity - Photo Elastic Materials - Concept Of Light - Photoelastic Effects - Stress Optic Law - Transmission Photoelasticity - Plane and Circular Polariscopes - Interpretation Of Fringe Pattern - Calibration Of Photoelastic Materials - Compensation and Separation Techniques - Introduction To Three Dimensional Photo Elasticity.	10
IV	**BRITTLE COATING AND MOIRE TECHNIQUES** Relation Between Stresses In Coating And Specimen - Use Of Failure Theories In Brittle Coating - Moire Method Of Strain Analysis.	8
V	**NON – DESTRUCTIVE TESTING** Fundamentals Of NDT - Acoustic Emission Technique – Radiography – Thermography – Ultrasonics - Eddy Current Testing - Fluorescent Penetrant Testing - Magnetic Particle Inspection - Guided Wave Testing - Electromagnetic Testing.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Measurement of strain in structures using mechanical and other means.
CO2. Measurement of strain in structures using electrical strain gauges.
CO3. Knowledge in testing and evaluation of stress in photoelastic materials.
CO4. Calculation of failure stress in coatings using different failure theories.
CO5. 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, 2005, IV edition.
R2 - Max Mark Frocht, "Photo Elasticity", John Wiley and Sons Inc., New York, 1968.
R3 - Durelli, A.J., "Applied Stress Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1970.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7306	HELICOPTER THEORY	3	0	0	3

Course Objective

1. To make the student familiarize with the principals 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 vibration.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Helicopter as an aircraft, Basic features, Layout, Configuration, Generation of lift, lead-lag, flapping and feathering motion, Rotor controls and various types of rotor, Blade loading, Effect of solidity - Blade area required, number of Blades, Power losses, Rotor efficiency.	9
II	**AERODYNAMICS OF ROTOR BLADE** Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter - calculation of Induced Power, High speed limitations; profile and parasite drag , power loading, ground effect	9
III	**POWER PLANTS AND FLIGHT PERFORMANCE** Piston engines, Gas turbines, Ramjet principle, Comparative performance, Power required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.	9
IV	**STABILITY AND CONTROL** Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.	9
V	**ROTOR VIBRATIONS** Dynamic model of the rotor, Motion of the rigid blades, Properties of vibrating system, phenomenon of vibration, vibration absorbers, Measurement of vibration in flight. Rotor Blade design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.	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. Control the vibration on 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 - Joseph Schafer, "Basic Helicopter Maintenance", Jeppesen 1980
R2 - R W Prouty, "Helicopter Aerodynamics"
R3 - Wayne Johnson "Helicopter Theory",Dover Publications,Inc., New York,1980.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7307	AIRCRAFT DESIGN	3	0	0	3

Course Objective

1. To familiarize students with the important issues and methodologies of aircraft design.
2. To make the students to understand the conceptual design of aircraft.
3. To understand the importance of aircraft design characteristics on performance.
4. To familiarize the students with the design and selection of controls in aircraft
5. To illustrate the process of aircraft synthesis as an outcome of the integration of the disciplines of aerodynamics, performance, stability and control, propulsion, structures and aero elasticity.

Unit	Description	Instructional Hours
I	**REVIEW OF DEVELOPMENTS IN AVIATION** Categories and types of aircrafts – various configurations – Layouts and their relative merits –strength, stiffness, fail safe and fatigue requirements – Manoeuvering load factors – Gust and manoeuverability envelopes – Balancing and maneuvering loads on tail planes.	9
II	**POWER PLANT TYPES AND CHARACTERISTICS** Characteristics of different types of power plants – Propeller characteristics and selection –Relative merits of location of power plant.	9
III	**PRELIMINARY DESIGN** Selection of geometric and aerodynamic parameters – Weight estimation and balance diagram –Drag estimation of complete aircraft – Level flight, climb, takeoff and landing calculations – range and endurance – static and dynamic stability estimates – control requirements.	9
IV	**SPECIAL PROBLEMS** Layout peculiarities of subsonic and supersonic aircraft – optimization of wing loading to achieve desired performance – loads on undercarriages and design requirements.	9
V	**STRUCTURAL DESIGN** Estimation of loads on complete aircraft and components – Structural design of fuselage, wings and undercarriages, controls, connections and joints. Materials for modern aircraft – Methods of analysis, testing and fabrication.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Conduct trade-off between the conflicting demands of different disciplines by performing a detailed preliminary design of a complete aircraft.
CO2: Select the appropriate power plant for the aircraft
CO3: Design the control surfaces based on the stability requirements and to select the wing planform based on the mission requirements.
CO4: Estimate weight, wing loading and other performance parameters related to conceptual design of a complete aircraft.
CO5: Identify design features of aerospace structures, and calculate load factors.

TEXT BOOKS:

T1 - D.P. Raymer, "Aircraft conceptual design", AIAA Series, 1988.
T2 - G. Corning, "Supersonic & Subsonic Airplane design", II Edition, Edwards Brothers Inc.,Michigan, 1953.

