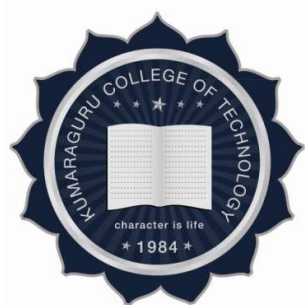


KUMARAGURU COLLEGE OF TECHNOLOGY,
An autonomous Institution affiliated to Anna University, Chennai
COIMBATORE – 641 049.

B.E., AERONAUTICAL ENGINEERING
REGULATIONS 2018



CURRICULUM AND SYLLABI
I to VIII Semesters

Department of Aeronautical Engineering

VISION

To attain excellence and global reputation in Aeronautical Engineering Education and Research.

MISSION

- The department is committed to provide quality education in Aeronautical Engineering to students to build their career and do quality research and thus contribute to the field of Aviation and Aerospace.
- The department aims to prepare students for their higher studies and research to contribute to the advanced technological needs of Aeronautical engineering.
- Encourage faculty to update their knowledge and teaching-learning process through continuous learning.
- Undertake inter-disciplinary research to contribute and support the industry.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives of Aeronautical Engineering Undergraduate Program are to prepare the students:

- I.** To pursue a successful profession in leading organizations.
- II.** To pursue postgraduate degrees and conduct research at leading technological universities to contribute to the advancement in the field of Aviation and Aerospace industries.
- III.** To continue their professional development by utilizing educational and career building opportunities through their employer, educational institutions, or professional bodies.

PROGRAM OUTCOMES (POs)

Graduates of the Aeronautical Engineering Undergraduate Program should have the ability to:

PO 1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: 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.

PO 6: 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.



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PO 7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the Aeronautical Engineering Undergraduate Program will have the ability to:

PSO 1: Apply fundamental principles of Aerodynamics, Structures, Propulsion, Materials, and Avionics to provide solutions to aerospace and non-aerospace industrial problems.

PSO 2: Use the software packages in the design, manufacturing, testing and maintenance of aeronautical and aerospace based components and systems




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COIMBATORE – 641 049
REGULATIONS 2018

B.E. AERONAUTICAL ENGINEERING
CURRICULUM


Semester I										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18ENI1201	Fundamentals of Communication-I	Embedded-Theory & Lab	HS	2	0	2	0	3	-----
2	U18MAI1201	Linear Algebra and Calculus	Embedded-Theory & Lab	BS	3	0	2	0	4	-----
3	U18PHI1201	Engineering Physics	Embedded-Theory & Lab	BS	3	0	2	0	4	-----
4	U18MEI1201	Engineering Graphics	Embedded-Theory & Lab	ES	2	0	2	0	3	-----
5	U18CSI1202	Problem Solving and Programming using C	Embedded-Theory & Lab	ES	2	0	2	0	3	-----
6	U18INI1600	Engineering Clinic 1	Embedded-Practical & Project	ES	0	0	4	2	3	-----
Total Credits									20	
Total Contact Hours/week									28	

Semester II										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18ENI2201	Fundamentals of Communication- II	Embedded-Theory & Lab	HS	2	0	2	0	3	U18ENI1201
2	U18MAI2201	Advanced Calculus and Laplace Transforms	Embedded-Theory & Lab	BS	3	0	2	0	4	U18MAI1201
3	U18CHI2201	Engineering Chemistry	Embedded-Theory & Lab	BS	3	0	2	0	4	-----
4	U18MET2003	Engineering Mechanics	Theory	ES	3	0	0	0	3	-----
5	U18CSI2201	Python Programming	Embedded-Theory & Lab	ES	2	0	2	0	3	U18CSI1202
6	U18AEI2201	Manufacturing Process	Embedded-Theory & Lab	PC	2	0	2	0	3	-----
7	U18INI2600	Engineering Clinic 2	Embedded-Practical & Project	ES	0	0	4	2	3	-----
Total Credits									23	
Total Contact Hours/week									27	


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Semester III										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18MAT3101	Partial Differential Equations and Transforms	Theory	BS	3	1	0	0	4	U18MAI2201
2	U18AEI3201	Fluid Mechanics	Embedded-Theory & Lab	PC	3	0	2	0	4	-----
3	U18AEI3202	Engineering Thermodynamics	Embedded-Theory & Lab	PC	3	0	2	0	4	-----
4	U18AEI3203	Mechanics of Solids	Embedded-Theory & Lab	PC	2	0	2	0	3	-----
5	U18EEI3202	Aircraft Electrical and Electronics Systems	Embedded-Theory & Lab	ES	2	0	2	0	3	-----
6	U18INI3600	Engineering Clinic 3	Embedded-Practical & Project	ES	0	0	4	2	3	-----
7	U18AEP3504	CAD Laboratory	Lab	PC	0	0	2	0	1	-----
Total Credits									22	
Total Contact Hours/week									30	

Semester IV										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18MAT4101	Numerical Methods and Probability	Theory	BS	3	1	0	0	4	U18MAT3101
2	U18AEI4201	Low Speed Aerodynamics	Embedded-Theory & Lab	PC	2	0	2	0	3	U18AEI3201
3	U18AEI4202	Automatic Control Systems	Embedded-Theory & Lab	PC	2	0	2	0	3	-----
4	U18AET4003	Aircraft Structures I	Theory	PC	3	0	0	0	3	U18AEI3203
5	U18AET4004	UAV System Design	Theory	PC	3	0	0	0	3	-----
6	U18AET4005	Aircraft Hardware and Materials	Theory	PC	3	0	0	0	3	-----
7	U18INI4600	Engineering Clinic 4	Embedded-Practical & Project	ES	0	0	4	2	3	-----
Total Credits									22	
Total Contact Hours/week									27	


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Semester V										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18AET5101	High Speed Aerodynamics	Theory	PC	2	1	0	0	3	U18AEI4201
2	U18AEI5202	Aircraft Structures II	Embedded-Theory & Lab	PC	2	0	2	0	3	U18AET4003
3	U18AET5003	Computational Fluid Dynamics	Theory	PC	3	0	0	0	3	U18AEI4201
4	U18AEI5204	Aircraft Systems and Instruments	Embedded-Theory & Lab	PC	2	0	2	0	3	-----
5	U18AEI5205	Aircraft Propulsion	Embedded-Theory & Lab	PC	2	0	2	0	3	U18AEI3202
6	OE I	Open Elective I	Theory	OE	3	0	0	0	3	-----
7	U18INI5600	Engineering Clinic 5	Embedded-Practical & Project	ES	0	0	4	2	3	-----
Total Credits									21	
Total Contact Hours/week									27	


Semester VI										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18AET6001	Flight Dynamics	Theory	PC	4	0	0	0	4	U18AEI4201
2	U18AET6002	Finite Element Method	Theory	PC	3	0	0	0	3	U18AEI3203
3	U18AET6003	Vibrations and Aeroelasticity	Theory	PC	3	0	0	0	3	U18AEI5202
4	U18AET6104	Rocket Propulsion	Theory	PC	2	1	0	0	3	U18AEI5205
5	OE II	Open Elective II	Theory	OE	3	0	0	0	3	-----
6	U18AEE00--	Professional Elective I	Theory	PE	3	0	0	0	3	-----
7	U18AEP6505	Design and Simulation Laboratory	Lab	PC	0	0	2	0	1	U18AET5003
8	U18AEP6506	Airframe and Aero Engine Maintenance Laboratory	Lab	PC	0	0	2	0	1	-----
Total Credits									21	
Total Contact Hours/week									23	


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Semester VII										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18AEI7201	Aircraft Design	Embedded-Theory & Lab	PC	3	0	2	0	4	U18AET6001
2	U18AET7002	Aviation Logistics and Supply Chain Management	Theory	PC	3	0	0	0	3	-----
3	U18AEI7203	Avionics	Embedded-Theory & Lab	PC	2	0	2	0	3	U18EEI3202
4	U18AEE00--	Professional Elective II	Theory	PE	3	0	0	0	3	-----
5	U18AEE00--	Professional Elective III	Theory	PE	3	0	0	0	3	-----
6	U18AEE00--	Professional Elective IV	Theory	PE	3	0	0	0	3	-----
7	U18AEP7704	Project Work – Phase I	Project	PW	0	0	0	6	3	-----
Total Credits									22	
Total Contact Hours/week									27	

Semester VIII										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U18AEP8701	Project Work –Phase II	PROJECT	PW	0	0	0	24	12	U18AEP7705
Total Credits									12	
Total Contact Hours/week									24	

Total Credits 163

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PROFESSIONAL ELECTIVES

Course Code	Course Title	Course category	Course Mode	L	T	P	J	C
U18AEE0001	Experimental Aerodynamics	Elective	Theory	3	0	0	0	3
U18AEE0002	Viscous Flow Theory	Elective	Theory	3	0	0	0	3
U18AEE0003	Hypersonic Aerodynamics	Elective	Theory	3	0	0	0	3
U18AEE0004	Cryogenic Engineering	Elective	Theory	3	0	0	0	3
U18AEE0005	Principles of Combustion	Elective	Theory	3	0	0	0	3
U18AEE0006	Heat and Mass Transfer	Elective	Theory	3	0	0	0	3
U18AEE0007	Composite Materials and Structures	Elective	Theory	3	0	0	0	3
U18AEE0008	Theory of Elasticity	Elective	Theory	3	0	0	0	3
U18AEE0009	Fatigue and Fracture Mechanics	Elective	Theory	3	0	0	0	3
U18AEE0010	Experimental Stress Analysis	Elective	Theory	3	0	0	0	3
U18AEE0011	Space Mechanics	Elective	Theory	3	0	0	0	3
U18AEE0012	Non Destructive Testing	Elective	Theory	3	0	0	0	3
U18AEE0013	Aircraft Maintenance Practices	Elective	Theory	3	0	0	0	3
U18AEE0014	Helicopter Aerodynamics	Elective	Theory	3	0	0	0	3
U18AEE0015	High Energetic Fuels and Propellants	Elective	Theory	3	0	0	0	3
U18AEE0016	Aircraft Structural Analysis	Elective	Theory	3	0	0	0	3
U18AEE0017	Autonomous Navigation	Elective	Theory	3	0	0	0	3
U18AEE0018	Additive Manufacturing and Tooling	Elective	Theory	3	0	0	0	3