REFERENCE BOOKS:

R1 - E. Torenbeek, "Synthesis of Subsonic Airplane design", Delft University Press, London,1976.
R2 - A.A. Lebedenski, "Notes on airplane design", Part-I, I.I.Sc., Bangalore, 1971.
R3 - Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7308	ENGINE SYSTEM AND CONTROL	3	0	0	3

Course Objective

1. To understand the basic components of aircraft engine.
2. To give an exposure to the different systems in Aircraft Engines.
3. To enumerate various safety procedures and maintenance equipment
4. To exposure the methodologies of various instruments used for engine controls & indication.
5. To know the knowledge of the various instruments used in engine

Unit	Description	Instructional Hours
I	**ENGINE CONSTRUCTION** Layout – Piston Engine – Turbo Prop-Gas Turbine Engines – Modular concept. Auxiliary system of gas turbine engine– Fuel systems – Heat Management system, Lubricants and Fuel used – Engine Materials – Compressor, Turbine, Frames and Casting etc.	10
II	**ENGINE SYSTEMS** Hydraulic and pneumatic systems– Engine controls – FADEC Fire Protection System – Ignition and Starting system – Engine Anti-icing system. Thrust augmentation- thrust vectoring-reversal.	9
III	**MAINTENANCE & INSPECTION** Maintenance aspects of Gas Turbine Engines – Preventive condition Monitoring – Boroscopic Inspection, on conditioning monitoring – On wing Trim Balance – Test bed overhaul.	6
IV	**CONTROL INSTRUMENTS** Engine sensors – Basic construction – Processing signals – Analog and Digital Indication – Scaling – Monitoring of Instruments / Indicators.	10
V	**ENGINE INSTRUMENTS** Primary instruments – Tachometer, Fuel flow, Exhaust Gas Temperature, Thrust parameters – Secondary Instruments – Vibration indicator, Oil Pressure and Oil Temperature indictor, Nacelle Temperature Indicator.	10
	Total Instructional Hours	**45**

Course Outcome

CO1. Understand the basic components of aircraft engine.
CO2. Know the operation of different systems in Aircraft Engines.
CO3. Ability to identify the engine instruments and maintenance of engine.
CO4. Knowledge to develop the various instruments used for engine controls & indication.
CO5. Identify the problem occurs in engine instruments and control the engine instruments.

TEXT BOOKS:

T1 - Aircraft Instruments – E H J Pallett, Pitman & Co., 1993.
T2 - Aircraft Gas Turbine Engine Technology – Irwin E Treager, English Book Stores, New Delhi.

REFERENCE BOOKS:

R1 - "General Hand Book of Airframe and Power Plant" US Department of Transportation, FAA, English Book Stores, New Delhi.
R2 - Aircraft Gas Turbine Guide, P&W Publications, English Book Stores, New Delhi.
R3 - Aircraft Gas Turbine and Operation – PRATT AND WHITENY, United Technologies, English Book Stores, New Delhi.

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PROFESSIONAL ELECTIVE-V

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8301	FATIGUE AND FRACTURE	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 – Fatigue of composite materials.	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 - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.	8
	Total Instructional Hours	**45**

Course Outcome

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

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.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8302	PROFESSIONAL ETHICS (ONLY FOR AERO)	3	0	0	3

Course Objective

1. To introduce the basic of professional ethics.
2. To create an awareness on engineering ethics.
3. To understand social experimentation of an engineer.
4. To understand social responsibility, rights and safety of an engineer.
5. To appreciate ethical dilemma in discharging duties in professional life

Unit	Description	Instructional Hours
I	**INTRODUCTION TO PROFESSIONAL ETHICS** Ethics in Workplace - Formulation of Ethics - Managerial Ethics - Managing Ethical Behaviour - Codes of Ethics - Encouraging Ethical Behaviour - Ethical Leadership - Ethical Decision making- Corporate Social Responsibility (CSR) - Intellectual Property Rights (IPR)- Meaning- Laws relating to Intellectual Property Rights (IPRs)	10
II	**MORAL ISSUES AND ETHICAL THEORIES** Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas – moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment.	9
III	**ENGINEERING AS SOCIAL EXPERIMENTATION** Engineering as experimentation – Engineers as Responsible Experimenters – Research Ethics – Codes ofEthics – Industrial Standards – A Balanced Outlook on Law – The Challenger Case Study	8
IV	**ENGINEER'S RESPONSIBILITY, RIGHTS AND SAFETY** Safety and Risk – Assessment of Safety and Risk – Risk benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk – Chernobyl Case and Bhopal Case studies. Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of interest – Occupational Crime – Professional Rights – Employee Rights	10
V	**GLOBAL ISSUES OF ENGINEERING ETHICS** Multinational Corporations – Business Ethics – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors -moral leadership.	8
	Total Instructional Hours	**45**

Course Outcome

CO1. Knowledge of professional ethics.
CO2. Ability to apply ethics in society.
CO3. Ability to discuss the ethical issues related to engineering.
CO4. Ability to realize the responsibilities.
CO5. Have knowledge on rights in the society.

TEXT BOOKS:

T1 - Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata Mc Graw Hill, New Delhi.
T2 - Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, 2000.003.

REFERENCE BOOKS:

R1 - Charles D Fleddermann, " Engineering Ethics", Prentice Hall, New Mexico, 1999.
R2 - John R Baatright. "Ethics and the Conduct of Business", Pearson Education 2003.
R3 - Edmund G Seeabauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers".Oxford University press 2001.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8303	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	**BASIC CONCEPTS** The Solar System – References Frames and Coordinate Systems – The Celestial Sphere – The Ecliptic – Motion of Vernal Equinox – Side real Time–Solar Time–Standard Time–The Earth's Atmosphere.	7
II	**THE GENERAL N-BODY PROBLEM** The many body Problem – Lagrange – Jacobian Identity –The Circular Restricted Three Body Problem – Liberation Points- Relative Motion in the N-body Problem –Two Body Problem – Satellite Orbits – Relations Between Position and Time – Orbital Elements.	10
III	**SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS** General Aspects of satellite Injections – Satellite Orbit Transfer –Various Cases – Orbit Deviations Due to Injection Errors – Special and General Perturbations – Cowell's Method – Encke's Method – Method of vibrations of Orbital Elements.	10
IV	**INTERPLANETARY TRAJECTORIES** Two Dimensional Interplanetary Trajectories –Fast Interplanetary Trajectories – Three Dimensional Interplanetary Trajectories – Launch if Interplanetary Spacecraft –Trajectory about the Target Planet.	8
V	**BALLISTIC MISSILE TRAJECTORIES AND MATERIALS** The Boost Phase – The Ballistic Phase –Trajectory Geometry- Optimal Flights – Time of Flight – Re – entry Phase – The Position of the Impact Point – Influence Coefficients. Space Environment – Peculiarities – Effect of Space Environment on the Selection of Spacecraft Material.	10
	Total Instructional Hours	**45**

Course Outcome

CO1. Understands the basic concepts of space.
CO2. Skill to locate the bodies' position in space with respect to time.
CO3. Ability to perform satellite injection, satellite perturbations.
CO4. Capability to find the interplanetary trajectories
CO5. Apply the orbital mechanics to control the missiles.

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 - Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
R2 - Van de Kamp, P., "Elements of Astromechanics", Pitman, 1979.
R3 - Thomas A Ward, "Aerospace Propulsion systems", John Wiley, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8304	AVIATION MANAGEMENT AND AIR SAFETY	3	0	0	3

Course Objective

1. To enable the students to learn the development and growth of Aviation Industry
2. To understand the concept of airport management and operations
3. To learn the legal background of Aviation world
4. To know about the importance of Air safety and security measures.
5. To familiarize the students with the technological improvements in aviation safety.

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	7
II	**AIRPORT MANAGEMENT AND AIRLINE OPERATIONS** **Airport Management-** Airport planning- Airport operations-Airport functions- Organization structure of Airports sectors-Airport Authorities- Global and Indian scenario of Airport management –DGCA –AAI. **Airline Operations -** Organisation Structure of Airline Sectors -Airline Terminal Management- Flight Information Counter/Reservation and Ticketing-Check In/Issue of Boarding pass-Customs and Immigration formalities-Co-ordination-Security Clearance-Baggage-Handling-Handling of Stretcher Passengers and Human Remains-Handling of CIP,VIP & VVIP- Co-ordination of Supporting Agencies /Departments – Introduction to Airport cargo management.	10
III	**AVIATION LAW AND AIRCRAFT RULES AND REGULATIONS** DGCA functions – Aircraft act 1934 – National legislation - Airport Authority of India Acts 1994 – Civil Aviation Requirements (CAR)- Section (1 to 7) – (General -Airworthiness Air Transport - Aerodrome standards and Air Traffic Services -Air Safety -Design standards and type certification - Flight crew standards, training and licensing) – Introduction to International conventions.	10
IV	**AIRTRANSPORTATION SAFETY AND SECURITY** Protecting Public Transportation -Screening- Metal Detectors -Xray Inspections, Trace- Detection Techniques. Terrorism –Introduction- Causes of Terrorism - Rival claim of pales tine- Palestine Liberation Organization - Nuclear Terrorism - Aircraft as Missiles - 9/11 Terrorist Act and its Consequences - Biological &Chemical Warfare - Steps to Combat Terrorism –Hijacking – security measures	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.	8
	Total Instructional Hours	**45**

Course Outcome

CO1. Ability to understand the role of IATA and ICAO in Air transportation
CO2. Proficiency in Airline management and Airport operations
CO3. Understand the concept of Aviation safety and security
CO4. Understand the various aviation standards in quality assurance, safety rules and regulations.
CO5. Understand Aviation laws and regulations related to each type of organization.

TEXT BOOKS:

T1 - Wells .A-Airport Planning and Management, 4th Edition-McGraw-hill, London-2000.
T2 - Aviation and Airport Security –Kathleen M. Sweet –Pearson Education Inc., Second edition, 2009.