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LIST OF MANDATORY COURSES

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Semester
1	U18VEP1501	Personal values	Lab	HS	0	0	2	0	0	I
2	U18VEP2502	Inter-Personal values	Lab	HS	0	0	2	0	0	II
3	U18CHT3000	Environmental Science and Engineering	Theory	MC	2	0	0	0	0	III
4	U18VEP3503	Family Values	Lab	HS	0	0	2	0	0	III
5	U18VEP4504	Professional Values	Lab	HS	0	0	2	0	0	IV
6	U18INT5000	Constitution of India	Theory	MC	2	0	0	0	0	V
7	U18VEP5505	Social Values	Lab	HS	0	0	2	0	0	V
8	U18VEP6506	National Values	Lab	HS	0	0	2	0	0	VI
9	U18VEP7507	Global Values	Lab	HS	0	0	2	0	0	VII
10	U18AER0001	Introduction to Aeronautics	Theory	MC	2	0	0	0	0	-----


OPEN ELECTIVES*

S. No.	Course Code	Course Title	Category	Contact Hours	Hours per Week & Credits			
					L	T	P	C
1	U18AE00001	Basics of Aeronautics	OE	3	3	0	0	3
2	U18AE00002	Industrial Aerodynamics	OE	3	3	0	0	3
3	U18AE00003	Non-destructive Testing for Engineering Applications	OE	3	3	0	0	3
4	U18AE00004	Autonomous Flying Robots	OE	3	3	0	0	3
5	U18AE00005	Wind Turbine Engineering	OE	3	3	0	0	3
6	U18AE00006	Theory behind Airplane: From birds to Human Flight	OE	3	3	0	0	3
7	U18AE00007	Satellite System and Application	OE	3	3	0	0	3
8	U18AE00008	Basics of aeroplanes and human life	OE	3	3	0	0	3
9	U18AE00009	Theory and Practice of Non Destructive Testing	OE	3	3	0	0	3


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INDUSTRY-ORIENTED ONE CREDIT COURSES*

S. No.	Course Code	Course Title	Category	Total Hours
1	U18AEC0201	Wind Turbine Design and Testing	PE	15
2	U18AEC0202	Theory and Practice of Aeronautics with Industrial Applications	PE	15
3	U18AEC0203	Aircraft Design Approach	PE	15
4	U18AEC0204	Introduction to CFD using RotCFD	PE	15
5	U18AEC0205	Satellite System and Application	PE	15
6	U18AEC0006	Smart Materials and Structures	PE	15



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SEMESTER I



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U18ENI1201	FUNDAMENTALS OF COMMUNICATION-I	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Communicate in English with correct grammar

CO2: Communicate effectively (Oral and Written)

CO3: Use communication skills in the real world


Pre-requisites : -**CO-PO and CO-PSO Mapping:**

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										S		S	-	-
CO2		M		W		W			M	S		S	-	-
CO3		M		M		W			M	S		S	-	-

Course Assessment methods

Direct
1. Continuous Assessment of Skills
2. Assignment
3. Written Test
4. End Semester Examination
Indirect
1. Course-end survey

No	Topic	Hours
MODULE I - 12 Hrs		
1.1	Parts of Speech	2
1.2	Subject Verb Agreement	2
1.3	Speak up (Self Introduction, JAM)	4
1.4	Writing sentences using 'Be-forms'	3
1.5	Test	1
MODULE II - 12Hrs		
2.1	Articles, Gerunds, Infinitives	2
2.2	Speak up (Greetings & Polite English)	4
2.3	Dialogue Writing	3
2.4	Skimming & Scanning	2
2.5	Listening Skills - I	1
MODULE III - 12 Hrs		
3.1	Tenses & Voice	2
3.2	Sentences & its kinds	2
3.3	Speak up (Narration & Description)	4
3.4	Summarizing & Note-making	3
3.5	Listening Skills - II	1
MODULE IV - 12 Hrs		



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4.1	Framing Questions – 4 types	2
4.2	Speak up (Role play)	4
4.3	Letter writing – Formal and Informal & Email Writing	3
4.4	Reading Comprehension & Cloze test	2
4.5	Listening Skills - III	1
MODULE V - 12 Hrs		
5.1	Degrees of Comparison	2
5.2	Clauses	2
5.3	Speak up (Power Point Presentation)	4
5.4	Writing (Picture perception)	3
5.5	Test	1
Total		60

Theory: 30	Tutorial:	Practical: 30	Project: 0	Total: 60 Hours
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REFERENCES

1. A Modern Approach to Non Verbal Reasoning (English, Paperback, Dr. R S Aggarwal)
2. The Power of Words(Bloomsbury, UK, 2012, Hyacinth Pink)
3. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary (By Norman Lewis)
4. Effective Technical Communication Tata Mc Graw Hills Publications (Ashraf Rizvi)
5. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)
6. Know Your Grammar: Trans.in Tamil & Malayalam –A Bilingual Approach (Bloomsbury, UK, 2012, Hyacinth Pink)


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U18MAI1201	LINEAR ALGEBRA AND CALCULUS (Common to All branches)	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify eigenvalues and eigenvectors and apply Cayley Hamilton theorem.

CO2: Apply orthogonal diagonalisation to convert quadratic form to canonical form.

CO3: Solve first order ordinary differential equations and apply them to certain physical situations.

CO4: Solve higher order ordinary differential equations.

CO5: Evaluate the total derivative of a function, expand the given function as series and locate the maximum and minimum for multivariate function.

CO6: Determine Rank, Inverse, Eigenvalues, Eigenvectors of the given matrix, Maxima-Minima of the function and Solving Differential equations using MATLAB

Pre-requisites : Basics of Matrices, Differentiation and Integration

CO-PO and CO-PSO Mapping:

CO/PO Mapping S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S			M				M	M		M	S	
CO2	S	S			M				M	M		M	S	
CO3	S	S			M				M	M		M	S	
CO4	S	S			M				M	M		M	S	
CO5	S	S			M				M	M		M	S	
CO6	S	S			M				M	M		M		S

Course Assessment methods


DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product 3. Demonstration etc (as applicable) (Theory component) 4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component) 5. Model Examination (lab component) 6. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

MATRICES

6 Hours

Rank of a matrix – Consistency of a system of linear equations - Rouche's theorem - Solution of a system of linear equations - Linearly dependent and independent vectors– Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof)


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DIAGONALISATION OF A REAL SYMMETRIC MATRIX**6 Hours**

Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS**11 Hours**

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS**11 Hours**

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Applications.

FUNCTIONS OF SEVERAL VARIABLES**11 Hours**

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2011.
4. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007
5. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai, 2003
7. Weir, MD, Hass J, Giordano FR: Thomas' Calculus, Pearson education 12th Edition, 2015

LAB COMPONENT**List of MATLAB Programmes:**

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigenvalues and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Solving first order ordinary differential equations.
8. Solving second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.
10. Determining Maxima and Minima of a function of two variables.

Theory: 45	Tutorial: 0	Practical: 30	Project: 0	Total: 75
Hours				



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U18PHI1201	ENGINEERING PHYSICS (COMMON TO ALL B.E., B.TECH.)	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Understand the principles of motion and rotation of a rigid body in the plane.
CO2: Enhance the fundamental knowledge in properties of matter and its applications relevant to various streams of Engineering and Technology.
CO3: Recognise the nature and role of the thermodynamic parameters.
CO4: Compute electrostatic field and electric potential due to point and distributed charges.
CO5: Use electrostatic & magneto static boundary conditions to relate fields in adjacent media.
CO6: Introduce and provide a broad view of the smart materials and Nano science to undergraduates.

Pre-requisites : High School Education

CO-PO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
Cos	Programme Outcomes (POs)										PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	S	M										M	W
CO2	S	M			S							M	M
CO3	S	M			S							M	M
CO4	S	M			S							M	S
CO5	S	M			S							M	M
CO6	S	M					M					M	W

Course Assessment Methods

Direct
<ol style="list-style-type: none"> Continuous Assessment Test I, II (Theory component) Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation, Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) Model examination (lab component) End Semester Examination (Theory and lab component)
Indirect
<ol style="list-style-type: none"> Course-end survey

THEORY COMPONENT

KINEMATICS & RIGID BODY MOTION


9 Hours

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

PROPERTIES OF MATTER AND MATERIALS TESTING

9 Hours

Properties of matter: Hooke's Law Stress - Strain Diagram - Elastic moduli - Relation between elastic constants - Poisson's Ratio - Expression for bending moment and depression


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- Cantilever - Expression for Young's modulus by Non uniform bending and its experimental determination.

Materials testing: Mechanism of plastic deformation, slip and twinning – types of fracture – Vickers Hardness test - fatigue and creep test.