REFERENCE BOOKS:

R1 - P.S. Senguttuvan –Fundamentals of Airport Transport Management –McGraw Hill 2003
R2 - Aircraft Manual, C.A.R. Sec. II
R3 - "Fundamentals of Air Traffic Control" Michael S. Nolan, Cengage Learning.

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PROFESSIONAL ELECTIVE-VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8305	STRUCTURAL DYNAMICS	3	0	0	3

Course Objective

1. Learn how to model discrete single-degree and multiple-degree vibratory systems
2. To calculate the free and forced response of mechanical systems.
3. To develop the equations of motion for vibratory systems.
4. Learn to use finite element methods for the analysis of the vibrations of structures.
5. To study the dynamics response by using approximate methods.

Unit	Description	Instructional Hours
I	**FORCE-DEFLECTION PROPERTIES OF STRUCTURES** Constraints and Generalized coordinates – Virtual work and generalized forces – Force – Deflection influence functions – stiffness and flexibility methods.	12
II	**PRINCIPLES OF DYNAMICS** Free and forced vibrations of systems with finite degrees of freedom – Damped oscillations – D"Alembert's principle – Hamilton's principle – Lagrangean equations of motion and applications.	9
III	**NATURAL MODES OF VIBRATION** Equations of motion for free vibrations Solution of Eigen value problems – Normal coordinates and orthogonality relations.	10
IV	**ENERGY METHODS** Rayleigh's principle – Rayleigh – Ritz method – Coupled natural modes – Effect of rotary inertia and shear on lateral vibrations of beams – Natural vibrations of plates.	8
V	**APPROXIMATE METHODS** Approximate methods of evaluating the Eigen frequencies and the dynamics response of continuous systems – Matrix methods of dynamic stress analysis.	6
	Total Instructional Hours	**45**

Course Outcome

1: To understand single and multi-degree vibrating systems
2: To identify, formulate and solve engineering problems.
3: Ability to develop the equations of motion for vibratory systems and solving for the free and forced response.
4: Capability to use numerical techniques for vibration problems
5: To analyze and modify a vibratory structure in order to achieve specified requirements.

TEXT BOOKS:

T1 - F.S.Tse, I.E. Morse and H.T. Hinkle, "Mechanical Vibration", Prentice Hall of India Pvt., Ltd., New Delhi, 1988.
T2 - S.P. Timoshenko and D.H. Young, "Vibration Problems in Engineering", John Willey & Sons Inc., 1984.

REFERENCE BOOKS:

R1 - Von. Karman and A.Biot, "Mathematical Methods in Engineering", McGraw-Hill Book Co., New York, 1985.
R2 - Craig R.R. Jr., Structural Dynamics – An Introduction to Computer Methods, John Wiley and Sons, 1981.
R3 - R.K. Vierck, "Vibration Analysis", 2nd Edition, Thomas Y. Crowell & Co., Harper & Row Publishers, New York, U.S.A., 1989.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8306	UAV SYSTEMS	3	0	0	3

Course Objective

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

Unit	Description	Instructional Hours
I	**INTRODUCTION TO UAV** History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications.	9
II	**THE DESIGN OF UAV SYSTEMS** Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations-Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe-Design for Stealth--control surfaces-specifications.	9
III	**AVIONICS HARDWARE** Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing.	9
IV	**COMMUNICATION PAYLOADS AND CONTROLS** Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting.	9
V	**THE DEVELOPMENT OF UAV SYSTEMS** Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing-Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Knowledge of classification, models, prototypes and applications of UAV
CO2. Ability to design UAV systems
CO3. Ability to design avionics hardwares
CO4. Ability to use different communication payloads and controls
CO5. 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 - Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8307	EXPERIMENTAL AERODYNAMICS	3	0	0	3

Course Objective

1. To provide details, operating principles and limitations of forces, pressure, velocity and temperature measurements.
2. To understand the principles behind the wind tunnel balancing
3. To describe flow visualization techniques and to highlight in depth discussion of analog methods.
4. To gain knowledge in basic measurements techniques.
5. To estimate the errors in special flows

Unit	Description	Instructional Hours
I	**BASIC MEASUREMENTS IN FLUID MECHANICS** Need for experimental studies – Fluid mechanics measurements –Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization –Components of measuring systems – Importance of model studies.	7
II	**CHARACTERISTICS OF MEASUREMENTS** Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation of wind tunnels – Turbulence- Wind tunnel balance –principles, types and classifications -Balance calibration	10
III	**FLOW VISUALIZATION AND ANALOGUE METHODS** Principles of Flow Visualization – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank.	9
IV	**PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS** Measurement of static and total pressures in low and high speed flows- Pitot-Static tube characteristics - Pressure transducers – principle and operation – Velocity measurements - Hot-wire anemometry – LDV – PIV: Temperature measurements.	9
V	**SPECIAL FLOWS AND UNCERTAINTY ANALYSIS** Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning - Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty analysis and calculation	10
	Total Instructional Hours	**45**

Course Outcome

CO1. Acquiring basics knowledge on aerodynamic flow and wind tunnel measurement systems
CO2. Apply knowledge in wind tunnel measurements
CO3. Learn various flow visualization techniques.
CO4. Execute specific instruments for flow parameter measurement like pressure, velocity, temperature etc.
CO5. Analyze the special flows and uncertainty problems.

TEXT BOOKS:

T1 - Rathakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRC Press – Taylor & Francis, 2007.
T2 - Robert B Northrop, "Introduction to Instrumentation and Measurements", Second Edition, CRC Press, Taylor & Francis, 2006.

REFERENCE BOOKS:

R1 - Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985.Bradsaw Experimental Fluid Mechanics.
R2 - Lecture course on "Advanced Flow diagnostic techniques" 17-19 September 2008 NAL, Bangalore.
R3 - NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE8308	AIR TRANSPORTATION CONTROL AND 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** Concepts of ATC , ATS and ATCS – Objectives of ATS – 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 – emergencies – 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, New Delhi.
R2 - "FUNDAMENTALS OF AIR TRAFFIC CONTROL" Michael S. Nolan, Cengage Learning.
R3 - Wells .A-Airport Planning and Management, 4th Edition-McGraw-hill, London-2000.

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OPEN ELECTIVE – II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7402	AERODYNAMICS FOR INDUSTRIAL APPLICATIONS	3	0	0	3

Course Objective

1. To familiarize the atmosphere and effects of wind with various parameters.
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	**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, 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 and architectural 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: Identify the Atmospheric wind properties with various terrain fields.
CO2: Analyze the design concept of wind turbines & power efficiency.
CO3. Ability to 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 - M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and Road vehicles", Plenum press, New York, 1978.
T2 - Sachs. P., "Winds forces in Engineering", Pergamon Press, 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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AE7403	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.

Chairman - BoS
AERO - HiCET

Chairman

Dean (Academics)
HiCET

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

B. E. AERONAUTICAL ENGINEERING (UG)

Academic Year 2020-2021

REGULATION-2016 (Revised) & 2019

SEMESTER-I														
19HE1101 & Technical English														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	-	1	2	1	2	3	1	3	3	2
CO2	1	2	1	1	1	2	1	1	1	3	1	2	2	3
CO3	1	2	1	1	1	2	1	1	2	3	1	2	2	2
C04	1	1	-	1	1	1	1	1	2	3	1	2	3	3
C05	-	1	1	1	1	1	1	2	2	3	1	2	2	2
AVG	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4
19MA1102 & Calculus and linear algebra														
	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	3
C04	3	3	3	3	3	-	-	-	-	-	-	2	1	2
C05	3	3	3	3	3	-	-	-	-	-	-	2	2	1
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2
19PH1151 & Applied Physics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	3
CO3	3	2	1	2	2	-	-	-	-	-	-	1	3	3
C04	3	2	3	2	3	1	-	-	-	-	-	1	2	2
C05	3	2	3	2	2	2	-	-	-	-	-	1	2	3
AVG	3	2.2	2	1.6	2	1.3	-	-	-	-	-	1	2.4	2.4
19CY1151 & Chemistry for Engineers														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	2	1	1	-	-	-	-	1	1	1

CO2	3	2	2	-	2	1	-	-	-	-	-	1	1	-
CO3	3	2	2	-	2	1	1	-	-	-	-	1	1	-
C04	3	2	2	2	2	1	-	-	-	-	-	1	1	1
C05	3	2	2	-	2	1	-	-	-	-	-	1	1	1
AVG	3	2	2	2	2	1	1	-	-	-	-	1	1	1
19CS1151 & 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
19ME1152 & 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
19HE1071 & Value Added Course 1: Language Competency Enhancement Course-I														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	-	1	2	1	2	3	1	3	3	2
CO2	1	2	1	1	1	2	1	1	1	3	1	2	2	3
CO3	1	2	1	1	1	2	1	1	2	3	1	2	2	2
C04	1	1	-	1	1	1	1	1	2	3	1	2	3	3
C05	-	1	1	1	1	1	1	2	2	3	1	2	2	2
AVG	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4
SEMESTER-II														
19HE2101 & Business English for Engineers														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	1	2	1	2	2	3	-	3	1	-
CO2	2	1	1	1	1	2	2	2	2	3	-	2	-	1
CO3	2	2	1	1	1	2	2	2	2	3	1	3	1	-
C04	2	2	1	1	2	2	2	2	3	3	1	3	1	1
C05	1	1	1	1	1	2	2	1	2	3	1	3	1	1
AVG	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1
19MA2101 & Differential equations and complex variables														
	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	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2