HEAT

9 Hours

Specific heat capacity, thermal capacity. Temperature rise. Coefficient of linear thermal expansion. Methods of measurement of thermal expansion. Thermal stresses in composite structures due to non-homogeneous thermal expansion. Applications -The bimetallic strip. Expansion gaps and rollers in engineering structures. Thermal conductivity: differential equation of heat flow. Lee's disc apparatus for determination of thermal conductivity. Thermal Insulation. Convection and radiation. Applications to refrigeration and power electronic devices.

ELECTROSTATICS & MAGNETOSTATICS

10 Hours

ELECTROSTATICS : Maxwell's equation for electrostatics – E due to straight conductors, circular loop, infinite sheet of current - electric field intensity (D) - Electric potential - dielectrics - dielectric polarization - internal field – Clausius - Mosotti equation - dielectric strength - applications.

MAGNETOSTATICS: Maxwell's equation for magnetostatics - B in straight conductors, circular loop, infinite sheet of current - Lorentz force, magnetic field intensity (H) – Biot–Savart's Law – Ampere's Circuit Law –Magnetic flux density (B) – magnetic materials – Magnetization – Applications.

NEW ENGINEERING MATERIALS AND NANO TECHNOLOGY


8 Hours

New Engineering Materials: Metallic glasses – preparation, properties and applications – Shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications - advantages and disadvantages of SMA.

Nano Materials: synthesis - Ball milling - Sol-gel - Electro deposition — properties of nano particles and applications. – Carbon Nano Tubes – fabrication by Chemical Vapour Deposition - structure, properties & applications.

REFERENCES:

1. Elements of Properties of Matter, Mathur D.S., Shyamlal Charitable Trust, New Delhi, 1993.
2. Properties of matter, brijlal and Subharamaniam, S.Chand and Co, New Delhi, 2004.
3. Fundamentals of General Properties of Matter by Gulati H.R., R. Chand & Co., New Delhi, 1982.
4. Engineering Mechanics (2nd ed.), Harbola M. K., Cengage publications, New Delhi, 2009.
5. Introduction to Mechanics, Verma M. K. (CRC Press), University Press, 2000.
6. Thermodynamics: An Engineering Approach (SI Units), yunus a. cengel & michael a. boles 7th edition, mcgraw-hill companies 2014.
7. Engineering Electromagnetics, W. H. Hayt and John A. Buck, 6th Edition, Tata McGraw Hill, New Delhi, 2014.
8. Electromagnetic Field Theory, 5th Edition, Gangadhar K.A. and Ramanathan P.M., Khanna Publishers, New Delhi, 2013.


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9. Problems and Solutions in Electromagnetics, 1st Edition, J.A. Buck and W. H. Hayt, Tata McGraw Hill, New Delhi, 2010.
10. Theory and Problems of Electromagnetic Schaum's Outline Series, 5th Edition, Joseph A. Edminister, Tata McGraw Hill Inc., New Delhi, 2010.
11. Engineering Physics, Rajendran V., Tata McGraw-Hill Education Pvt. Ltd., 2010
12. Nano – the Essentials, Pradeep T., McGraw-Hill Education, Pvt. Ltd., 2007.

Lab component:

LIST OF EXPERIMENTS

1. Determination of thermal conductivity of a bad conductor - Lee's disc
2. Determination of Acceleration due to Gravity – Compound Pendulum
3. Determination of wavelength of light, Numerical aperture and acceptance of optical fibre
4. Determination of band gap of a semiconductor
5. Determination of compressibility of a given liquid - Ultrasonic Interferometer
6. Determination of thickness of thin sheet – Air wedge
7. Determination of frequency of an electrically maintained tuning fork – Melde's string
8. Determination of wavelength of mercury source using diffraction grating - Spectrometer
9. Determination of solar cell efficiency using Lux Meter
10. Determination of Young's Modulus – Non-uniform bending

Experiments for Demonstration:

1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Hysteresis curve

Theory: 45	Tutorial: 0	Practical: 30	Project: 0	Total: 75 Hours
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REFERENCES

1. Laboratory Manual of Engineering Physics, Dr. Y. Aparna & Dr. K. Venkateswara Rao, V.G.S Publishers.
2. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
3. Great Experiments in Physics, M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.



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U18MEI1201	ENGINEERING GRAPHICS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Construct various plane curves.
CO2: Construct projection of points and projection of lines.
CO3: Develop projection of surfaces and solids.
CO4: Solve problems in sections of solids and development of surfaces.
CO5: Apply free hand sketching and concepts of isometric in engineering practice.
CO6: Draw engineering drawing in AutoCAD with dimensions.

Pre-requisites : -

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											M	
CO2	S	S									W		M	
CO3	S	S									M		M	
CO4	S	S											S	
CO5	S	S											S	
CO6	S													S

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test, Assignment, Group Presentation 3. Viva, Experimental Report for each Experiment (lab Component) 4. Model Examination (lab component) 5. End Semester Examination (Theory and lab components)
Indirect
1. Course-end survey

PLANE CURVES, PROJECTION OF POINTS, LINES AND PLANES**10 Hours**


Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true length and true inclinations.

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane.

PROJECTION AND SECTION OF SOLIDS**10 Hours**

Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.


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Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS AND FREE-HAND SKETCHING **10 Hours**

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

INTRODUCTION TO AUTOCAD **15 Hours**

Introduction to Drafting Software (AutoCAD) & its Basic Commands. Introduction to coordinate systems, object selection methods, selection of units and precession. Sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer.

ISOMETRIC VIEWS WITH AUTOCAD **15 Hours**

Building drawings – Single and double bed room house (sectional Top view only). Introduction to Motion path animation. Isometric views of simple solid blocks.

Theory: 30 Hours	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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REFERENCES

1. Basant Agrawal and CM Agrawal, Engineering Drawing, McGraw-Hill, New Delhi, First Edition, 2008.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2008.
3. Natarajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2005.
4. Warren J. Luzadder and Jon. M. Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., New Delhi, Eleventh Edition, 2005.
5. Gopalakrishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2001.
6. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.



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U18CSI1202	PROBLEM SOLVING AND PROGRAMMING USING C	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Acquire knowledge on different problem solving techniques.

CO2: Use appropriate data types and control structures for solving a given problem.

CO3: Execute different array and string operations.

CO4: Experiment with the usage of pointers and functions.

CO5: Organize data using structures and unions.

Pre-requisites :-

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M							W				W	
CO2	S	M							W	W				S
CO3	S	W			W	W			W	W		W		S
CO4	M	W	M	W	W	W			W	W		M		S
CO5	M	W	M	W	W	W			W	W		M		S

Course Assessment methods

Direct
<ol style="list-style-type: none"> 1. Continuous Assessment Test I, II (Theory Component) 2. Assignment (Theory Component) 3. Group Presentation (Theory Component) 4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 5. Model examination (lab component) 6. End Semester Examination (Theory and lab component)
Indirect
<ol style="list-style-type: none"> 1. Course-end survey

THEORY COMPONENT CONTENTS

STRUCTURED PROGRAMMING


6 Hours

Algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration). Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements.

ARRAYS AND STRINGS

6 Hours

Defining an array – Processing an array –Multidimensional Arrays Character Arithmetic – Defining a string – Initialization of Strings – Reading and Writing Strings – Processing Strings –Searching and Sorting of Strings


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FUNCTIONS, STORAGE CLASSES**6 Hours**

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Passing arrays to functions – Function with string - Recursion – Storage classes

POINTERS**7 Hours**

Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers– Dynamic memory allocation.

STRUCTURES AND UNIONS**5 Hours**

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions

Theory: 30 Hours	Tutorial: 0	Practical: 0	Project: 0	Total: 30 Hours
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REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. Pradip Dey and Manas Ghosh, “Programming in C”, Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.
5. Reema Thareja, “Programming in C”, Second Edition, Oxford University Press, 2011.


LAB COMPONENT CONTENTS**LIST OF EXPERIMENTS**

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.

Theory: 0	Tutorial: 0	Practical: 30 Hours	Project: 0	Total: 30 Hours
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REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. Pradip Dey and Manas Ghosh, “Programming in C”, Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.



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U18VEP1501	PERSONAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

- CO 1: Become an individual in knowing the self
 CO 2: Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.
 CO 3: Practice simple physical exercise and breathing techniques
 CO 4: Practice Yoga asana which will enhance the quality of life.
 CO 5: Practice Meditation and get benefited.
 CO 6: Procure Self-Healing techniques for propagating healthy society

Pre-requisites :-

CO-PO and CO-PSO Mapping:

CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2
CO1												M	-	-
CO2										S			-	-
CO3						M							-	-
CO4						S			M				-	-
CO5										M			-	-
CO6								W				S	-	-

Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values Through Practical

Activities:

- 1.Knowing the self** :Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.
- 2. Mental Health** :Evolution of senses – functioning steps of human mind – Body and Mind coordination - Analysis of thoughts – moralization of desires– autosuggestions – power of positive affirmations. – Meditation and its benefits.
- 3.Physical Health**: Physical body constitution– Types of food - effects of food on body and mind – healthy eating habits – food as medicine– self healing techniques.
- 4.Core value : Self love& Self care** Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.
- 5.Fitness**: Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadi suddhi pranayama – Silent sitting and listening to nature – Meditation.

Workshop mode


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REFERENCES

1. KNOW YOURSELF — SOCRATES – PDF format at www.au.af.mil/au/awc/awcgate/army/rotc_self-aware.pdf
2. STEPS TO KNOWLEDGE: The Book of Inner Knowing – PDF format at www.newmessage.org/wp-content/uploads/pdfs/books/STK_NKL_v1.5.pdf
3. PROMOTING MENTAL HEALTH - World Health Organization – PDF format at www.who.int/mental_health/evidence/MH_Promotion_Book.pdf
4. LEARNING TO BE: A HOLISTIC AND INTEGRATED APPROACH TO VALUES – UNESCO PDF format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf
5. PERSONALITY DEVELOPMENT By SWAMI VIVEKANANDA www.estudentedavedanta.net/Personality-Development.pdf



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U18INI1600	ENGINEERING CLINIC - I	L	T	P	J	C
		0	0	4	2	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify a practical problems and find a solution

CO2: Understand the project management techniques

CO3: Demonstrate their technical report writing and presentation skills

Pre-requisites :-

CO-PO and CO-PSO Mapping:

CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	
CO2											S		W	
CO3										S			W	

Course Assessment methods

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:


The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the I semester, students will focus primarily on IOT with C programming using Audino

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total: 90 Hours


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SEMESTER II



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U18ENI2201	FUNDAMENTALS OF COMMUNICATION - II	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Read, understand, and interpret material on technology.

CO2: Communicate knowledge and information through oral and written medium.

CO3: Compare, collate and present technical information according to the audience and purpose.

Pre-requisites : -


CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak															
COs	Programme Outcomes(POs)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1		W		S					S	S		S	W	-	
CO2				S					S	S		W	W	-	
CO3				M					S	S		S	-	-	

Course Assessment methods

Direct
1. Continuous Assessment of Skills
2. Assignment
3. Written Test
4. End Semester Examination
Indirect
1. Course-end survey

No	TOPIC	
	MODULE I	12 Hrs
1.1	Introduction to Technical Writing Technical Definitions	2
1.2	Writing Instructions / Instruction Manual	2
1.3	Writing Recommendations	2
1.4	Speaking Activity I	6
	MODULE II	12 Hrs
2.1	Process Writing	2
2.2	Review Writing I - Product	2
2.3	Review Writing II – Article	2
2.4	Speaking Activity II	6
	MODULE III	12 Hrs
3.1	Interpreting and Transcoding Graphics	2
3.2	Types of Report / Writing a Report	2
3.3	Reading & Responding to texts	2
3.4	Speaking Activity III	6
	MODULE IV	12 Hrs
4.1	Drafting a project proposal	2



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4.2	Listening to technical talks	2
4.3	Preparing a survey Questionnaire	2
4.4	Speaking Activity IV	6
	MODULE V	12 Hrs
5.1	Writing Memos, Circulars, Notices	2
5.2	Writing Agenda and Minutes	2
5.3	Inferential Reading	2
5.4	Speaking Activity V	6
	Total	60

Theory: 30 Hours	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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REFERENCES

1. Technical English Workbook, VRB Publishers Pvt. Ltd (Prof. Jewelcy Jawahar, Dr.P.Ratna)
2. Effective Technical Communication, Tata McGraw Hills Publications (Ashraf Rizvi)
3. Technical Communication – English Skills for Engineers, Oxford Higher Education (Meenakshi Raman, Sangeeta Sharma)


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U18MAI2201	ADVANCED CALCULUS AND LAPLACE TRANSFORMS	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.
- CO2:** Apply various integral theorems for solving engineering problems involving cubes and rectangular parallelepipeds.
- CO3:** Construct analytic functions of complex variables and transform functions from z-plane to w-plane and vice-versa, using conformal mappings.
- CO4:** Apply the techniques of complex integration to evaluate real and complex integrals over suitable closed paths or contours.
- CO5:** Solve linear differential equations using Laplace transform technique.
- CO6:** Determine multiple integrals, vector differentials, vector integrals and Laplace transforms using MATLAB.

Pre-requisites : U18MAI1201 - Linear Algebra And Calculus

CO-PO and CO-PSO Mapping:

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	PROGRAMME OUTCOMES (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S			M				M	M		M	S	
CO2	S	S			M				M	M		M	S	
CO3	S	S			M				M	M		M	S	
CO4	S	S			M				M	M		M	S	
CO5	S	S			M				M	M		M	S	
CO6	S	S			S				M	M		M		S

Course Assessment methods

DIRECT
<ol style="list-style-type: none"> Continuous Assessment Test I, II (Theory component) Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component) Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) Model examination (lab component) End Semester Examination (Theory and lab component)
INDIRECT
<ol style="list-style-type: none"> Course-end survey

THEORY COMPONENT CONTENTS


MULTIPLE INTEGRALS

9 Hours

Double integration – Cartesian coordinates – Change of order of integration - Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral.

VECTOR CALCULUS

9 Hours


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Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields
 - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs)
 - Verification of theorem and simple applications.

ANALYTIC FUNCTIONS

9 Hours

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy- Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs)– Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ – Bilinear Transformation

COMPLEX INTEGRATION

9 Hours

Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series – Singularities –Residues –Residue theorem –Application of residue theorem for evaluation of real integrals – Contour Integration (excluding poles on the real axis).

LAPLACE TRANSFORMS

9 Hours

Definition - Properties: Superposition, Shift in t or Time Delay, Shift in s, Time Derivatives, Time Integral-Initial Value Theorem - Final Value Theorem - Transform of periodic functions - Inverse transforms - Convolution theorem – Applications: Solution of linear ordinary differential equations of second order with constant coefficients.

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
4. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008.
5. Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2011.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai, 2003.
7. Weir, MD, Hass J, Giordano FR: Thomas' Calculus Pearson education 12th ED, 2015.

LAB COMPONENT

List of MATLAB Programmes:

1. Evaluating double integral with constant and variable limits.
2. Area as double integral
3. Evaluating triple integral with constant and variable limits
4. Volume as triple integral
5. Evaluating gradient, divergence and curl
6. Evaluating line integrals and work done
7. Verifying Green's theorem in the plane
8. Evaluating Laplace transforms and inverse Laplace transforms of functions including impulse.
9. Heaviside functions and applying convolution.
10. Applying the technique of Laplace transform to solve differential equations.

Theory: 45	Tutorial: 0	Practical: 30	Project: 0	Total: 75 Hours
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U18CHI2201	ENGINEERING CHEMISTRY	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Apply the basic principles of chemistry at the atomic and molecular level.

CO2: Analyze the impact of engineering solutions from the point of view of chemical principles

CO3: Apply the chemical properties to categorize the engineering materials and their uses

CO4: Integrate the chemical principles in the projects undertaken in field of engineering and technology

CO5: Develop analytical proficiency through lab skill sets to demonstrate in professional practice.

Pre-requisites : -**CO-PO and CO-PSO Mapping:**

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											S	
CO2	S	M		M									S	
CO3	S	M		S									S	
CO4	S	M		S									S	
CO5	M	S		S									M	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group 3. Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) 4. End Semester Examination
Indirect
1. Course-end survey


THEORY COMPONENT CONTENTS**CHEMICAL BONDING****7 Hours**

Bonding: Introduction – Ionic bonding - Van der Waal's forces (dipole - dipole, dipole - induced dipole, induced dipole - induced dipole interactions) - hydrophobic interaction.

Bonding in organic molecules: covalent and co-ordinate bonds (overview only) - hybridization (sp, sp², sp³) - hydrogen bonding and its consequences.

THERMODYNAMICS**7 Hours**

Introduction - Thermodynamic process – Internal energy – Enthalpy – limitations of First law of thermodynamics – Second law of thermodynamics - Entropy - Third law of thermodynamics – Free Energy and Work Function – Clausius-Clapeyron equation – Maxwell's relations – Kirchhoff's equation.



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ELECTROCHEMISTRY AND CORROSION**7 Hours**

Electrodes - Electrode Potential – Nernst equation and problems - Galvanic cell - Electrochemical Series.

Corrosion: Classification and mechanism of chemical and electrochemical corrosion - Factors influencing corrosion

Corrosion control: Inhibitors – Cathodic protection (Sacrificial anodic protection, Impressed current cathodic protection) – Protective coating: Electroplating (Au) and Electroless plating (Ni).

WATER TECHNOLOGY**6 Hours**

Introduction - soft/hard water - Disadvantages of hard water in industries– scale, sludge, priming and foaming, caustic embrittlement.

Treatment of hard water: External treatment (Ion exchange method) - Internal treatment (colloidal, carbonate, phosphate and calgon conditioning) - Desalination (Reverse osmosis, Electrodialysis)

ENGINEERING MATERIALS**9 Hours**

Polymer: Introduction – Preparation, Properties and Applications of PMMA, PET, PVC.

Composites: Constituents of Composites – Polymer Composites - Metal Matrix Composites - Ceramic Matrix Composites – Applications

Lubricants: Classification - Functions - Properties (viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud point and pour point) - Semi solid lubricant (greases with calcium based, sodium based, lithium based) - Solid lubricants (graphite, molybdenum disulphide)

SURFACE CHEMISTRY AND CATALYSIS**9 Hours**

Adsorption: Types of adsorption – Adsorption isotherms: Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Applications of adsorption on pollution abatement.


Catalysis: Catalyst – catalytic poisoning and catalytic promoters - autocatalysis – acid base catalysis – enzyme catalysis – Michaelis-Menten equation – applications.

Chemical kinetics: Introduction – first order, pseudo first order, second order, zero order equations – parallel reactions – opposing reactions.