C04	3	3	3	2	2	-	-	-	-	-	-	2	2	2
C05	3	3	3	3	3	-	-	-	-	-	-	2	2	2
AVG	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2
19EE2103 & Basic of Electrical and Electronics Engineering														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	1	2	1	-	2	-	-	-	-	-	-	3	3
C04	-	-	-	-	-	-	-	-	1	-	1	-	3	-
C05	-	-	1	1	1	-	-	-	-	-	-	-	3	-
AVG	3	3	1.5	1	1	2	-	-	1	-	1	-	3	3
19ME2101 & 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
19PH2151 & Material Science														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	2	-	-	-	-	-	-	1	2	3
C04	3	3	1	2	2	1	-	-	-	-	-	1	2	2
C05	3	2	2	3	2	1	2	-	-	-	-	1	2	3
AVG	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2
19CY2151 & Environmental Studies														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO2	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO3	2	1	1	-	-	2	3	3	2	-	-	2	-	-
C04	2	1	2	-	-	2	3	3	2	-	-	2	-	-
C05	2	1	2	-	-	2	3	3	2	-	-	2	-	-
AVG	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-
19HE2071 & Language Competency Enhancement Course-II														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	1	2	1	2	2	3	-	3	1	-
CO2	2	1	1	1	1	2	2	2	2	3	-	2	-	1
CO3	2	2	1	1	1	2	2	2	2	3	1	3	1	-
C04	2	2	1	1	2	2	2	2	3	3	1	3	1	1
C05	1	1	1	1	1	2	2	1	2	3	1	3	1	1
AVG	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1

19ME2001 & Engineering Practices Laboratory														
	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

19MA3101 & 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

19AE3201 & 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

19AE3202 & 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

19AE3203 & 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
19AE3251 & 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
19AE3001 & 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
19AE3002 & 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														
19MA4101 & 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
19AE4201 & 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
19AE4202 & 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
19AE4203 & 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
19AE4251 & 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
19AE4001 & 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

19AE4002 & 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

16AE5201-Aircraft Performance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	2	3	1
CO2	3	2	2	-	-	1	-	-	1	-	1	2	3	2
CO3	3	2	1	2	-	-	-	-	1	-	1	2	3	2
CO4	3	2	1	2	-	2	1	-	1	-	1	2	3	2
CO5	3	2	2	2	-	2	1	-	1	-	1	2	2	2
AVG	3	1.8	1.5	2	-	1.67	1	-	1	-	1	2	2.8	1.8

16AE5202-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
CO4	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO5	3	-	2	-	2	-	-	-	-	1	-	2	3	3
AVG	3	3	2.33	2	2	-	-	-	-	1	-	2	3	1.5

16AE5203-Aircraft Structures

	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	2	-	2	-	-	-	-	-	-	2	3	2
CO3	3	3	2	-	2	-	-	-	-	-	-	2	3	2
CO4	3	3	2	-	2	-	-	-	-	-	-	2	3	2
CO5	3	3	2	-	2	2	-	-	-	-	-	2	3	2
AVG	3	3	2	-	2	2	-	-	-	-	-	2	3	2

16AE5204-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

CO4	3	3	2	2	-	-	2	-	-	-	-	2	3	2
CO5	3	-	-	-	-	-	2	-	-	-	-	2	3	2
AVG	3	3	2.25	2	-	-	2	-	-	-	-	2	3	2
16AE5205-Aircraft General Engineering Maintenance and practice														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	-	2	2	3	3
CO2	3	3	2	3	3	-	-	-	-	-	2	2	3	3
CO3	2	3	2	-	3	-	-	-	-	-	2	2	3	2
CO4	2	2	2	3	3	-	-	-	-	-	2	3	3	3
CO5	2	2	2	-	3	-	-	-	-	-	2	3	3	2
AVG	2.4	2.4	2	2.67	3	-	-	-	-	-	2	2.4	3	2.6
16AE5001-Aircraft Structures Laboratory														
	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
CO4	3	-	2	-	-	-	-	-	2	-	-	2	3	3
CO5	3	-	2	-	-	-	-	-	2	-	-	2	3	3
AVG	3	-	2	-	2	-	-	-	2	-	-	2	3	3
16AE5002-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
CO4	3	2	-		-	-	-	-	-	2	-	2	3	3
CO5	3	3	-	2	-	-	-	-	-	2	-	2	3	3
AVG	3	2.75	-	2	2	-	-	-	-	2	-	2	3	2.8
SEMESTER-VI														
16AE6201-Aircraft stability and control														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	-	-	1	-	1	2	1
CO2	3	2	2	2	-	1	1	-	-	1	-	2	3	2
CO3	3	2	2	2	-	1	1	-	-	1	-	2	3	2
CO4	3	2	2	2	-	1	1	-	-	1	-	2	3	2
CO5	3	3	2	2	-	1	1	1	-	1	-	2	3	2
AVG	2.8	2	1.8	1.8	-	1	1	1	-	1	-	1.8	2.8	1.8
16AE6202-Finite Element Methods in Engineering														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	-	-	-	-	1	-	-	1	2	3
CO2	2	2	2	3	1	-	1	-	-	-	-	2	1	3
CO3	3	1	1	2	2	1	2	-	-	-	-	2	2	3
CO4	1	2	3	2	-	-	-	-	-	-	-	1	2	1
CO5	1	1	2	3	-	-	1	-	-	-	-	2	1	2