Theory: 45 Hours	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Jain P.C. and Jain. M., Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2017.
2. Puri B.R., Sharma L.R., Pathania, M.S. Principles of physical chemistry, Vishal Publishing Co., 2017
3. Atkins, P. and de Paula, J., Atkin's Physical Chemistry, 9th ed., Oxford Univ. Press, 2009.
4. Glasstone S., An introduction to Electrochemistry, 10th Edition, Affiliated to East West Press Private Limited, 2007.
5. Samir Sarkar., Fuels and Combustion, 3rd Edition, Orient Longman, India, 2009.
6. Dara S.S. and Umare S.S., A text book of Engineering Chemistry, S.Chand and Company Limited, New Delhi, 2014.
7. Engineering Chemistry, Wiley India Editorial Team, Wiley, 2018.



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LAB COMPONENT CONTENTS

LIST OF EXPERIMENTS

1. Preparation of Standard solutions
2. Conductometric estimation of mixture of acids vs strong base
3. Estimation of extent of corrosion of Iron pieces by Potentiometry
4. Estimation of the extent of dissolution of Copper / Ferrous ions by spectrophotometry.
5. Estimation of acids by pH metry.
6. Determination of total, temporary and permanent hardness by EDTA method.
7. Estimation of DO by Winkler's method
8. Estimation of Alkalinity by Indicator method.
9. Estimation of Chloride by Argentometric method
10. Estimation of Sodium and Potassium in water by Flame photometry.
11. Determination of Flash and Fire point of lubricating oil
12. Determination of Cloud and Pour point of lubricating oil
13. Determination of relative and kinematic viscosities of lubricating oil at different temperatures
14. Determination of corrosion rate on mild steel by Weight loss method
15. Morphological studies of corrosion on mild steel by microscopic techniques

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 Hours
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REFERENCES

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London, 2012.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co., Ltd., London, 2003.



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U18MET2003	ENGINEERING MECHANICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Apply the fundamental concepts in determining the effect of forces on a particle.
CO2: Make use of various principles in the determination of effect of forces in a rigid body.
CO3: Determine the geometry dependant properties of solids and sections
CO4: Solve problems in static friction.
CO5: Identify motion and determine the velocity and acceleration of a particle.
CO6: Apply the principles of kinetics in solving problems in dynamics.

Pre-requisites : -

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs)												PSOs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	S								M	M			S
CO2	S								M	M			S
CO3	S								M	M			S
CO4	S								M	M			S
CO5	S								M	M			S
CO6	S								M	M			S

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

STATICS OF PARTICLES

9 Hours

Introduction - Laws of Mechanics, Parallelogram and triangular Laws of forces – Coplanar Forces - Resolution and Composition of forces – Free body diagram - Equilibrium of a particle – Lami's theorem – Equilibrium of a particle in space.

STATICS OF RIGID BODIES


9 Hours

Principle of transmissibility – Moment of force about a point – Varignon's theorem – Moment of a couple – Equivalent couple – Moment of force about an axis – Coplanar non-concurrent forces acting on rigid bodies – Resultant and equilibrium – Resolution of a given force into force couple system – Equilibrium in three dimensions – Reactions and supports.

GEOMETRY DEPENDANT PROPERTIES

9 Hours

Centre of gravity, Centre of mass and Centroid – Moment of Inertia of simple and complex areas – Transfer formula – Radius of gyration – Polar moment of inertia – Product of inertia - Mass moment of Inertia of simple solids.


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FRICTION**6 Hours**

Laws of friction – coefficient of friction – Dry friction – wedge friction – ladder friction – rolling resistance.

DYNAMICS OF PARTICLES**12 Hours**

Kinematics – Rectilinear and curvilinear motion – projectile motion

Kinetics – Newton’s second law – D’Alembert’s Principle – Work Energy method – Principle of Impulse momentum – Impact of Elastic Bodies.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Beer F P and Johnson E R, “Vector Mechanics for Engineers, Statics and Dynamics”, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2006.
2. Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics (Volume II), 7th edition, Wiley student edition, 2013.
4. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
5. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
6. Rajasekaran S and Sankarasubramanian G, “Engineering Mechanics-Statics and Dynamics”, Vikas Publishing House Pvt. Ltd., New Delhi, 2006



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U18CSI2201	PYTHON PROGRAMMING	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Classify and make use of python programming elements to solve and debug simple logical problems.(K4,S3)
- CO2:** Experiment with the various control statements in Python.(K3,S2)
- CO3:** Develop Python programs using functions and strings.(K3,S2)
- CO4:** Analyze a problem and use appropriate data structures to solve it.(K4,S3)
- CO5:** Develop python programs to implement various file operations and exception handling.(K3,S2)

Pre-requisites : -

CO-PO and CO-PSO Mapping:

CO/PO MAPPING															
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak															
Cos	PROGRAMME OUTCOMES (POs)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1		S			M					M		M			
CO2			M							M		M			
CO3			M							M		M		M	
CO4	S	S	M		M					M		M	M	M	
CO5			M							M		M			

Course Assessment methods

DIRECT
<ol style="list-style-type: none"> 1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test, Assignment 3. Viva, Experimental Report for each Experiment (lab Component) 4. Model Examination (lab component) 5. End Semester Examination (Theory and lab components)
INDIRECT
Course-end survey

THEORY COMPONENT CONTENTS

BASICS OF PYTHON PROGRAMMING

6 Hours

Introduction-Python Interpreter-Interactive and script mode -Values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON


6 Hours

Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

DATA STRUCTURES: STRINGS, LISTS and SETS

7 Hours

Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting, Sets-creating sets, set operations.


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DATA STRUCTURES: TUPLES, DICTIONARIES**5 Hours**

Tuples-Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Nested Dictionaries.

FILES, MODULES, PACKAGES**6 Hours**

Files and Exception-Text files, reading and writing files, format Operator-Modules-Python Modules-Creating own Python Modules-packages, Introduction to exception handling.

REFERENCES

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python", Mc-Graw Hill Education, 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013.

E BOOKS AND ONLINE LEARNING MATERIALS

1. www.mhhe.com/kamthane/python
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)

LAB COMPONENT CONTENTS**LIST OF EXPERIMENTS**

1. Implement simple python programs using interactive and script mode.
2. Develop python programs using id() and type() functions
3. Implement range() function in python
4. Implement various control statements in python.
5. Develop python programs to perform various string operations like concatenation, slicing, Indexing.
6. Demonstrate string functions using python.
7. Implement user defined functions using python.
8. Develop python programs to perform operations on list
9. Implement dictionary and set in python
10. Develop programs to work with Tuples.
11. Create programs to solve problems using various data structures in python.
12. Implement python program to perform file operations.
13. Implement python programs using modules and packages.

Theory: 30 Hours	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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ONLINE COURSES AND VIDEO LECTURES:

<http://nptel.ac.in>

<https://www.edx.org/course/introduction-to-python-fundamentals-1>

<https://www.edx.org/course/computing-in-python-ii-control-structures-0>

https://www.edx.org/course?search_query=Computing+in+Python+III%3A+Data+Structures


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U18AEI2201	MANUFACTURING PROCESS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Describe the different casting processes starting from the part design.

CO2: Explain the basic use and operation of various welding methods.

CO3: Describe metal cutting processes using conventional machines.

CO4: Explain the principle of working, mechanism of metal removal in unconventional machining processes.

CO5: Explain the principle of working and mechanism of various types of forging processes.

Pre-requisites : -

CO-PO and CO-PSO Mapping:

COs	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												PSO Mapping	
	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M			S									M
CO 2	S	M			S									M
CO 3	S	M			S									M
CO 4	S	M			S									M
CO 5	S	M			S									M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable)
3. End Semester Examination
Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS

CASTING

6 Hours

Methods of production processes – comparison - sand casting -mould, pattern, die - pattern allowances - materials - types - 2 and 3 box molding process-steps involved - core function and core making - runner, riser ,gate purpose - construction, principle, merits, demerits and applications of following casting processes: sand mould, shell mould, investment molding, permanent mould casting, casting defects and their remedy.


WELDING

6 Hours

Classification of welding processes, principles of gas welding, metal arc welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, resistance welding, soldering and brazing, welding discontinuities and their remedy.

MACHINING

6 Hours


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Machine tools - construction - parts and working of lathe, drilling machine, shaper, milling machine and grinding machine. Machining operations performed on lathe and drilling machines. Introduction to CNC machines.

UNCONVENTIONAL MACHINING PROCESS

6 Hours

Working principle and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining – advantages and disadvantages.

METAL FORMING

6 Hours

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning.