AVG	2	1.6	2	2.2	1.5	1	1.33	-	1	-	-	1.6	1.6	2.4
16AE6203-Composite Materials and Structures														
	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	-	-	-	-	-	-	-	1	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	1	3	2
CO4	3		2	2	2	-	-	-	-	-	-	1	1	1
CO5	3	2	2	2	-	-	-	-	-	-	-	1	3	2
AVG	3	2	2	2	2	-	-	-	-	-	-	1	2.6	1.8
16AE6001-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	3	1	-	1	3	2	2	2	3	3
CO4	3	3	3	3	2	-	2	1	3	2	2	2	3	3
CO5	3	2	3	3	3	2	-	2	3	2	2	2	3	3
AVG	3	2.8	3	3	2.6	1.33	1.33	1.4	3	2	2	2	3	3
16AE6002-Computer Aided Simulation Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	-	-	-	-	-	-	-	-	-	1	1
CO2	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO3	3	2	3	3	3	-	-	-	-	-	-	2	3	3
CO4	3	2	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	1	-	-	-	1	2	3	3
AVG	2.4	2.2	2.6	2.75	2.75	-	1	-	-	-	1	2	2.4	2.4
16AE6003-Aircraft Systems 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
CO4	3	2	2	3	-	2	-	-	2	3	-	2	3	1
CO5	3	2	2	3	-	3	-	-	2	2	-	2	3	2
AVG	3	2.2	2.2	2.6	-	2.67	-	-	2	2.2	-	2	3	1.8
16AE6801-Mini Project														
	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-VII														
16AE7201-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
CO4	3	3	3	-	3	3	2	-	-	-	-	2	3	2
CO5	3	3	1	2	3	-	-	-	-	-	-	3	3	2
AVG	3.00	2.20	2.40	2.67	3.00	1.75	2.00	-	-	-	1.00	2.75	3.00	2.20
16AE7202-Computational Fluid Dynamics														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	-	-	-	-	-	-	2	3	2
CO2	3	2	3	2	3	-	-	-	-	-	-	2	3	2
CO3	3	2	3	2	3	-	-	-	-	-	-	2	3	2
CO4	3	2	3	2	3	-	-	-	-	-	-	2	3	2
CO5	3	2	3	2	3	-	-	-	-	-	-	2	3	2
AVG	3	2	3	2	3	-	-	-	-	-	-	2	3	2
16AE7001-Aero Engine and Airframe Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	3	-	-	-	2	1	-	2	3	2
CO2	3	-	3	-	2	-	-	-	3	1	-	2	3	3
CO3	3	2	2	-	2	-	3	-	3	1	-	2	3	3
CO4	3	2	3	-	3	-	2	-	2	1	-	2	2	3
CO5	3	3	3	-	3	-	2	-	2	1	-	2	2	2
AVG	3.00	2.33	2.60	-	2.60	-	2.33	-	2.40	1.00	-	2.00	2.60	2.60
16AE7002-Avionics Laboratory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	1	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	1	-	-	-	2	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	2	-	-	-	-	-	2	1	2	3
CO5	3	3	3	-	2	-	-	-	-	-	2	1	3	3
AVG	3	3	3	-	2	-	-	-	1	-	2	1	2.6	3
16AE7701-Internship / Industrial Training														
	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
16AE7702-Technical Publication														
	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														
16AE8901-Project work														
	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

16AE5301-Aircraft materials and processes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-	-	-	-	3	3
CO2	3	-	-	3	-	-	-	-	-	-	-	-	3	3
CO3	3	-	-	3	-	3	-	-	-	-	-	-	3	3
CO4	3	-	-	3	-	-	-	-	-	-	-	-	3	3
CO5	3	-	-	3	-	-	-	-	-	-	-	-	3	3
AVG	3	-	-	3	-	3	-	-	-	-	-	-	3	3
16AE5302- Heat Transfer														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	-	2	-	-	-	-	2	3	1
CO2	3	3	2	3	-	-	2	-	-	-	-	2	3	1
CO3	3	3	2	3	-	-	2	-	-	-	-	2	3	1
CO4	3	3	2	3	-	-	2	-	-	-	-	2	3	1
CO5	3	3	2	3	-	-	2	-	-	-	-	2	3	1
AVG	3	3	2	3	-	-	2	-	-	-	-	2	3	1
16AE5303-Boundary layer Theory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2.2	1.2	1	-	-	-	-	-	-	-	-	3	2.2
CO2	3	3	2	2	2	-	-	-	-	1	-	2	-	3
CO3	3	3	1	2	1	-	-	-	-	1	-	2	-	3
C04	3	2	2	1	2	1	1	-	-	-	1	1	2	2
C05	3	2	1	-	1	-	-	2	-	-	1	1	2	1
AVG	3	3	2	1	2	1	-	2	1	1	2	2	2	2
16AE5304-Principles of 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	-	-	-
16AE6301 -Theory of Elasticity														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	2
AVG	3	2.8	2.8	2	-	-	-	-	-	-	-	-	3	2
16AE6302- 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
16AE6303 - Wind Tunnel Techniques														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	3	-	3	3
CO2	3	3	3	3	-	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	3	-	3	3
CO4	3	3	1	3	-	-	-	-	-	-	1	-	3	2
CO5	3	3	1	2	-	-	-	-	-	-	1	-	3	2
AVG	3	3	2.2	2.8	-	-	-	-	-	-	2.2	-	3	2.6
16AE6304 - Aero Engine Maintenance and Repair														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	-	-	-	-	-	2	1	-	3	3	1
CO2	3	3	1	3	2	-	-	-	2	-	-	-	3	2
CO3	3	1	1	-	-	-	-	-	-	-	-	-	3	1
CO4	3	3	2	1	-	-	-	-	-	1	-	-	3	1
CO5	3	1	1	2	-	-	-	-	2	-	-	-	3	2
AVG	3	1.8	1.4	2	2	-	-	-	2	1	-	3	3	1.4
16AE7301-Vibration 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
16AE7302-Satellite Propulsion														
	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
16AE7303-Rockets and Missiles														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	3	-	-	-	2	1	-	2	3	2
CO2	3	-	3	-	2	-	-	-	3	1	-	2	3	3
CO3	3	2	2	-	2	-	3	-	3	1	-	2	3	3
C04	3	2	3	-	3	-	2	-	2	1	-	2	2	3
C05	3	3	3	-	3	-	2	-	2	1	-	2	2	2
AVG	3	2.3	2.6	-	2.6	-	2.3	-	2.4	1	-	2	2.6	2.6
16AE7304-Airframe Maintenance and Repair														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	1	3	-	2	-	1	2	2	-	2	2	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	2
C04	3	3	3	3	3	-	-	-	-	-	-	2	3	3
C05	2	3	3	3	2	3	-	-	-	-	-	3	3	2
AVG	2.8	2.5	3	3	2.5	3	1	2	2	-	2	2.4	3	2.6
16AE7305-Experimental Stress analysis														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	1	3		2	-	1	2	2		2	2	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	2
C04	3	3	3	3	3	-	-	-	-	-	-	2	3	3
C05	2	3	3	3	2	3	-	-	-	-	-	3	3	2
AVG	2.8	2.5	3	3	2.5	3	1	2	2	-	2	2.4	3	2.6
16AE7306-Helicopter Theory														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	-	-	-	3	1
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	-	2	-	-	-	-	-	-	-	-	2	3	1
C04	3	-	3	2	-	-	-	-	-	-	-	-	3	2
C05	3	-	3	2	3	2	-	-	-	-	-	3	3	3
AVG	3	-	2.4	2	3	2	-	-	-	-	-	2.5	3	1.8
16AE7307-Aircraft Design														

	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	3	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	-	2	3	2	2	2	3	3
AVG	3	2.8	3	3	2.6	1.3	1.3	1.4	3	2	2	2	3	3

16AE7308-Engine system and control

	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

16AE8301-Fatigue and Fracture

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	-	-	-	-	-	-	-	2	3	1
CO2	3	2	3	2	-	-	-	-	-	-	-	2	3	2
CO3	3	2	3	3	2	-	-	-	-	-	-	2	2	3
C04	3	2	3	3	3	-	-	-	-	-	-	2	3	2
C05	3	2	3	3	2	-	-	-	-	-	-	2	3	2
AVG	3	2	2.8	2.8	2.33	-	-	-	-	-	-	2	2.8	2

16AE8302-Professional Ethics

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

16AE8303-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

16AE8304-Aviation Management and Air safety

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

CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	1
C04	3	1	1	-	-	-	-	-	-	-	-	-	3	1
C05	2	1	1	-	-	-	-	-	-	-	-	-	3	1
AVG	2.6	1.2	1	-	-	-	-	-	-	-	-	-	3	1
16AE8305-Structural Dynamics														
	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
16AE8306-UAV Systems														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	2	-	-	-	3	-	2	3	-
CO2	3	3	3	2	-		-	-	-	-	-	3	3	-
CO3	3	2	3	2	-	3	3	-	-	-	-	3	3	2
C04	2	2	2	-	-	3	3	-	-	-	-	2	3	2
C05	2	2	2	2	3	2	-	2	-	3	-	3	3	2
AVG	2.4	2.25	2.5	2	3	2.5	3	2	-	3	-	2.6	3	2
16AE8307-Experimental Aerodynamics														
	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
16AE8308-Air Traffic Control and 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	-	-	-	-	-	-	-	-	-	-	-

OPEN ELECTIVES

16AE6401-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	-
16AE7402-Aerodynamics for Industrial Applications														
	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
16AE7403-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

V.T.
Chairman - BoS
AERO - HiCET

ACADEMIC COUNCIL
Chairman

Dean (Academics)
HiCET