REFERENCES


1. S.K Hajra Choudhury, 'Elements of Workshop Technology', Vol. I and II, Media Promoters and Publishers Pvt. Ltd., Mumbai, 2001.
2. R. K. Jain and S. C. Gupta, 'Production Technology', Sixteenth Edition, Khanna Publishers, 2001.
3. H. M. T. Bangalore, 'Production Technology – Hand Book', Tata McGraw-Hill Education, 2001.
4. Serope Kalpajian and Steven R. Schmid, 'Manufacturing Engineering and Technology', Pearson Education, Inc., 2002.
5. M P Grover, Modern Manufacturing Processes, John Wiley (2002).
6. R S Parmar, Welding process and technology, Khanna Publisher, New Delhi (2004).
P N Rao, Manufacturing Technology Vol. I & II, Tata McGraw Hill (2009)

LAB COMPONENT CONTENTS

LIST OF EXPERIMENTS

1. Mould with solid, split pattern and loose-piece pattern
2. Mould with Core
3. SMAW of different types of joints
4. MIG and TIG Welding of different types of joints
5. Facing, plain and step turning
6. Taper turning using compound rest method
7. Drilling, reaming and tapping for a given dimension of hole
8. Boring and internal thread cutting.
9. Dove tail machining using shaper machine
10. Spur Gear cutting using Milling machine
11. Cylindrical grinding of a shaft
12. Conversion of round rod in to square rod
13. Conversion of round rod in to rectangular rod

Theory: 30 Hours	Tutorial: 0	Practical: 30 Hours	Project: 0	Total: 60 Hours
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U18VEP2502	INTERPERSONAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

- CO 1:** Develop a healthy relationship & harmony with others
CO 2: Practice respecting every human being
CO 3: Practice to eradicate negative temperaments
CO 4: Acquire Respect, Honesty, Empathy, Forgiveness and Equality
CO 5: Practice Exercises and Meditation to lead a healthy life
CO 6: Manage the cognitive abilities of an Individual

Pre-requisites :

1. U18VEP1501 / Personal Values

CO-PO and CO-PSO Mapping:


CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										S			-	-
CO2									S				-	-
CO3											M	S	-	-
CO4						M							-	-
CO5												M	-	-
CO6											M		-	-

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values Through Practical Activities:

- 1. Introduction:** Introduction to interpersonal values – Developing harmony with others – Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.
- 2. Maneuvering the temperaments:** From Greed To Contentment - Anger To Tolerance - Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.
- 3. Core value : Truthfulness** - Honesty –Helping–Friendship – Brotherhood – Tolerance – Caring & Sharing – Forgiveness – Charity –Sympathy — Generosity – Brotherhood - Adaptability.
- 4.Pathway to Blissful life :**
Signs of anger – Root cause – Chain reaction – Evil effects on Body and Mind – Analyzing roots of worries – Techniques to eradicate worries.
- 5.Therapeutic measures:** Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.


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Workshop mode

REFERENCES

1. INTERPERSONAL SKILLS Tutorial (PDF Version) - Tutorialspoint
www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf
2. INTERPERSONAL RELATIONSHIPS AT WORK - KI Open Archive - Karolinska
[www. publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1](http://www.publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1)
3. VALUES EDUCATION FOR PEACE, HUMAN RIGHTS, DEMOCRACY – UNESCO
www.unesdoc.unesco.org/images/0011/001143/114357eo.pdf
4. MANEUVERING OF SIX TEMPERAMENTS - Vethathiri Maharishi
[www.ijhssi.org/papers/v5\(5\)/F0505034036.pdf](http://www.ijhssi.org/papers/v5(5)/F0505034036.pdf)
5. THE BLISS OF INNER FIRE: HEART PRACTICE OF THE SIX ... - Wisdom Publications -
[www.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.p
d...](http://www.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.pdf...)



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U18INI2600	ENGINEERING CLINIC - II	L	T	P	J	C
		0	0	4	2	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify a practical problems and find a solution

CO2: Understand the project management techniques

CO3: Demonstrate their technical report writing and presentation skills

Pre-requisites :

1. U18INI1600 - Engineering Clinic - I

CO-PO and CO-PSO Mapping:

CO/PO Mapping													
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	S	S	S	S	S	M	W		S			S	S
CO2											S		W
CO3										S			W

Course Assessment methods

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:


The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the II semester, students will focus primarily on Raspberry pi based controllers with Python programming

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total: 90 Hours


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SEMESTER III



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U18MAT3101	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	J	C
		3	1	0	0	4

(Common to AE/AUE/CE/ME/MCE/EEE)

Course Outcomes (COs):

After successful completion of this course, the students should be able to:

- CO1:** Form partial differential equations and solve certain types of partial differential equations.
- CO2:** Determine the Fourier Series and half range Fourier Series of a function
- CO3:** Solve one dimensional wave equation, one dimensional heat equation in steady state using Fourier series.
- CO4:** Apply Fourier series to solve the steady state two dimensional heat equation in cartesian coordinates.
- CO5:** Identify Fourier transform, Fourier sine and cosine transform of certain functions and use Parseval's identity to evaluate integrals.
- CO6:** Evaluate Z – transform of sequences and inverse Z – transform of functions and solve difference equations.

Pre-requisite: -

CO-PO and CO-PSO Mapping:

CO/PO Mapping (Subject to vary from dept to dept.) (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M			M				M	M		S	M	
CO2	S	M		M									M	
CO3	S	S	S		S				M	M		S	S	
CO4	S	M	M									M	S	
CO5	S	M	M		S								S	
CO6	S	S			S				M	M		S	S	

Course Assessment Methods:

Direct
1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination
Indirect
1. Course-end survey

PARTIAL DIFFERENTIAL EQUATIONS


9+3 Hours

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES

9+3 Hours

Dirichlet's conditions – General Fourier series – Odd and Even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.


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BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS **5+2 Hours**

Classification of second order quasi linear partial differential equations –Solution of one dimensional wave equation – One dimensional heat equation (excluding insulated ends) – Fourier series solutions in Cartesian coordinates.

BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS **4+1 Hours**

Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

FOURIER TRANSFORM **9+3 Hours**

Statement of Fourier integral theorem – Infinite Fourier transforms – Sine and Cosine Transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.


Z –TRANSFORM **9+3 Hours**

Z-transform - Elementary properties – Convolution theorem- Inverse Z – transform (by using partial fractions, residues and convolution theorem) – Solution of difference equations using Z - transform.

Theory : 45 Hours	Tutorial: 15 Hours	Practical: 0	Project: 0	Total: 60 Hours
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REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition. 2014.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 2006.
4. Ian Sneddon., "Elements of partial differential equations", McGraw – Hill, New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2013.


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U18AEI3201	FLUID MECHANICS	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- CO 1:** Apply the basic equation of fluid statics to determine forces on planar and curved surfaces that are submerged in a static fluid.
- CO 2:** Apply conservation laws to determine velocities, pressures, and accelerations for incompressible and inviscid fluids.
- CO 3:** Apply principles of dimensional analysis to identify non dimensional parameters
- CO 4:** Explain the concepts of viscous boundary layers
- CO 5:** Apply principles of impacts of jets in fluid machineries.
- CO 6:** Measure coefficient of discharge of fluid flows

Pre-requisites : -

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M									S			
CO2	S	M		S						M				
CO3	S	M									S		M	
CO4		M									S		M	
CO5	S	M									S	M		
CO6	S			S	W								S	

Course Assessment methods

Direct	
1. Internal Test I 2. Internal Test II 3. Assignments 4. End Semester Exam	1. Lab Workbook 2. Viva-voce 3. Model Practical Exams
Indirect	
1. Course-end survey	

FLUID STATICS**10 Hours**

Introduction to Fluid — Units and Dimensions – Mass density – Specific weight – Specific volume – Specific gravity – Energy and Specific heats – Viscosity – Compressibility – Surface tension – Capillarity – Vapor pressure and Cavitation.


Hydrostatic equation – Forces on plane and curved surfaces – Buoyancy – Metacentre – Simple and differential manometers – Mechanical pressure gauges – Relative equilibrium.

FLUID DYNAMICS**10 Hours**

Lagrangian vs Eulerian descriptions, Classification of fluid flows - Flow Visualization – Path line – Stream line – Streak line – Stream and Potential functions – Flownets.

Governing equations: Continuity equation – Momentum equation – Energy equation – Euler's equation – Bernoulli's equation – Applications.

DIMENSIONAL ANALYSIS AND SIMILITUDE**9 Hours**


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Rayleigh's method – Buckingham's π theorem – Geometric, Kinematic, and Dynamic similitude – Scale effect – Dimensionless parameters – Mach Number, Reynolds Number, Prandtl Number – Model laws.

BOUNDARY LAYER FLOW

9 Hours

Boundary layer, Boundary layer thickness: Displacement, Momentum and Energy thickness. Drag force on a flat plate due to boundary layer – Turbulent boundary layer on a flat plate - Deduction of Governing equations of boundary layer from Navier Stoke's Equation – Separation of boundary layer.

IMPACT OF JETS

7 Hours

Force exerted by the jet on a stationary vertical plate, Hinged plate and moving plates.

REFERENCES

1. Yunus A. Cengel and John M. Cimbala, 'Fluid Mechanics: Fundamentals and Applications', Fourth Edition, McGraw-Hill, 2017.
2. Frank M. White, 'Fluid Mechanics', McGraw Hill Education India Private Limited, Eighth Edition, 2017.
3. Philip J. Pritchard, Fox and McDonald, 'Introduction to Fluid Mechanics', John Wiley & Sons Inc, Ninth Edition, 2015.
4. Pijush K. Kundu, Ira M. Cohen and David R. Dowling, 'Fluid Mechanics', Sixth Edition, Academic Press, 2015.
5. S K Som, Gautam Biswas, and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education, Third edition, 2017.
6. R. K Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications; Tenth edition, 2018.
7. Egon Krause, 'Fluid Mechanics with Problems and Solutions, and an Aerodynamic Laboratory', Springer Publications, 2010.
8. Ethirajan Rathakrishnan, Fluid Mechanics: An Introduction, PHI, Third edition, 2012.

WEBSITE REFERENCES

1. <http://nptel.ac.in/courses/101103004/> Principles of Fluid Dynamics
2. <https://nptel.ac.in/courses/112104118/> Fluid Mechanics
3. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/fluid-mechanics/>

LIST OF EXPERIMENTS

1. Determination of Darcy's friction factor
2. Determination of coefficient of discharge of Venturimeter
3. Determination of coefficient of discharge of Orificemeter
4. Determination of minor losses
5. Determination of coefficient of discharge of notches
6. Determination of coefficient of discharge of mouthpiece – variable head
7. Determination of coefficient of discharge of orifice– constant head
8. Determination of coefficient of discharge of Rotometer
9. Verification of Bernoulli's theorem
10. Determination of Reynolds Number


Theory: 45

Tutorial: 0

Practical: 30

Project: 0

Total: 75 Hours



Signature of BOS chairman, AE

U18AEI3202	ENGINEERING THERMODYNAMICS	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Analyse open and closed systems using first law of thermodynamics.
CO2: Apply the second law of thermodynamics for various engineering systems.
CO3: Analyse Otto, Diesel, Dual and Bryton cycle under various operating conditions.
CO4: Calculate the stoichiometric air fuel ratio required for combustion.
CO5: Conduct experiments on various thermodynamics systems.

Pre-requisites : -**CO-PO and CO-PSO Mapping:**

COs	CO/PO Mapping												PSO Mapping	
	(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												PSOs	
	Programme Outcomes (POs)												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	S												M	
CO 2	S	M											M	
CO 3	S		S										M	
CO 4			M	S									M	
CO 5		S											S	

Course Assessment methods**Direct**

1. Continuous Assessment Test I, II (Theory component).
2. Assignment (Theory component).
3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
4. Model examination (lab component)
5. End Semester Examination (Theory and lab component)

Indirect

1. Course-end survey

THEORY COMPONENT CONTENTS**BASIC CONCEPTS AND FIRST LAW****12 Hours**


Concept of continuum, macroscopic approach, and thermodynamic systems – Property, state, path and process-quasi-static process - 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 and its applications to closed and open systems – Introduction heat transfer - Numerical problems.

SECOND LAW AND ENTROPY**9 Hours**

Second law of thermodynamics – Kelvin planck and clausius statements of second law – Reversibility and irreversibility – Carnot theorem – Carnot cycle, Reversed Carnot cycle, Efficiency– Thermodynamic temperature scale – Clausius inequality, concept of entropy, entropy of ideal gas - principle of increase of entropy-Numerical problems.

AIRCYCLES**10 Hours**

Otto, Diesel, Dual and Brayton cycles – P-V and T-S diagrams, description -Air standard efficiency - Mean effective pressure. Comparison of Otto, Diesel and Dual cycle, introduction to modified Brayton cycle and Jet Propulsion cycle -Numerical problems.



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REFRIGERATION CYCLES**6 Hours**

Vapor compression refrigeration, Absorption refrigeration and Gas refrigeration Cycles.

Introduction to air conditioning system.

I LAW APPLICATION TO CHEMICALLY REACTING SYSTEMS**8 Hours**

Theoretical (Stoichiometric) air for combustion of fuels. Excess air, mass balance, Exhaust gas analysis, A/F ratio. Energy balance for a chemical reaction, enthalpy of formation - Adiabatic flame temperature.

REFERENCES

1. Cengel, Y. A. and Boles, M. A., Thermodynamics: An Engineering Approach, 8th ed., McGraw-Hill (2014).
2. Moran, M. J., Shapiro, H. N., Boettner, D. D., and Bailey, M. B., Principles of Engineering Thermodynamics (SI Version), 8th ed., Wiley (2015).
3. Spalding, D. B. and Cole, E. H., Engineering Thermodynamics, 3rd ed., Edward Arnold (1973).
4. Nag, P. K., Engineering Thermodynamics, 5th edition. Tata McGraw-Hill (2013).
5. D. P. Mishra, Fundamentals of Combustion, PHI Learning Pvt. Ltd. Revised 1st edition 2007.
6. Borgnakke, C. and Sonntag, R. E., Fundamentals of Thermodynamics, 8th ed., Wiley (2013).
7. Balmer, R. T., Modern Engineering Thermodynamics, Academic Press (2011)

WEBSITE REFERENCES

1. <https://www.edx.org/learn/thermodynamics>
2. <https://www.coursera.org/learn/thermodynamics-intro>
3. <https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/index.htm>
4. <http://nptel.ac.in/courses/101104063/#>


LAB COMPONENT CONTENTS**LIST OF EXPERIMENTS**

1. Determination of viscosity in a given fuel.
2. Determination of flash and fire point in a given fuel.
3. Determination of Thermal Conductivity of solid.
4. Valve Timing and Port Timing Diagrams.
5. COP test on a vapour compression refrigeration test rig.
6. Performance Test on Diesel Engine by Hydraulic loading.

LIST OF EQUIPMENTS

1. Redwood viscometer.
2. Flash and Fire point apparatus.
3. Conductive Heat Transfer set up.
4. Cut Section of 4-Stroke and 2-Stroke Engine.
5. Vapour compression refrigeration test rig.
6. Single cylinder 4-stroke Diesel engine with Hydraulic loading.

Theory: 45	Tutorial: 0	Practical: 30	Project: 0	Total: 75 Hours
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U18AEI3203	MECHANICS OF SOLIDS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Solve the problems on structural members subjected to Uni-axial load

CO2: Construct Shear Force, Bending moment and Bending stress distribution in beams subjected to transverse load

CO3: Determine the deflection of statically determinant beam

CO4: Solve the problems on torsion Circular Shafts

CO5: Solve the problems on 2d structural element

CO6: Demonstrate the experiments with UTM and Determinate Beam structures to determinate the predominant parameters

Pre-requisites : -

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M	W										M	
CO 2	S	M	W										M	
CO 3	S	M	W										M	
CO 4	S	M	W										M	
CO 5	S	M	W										M	
CO 6	S	M	W										M	

Course Assessment methods

Direct
<ol style="list-style-type: none"> 1. Continuous Assessment Test I, II 2. Assignment; Group Presentation 3. Model Practical; Viva voice 4. End Semester Examination
Indirect
<ol style="list-style-type: none"> 1. Course-end survey

THEORY COMPONENT CONTENTS

STRESS, STRAIN AND DEFORMATION OF SOLIDS

6 Hours

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Strain – Poisson's ratio – Lateral strain – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Numerical Problems.


BEAMS – LOADS AND STRESSES

6 Hours

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever and Simply supported beams – Stresses in beams – Theory of simple bending – Bending stress distribution in the beam section. – Numerical Problems.

BEAM DEFLECTION

6 Hours


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Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method -Numerical Problems.

TORSION

6 Hours

Analysis of torsion of circular bars – Shear stress distribution – Bars of solid and hollow circular section – Twist and torsion stiffness – Compound shafts – Numerical Problems.

ANALYSIS OF STRESSES IN 2D ELEMENTS

6 Hours

Biaxial state of stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress – Numerical Problems.

REFERENCES

1. S. Timoshenko, "Strength of Materials", Vol. II, CBS Publishers, 2002.
2. F. P. Beer, E. R. Johnston and J. T. DeWolf, "*Mechanics of Materials*", McGraw-Hill Publication, NY, 2012.
3. Srinath L.S., "Advanced Mechanics of Solids", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
4. William A. Nash, "Schaum's Outline of Theory and Problems of Strength of Materials", Tata McGraw-Hill Publishing Co., New Delhi, 2007.

WEBSITE REFERENCES

1. <https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006/index.htm>
2. <https://cosmolearning.org/courses/mechanics-solids-structural-mechanics/>
3. <http://nptel.ac.in/courses/112107146/>
4. <http://www.engineeringcorecourses.com/solidmechanics1/>

LAB COMPONENT CONTENTS


LIST OF EXPERIMENTS

1. Determination of Young's Modulus using deflection of Cantilever beam.
2. Determination of Young's modulus and fracture strength of steel using UTM
3. Determination beam support reaction
4. Verification of Principle of Superposition.
5. Verification of Maxwell's Reciprocal theorem.
6. Determination of Stresses of constant strength beam.
7. Charpy Impact tests on different materials.

LIST OF EQUIPMENTS:

S. No.	Name of the equipment	Quantity Required
1	Universal Testing Machine	1
2	Beam Test set up	3
3	Constant Strength Beam Setup	1
4	Charpy Impact Testing Machine	1

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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 Signature of BOS chairman, AE

U18EEI3202	AIRCRAFT ELECTRICAL AND ELECTRONICS SYSTEMS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students will be able to

CO 1: Discuss the fundamentals of DC circuits and its applications in aircraft systems.

CO 2: Explain the relationships among current, voltage and power in AC circuits and their role in aircraft systems.

CO 3: Explain the construction, working principle of electrical machines and their applications in aircraft systems.

CO 4: Explain the working of semiconductor devices and their role in aircraft systems.

CO 5: Apply the fundamentals of digital electronics to digital circuits.

Pre-requisite(s): -

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M		W	-	-	-	-	-	-	-	W	M	-
CO 2	S	M		W	-	-	-	-	-	-	-	W	M	-
CO 3	S	M		W	-	-	-	-	-	-	-	W	M	-
CO 4	S	M		W	-	-	-	-	-	-	-	W	M	-
CO 5	S	M		W	-	-	-	-	-	-	-	W	M	-

Course Assessment Methods

Direct Assessment
1. Internal Tests
2. Assignments
3. Practical Exams
4. End Semester Exam
Indirect Assessment
Course exit survey

Theory Component:

DC CIRCUITS

6 Hours

Basic circuit elements and sources, Ohms law, Kirchhoff's laws, Series and parallel connection of circuit elements, Power, Work, Energy, Capacitance, Energy stored in a capacitor, DC circuits in Aircraft systems.

AC CIRCUITS

6 Hours

Alternating voltages and current, Sinusoidal waveform, Cycle and frequency, RMS value, Alternating current through Resistance, Inductance and Capacitance, Power factor, Active and Reactive power, AC circuits in Aircraft systems.

ELECTRICAL MACHINES (Qualitative Treatment Only)


7 Hours

Construction and working Principle of DC Machines, Single phase Transformers, Alternators and single phase induction motors, Application of Electrical machines in Aircraft systems.

SEMICONDUCTOR DEVICES AND CIRCUITS

5 Hours

Construction and working Principle of PN junction diode, Zener Diode, Half wave and Full wave rectifiers, BJT, JFET, Integrated circuits in Aircrafts.


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DIGITAL CIRCUITS**6 Hours**

Binary number system, Logic Gates, Boolean algebra, Half adder, Full Adder/ Subtractor, Multiplexer, Demultiplexer.

Lab Component:**List of Experiments/Exercises**

1. Verification of Kirchoff's Voltage and Current Laws.
2. Load test on DC shunt motor.
3. Load test on single phase transformer.
4. Load test on single phase induction motor.
5. Open Circuit Characteristics of Three-Phase Alternator.
6. Characteristics of PN junction diode and Zener diode.
7. Full wave rectifier with and without filter.
8. Verification of truth tables.
9. Inspection of Electrical circuit in Cessna 172 aircraft.
10. Inspection of Electrical circuit in Hansa aircraft.


Theory: 30 Hours	Tutorial: 0	Practical: 30 Hours	Project: 0	Total: 60 Hours
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REFERENCES

1. Mike Tooley and David Wyatt, 'Aircraft Electrical and Electronic Systems Principles, Operation and Maintenance', Elsevier, 2009.
2. Theraja B.L., 'Fundamentals of Electrical Engineering and Electronics', S. Chand Publishing, 2012.
3. Muthusubramanian R, Salivahanan S and Muraleedharan K A, 'Basic Electrical, Electronics and Computer Engineering', Second Edition, Tata McGraw Hill, 2006.
4. Thomas L Floyd, 'Electronic Devices', Sixth Edition, Pearson Education, 2003.
5. Sedha R.S., 'Applied Electronics', S. Chand and Co., 2006.

WEBSITE REFERENCES

1. NPTEL Online course materials on Semiconductor Devices and Circuits:
<https://nptel.ac.in/courses/108108112/>
2. NPTEL Online course materials on Electrical Machines-I:
<https://nptel.ac.in/courses/108105017/>
3. NPTEL Online course materials on Basic Electrical Technology:
<https://nptel.ac.in/downloads/108105053/>
4. NPTEL Online course materials on Digital Circuits and Systems:
<https://nptel.ac.in/courses/117106114/>



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U18AEP3504	CAD LABORATORY	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Use the CATIA software program to create drawings from scratch and to modify, manipulate, copy, delete and save drawings.

CO2: Design simple and critical components using CATIA modeling software.

CO3: Assemble and animate the three dimensional complex parts.

CO4: Design the surface model of critical shape components.

Use the full range of CATIA commands and options and employ shortcuts and time-

CO5: saving strategies to operate the program at a level of efficiency acceptable for employment as a CAD Engineer.

Pre-requisites :-

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1					S									M
CO 2					S									M
CO 3					S									M
CO 4					S									M
CO 5					S									M


Course Assessment methods

Direct
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments

1. Study of modeling software (CATIA)
2. Part modeling of simple mechanical components.
3. Part modeling of upper housing of a blower
4. Part modeling of helical gear.
5. Assembly of universal coupling.
6. Assembly of plumber block
7. Study of surface modeling
8. Animation of slider crank mechanism
9. Animation of I.C Engine
10. Drafting

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30Hours
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U18INI3600	ENGINEERING CLINIC - III	L	T	P	J	C
		0	0	4	2	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify a practical problems and find a solution

CO2: Understand the project management techniques

CO3: Demonstrate their technical report writing and presentation skills

Pre-requisites : U18INI2600 - Engineering Clinic - II

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak															
COs	Programme Outcomes(POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	S	M	W		S			S			S
CO2											S				W
CO3										S					W

Course Assessment methods

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:


The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the III semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total: 90 Hours


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U18CHT3000	ENVIRONMENTAL SCIENCE AND ENGINEERING (COMMON TO ALL BRANCHES)
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Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Analyze the impact of engineering solutions in a global and societal context.
CO2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.
CO3: Highlight the importance of ecosystem and biodiversity.
CO4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.
CO5: Paraphrase the importance of conservation of resources.
CO6: Play an important role in transferring a healthy environment for future generations.

Pre-requisites : -

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M					S		M				W	-
CO2						M				M			-	-
CO3							M						-	-
CO4						M	S						-	-
CO5							S						-	-
CO6			W				S					M	-	-

Course Assessment methods

Direct
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End Semester Exam
Indirect
Course end survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

14 Hours

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.

Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.


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Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY

9 Hours

ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

BIODIVERSITY: Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION

8 Hours

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT

7 Hours

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights.

HUMAN POPULATION AND THE ENVIRONMENT


7 Hours

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Hours	Tutorial:	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. G. Tyler Miller and Scott Spoolman, 'Environmental Science', Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, 'Introduction to Environmental Engineering and Science', Third Edition, Pearson Education, 2013.
3. Bharucha Erach, 'The Biodiversity of India', Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.


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4. Trivedi R.K and P.K.Goel, 'Introduction to Air Pollution', Techno-Science Publications, 2003.
5. Trivedi R.K., 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 1996.
6. Cunningham, W.P.Cooper and T.H.Gorhani, 'Environmental Encyclopedia', Jaico Publication House, Mumbai, 2001.
7. Wager K.D., 'Environmental Management', W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, 'Essentials of Ecology', Third Edition, Blackwell Publishing, 2008.



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U18VEP3503	FAMILY VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

- CO 1:** Develop skills in maintaining the harmony in the family.
CO 2: Create impulsive activities for healthy family
CO 3: Be receptive to troubled Individuals
CO 4: Gain healthy life by practicing Kundalini Yoga & Kayakalpa
CO 5: Possess Empathy among family members.
CO 6: Reason the life and its significance

Pre-requisites :

1. U18VEP1501 / Personal Values
2. U18VEP2502 / Interpersonal Values

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									S				-	-
CO2							M						-	-
CO3										M			-	-
CO4												S	-	-
CO5						S							-	-
CO6								M					-	-


Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment
2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values Through Practical Activities:

- 1. Family system:** Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
- 2. Peace in Family :**Family members and their responsibility - Roles of parents, children, grand parents -. Respectable women hood
- 3. Core value: Empathy:** Unconditional love - Respect - Compassion - sacrifice–Care &share - helping – emotional support- hospitality – cleanliness
- 4. Blessing:** Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in the Family and resolution through blessings.
- 5. Healthy Family:** Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

Workshop mode


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REFERENCES:

1. Family - Www.Download.Nos.Org/331course/L-13%20family.Pdf
2. Framework For Action On Values Education In Early Childhood – Unesco – Pdf – Www.Unesdoc.Unesco.Org/Images/0012/001287/128712e.Pdf
3. True Family Values Third Edition - Tparents Home
Www.Tparents.Org/Library/Unification/Books/Tfv3/_Tfv3.Pdf
4. Family Values In A Historical Perspective - The Tanner Lectures On
Www.Tannerlectures.Utah.Edu/_Documents/A-To-Z/S/Stone95.Pdf
5. Problems Of India's Changing Family And State ... - The United Nations -
Www.Un.Org/Esa/Socdev/Family/Docs/Egm09/Singh.Pdf



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SEMESTER IV



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U18MAT4101	NUMERICAL METHODS AND PROBABILITY	L	T	P	J	C
		3	1	0	0	4

(Common to AE/AUE/CE/ME/MCE/EEE)

COURSE OUTCOMES

After successful completion of this course, the students will be able to

- CO1:** Apply various numerical techniques for solving non-linear equations and systems of linear equations.
- CO2:** Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.
- CO3:** Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.
- CO4:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
- CO5:** Apply the concepts of probability to random variables.
- CO6:** Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

Pre-requisite: -

CO-PO and CO-PSO Mapping:


CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S											S	
CO2	S	S											S	
CO3	S	S							M				S	
CO4	S	S											S	
CO5	S	S							M				S	
CO6	S	S											S	

Course Assessment Methods:

Direct
1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination
Indirect
1. Course-end survey

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS **9+3 Hours**

Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss – Jordan method – Eigenvalues of a matrix by Power method.


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INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3 Hours

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3 Hours

Single step methods: Taylor's series method – Euler and Improved Euler methods for solving a first order equations – Fourth order Runge-Kutta method for solving first and second order equations – Multistep method: Milne's predictor and corrector method.

BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 9+3 Hours

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain–Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.


PROBABILITY AND RANDOM VARIABLES 9+3 Hours

Axioms of probability - Conditional probability – Total probability – Bayes' theorem – Random variable – Distribution function – properties – Probability mass function- Probability density function – moments - Binomial, Poisson and Normal distributions – Properties.

Theory: 45 Hours	Tutorials: 15 Hours	Practical: 0	Project: 0	Total: 60 Hours
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1. Grewal, B.S. and Grewal, J.S., “ Numerical methods in Engineering and Science”, 9th Edition, Khanna Publishers, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., “Applied Numerical Analysis”, 7th Edition, Pearson Education Asia, New Delhi, 2007.
3. Chapra, S. C and Canale, R. P. “Numerical Methods for Engineers”, 7th Edition, Tata McGraw-Hill, New Delhi, 2016.
4. R.A. Johnson and C.B. Gupta, “Miller and Freund's Probability and Statistics for Engineers”, Pearson Education, Asia, 9th Edition, 2016.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K. Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education, Asia, 9th edition, 2017.
6. Gupta S.C, and Kapur V.K “Fundamentals of Applied Statistics”, Sultan Chand, New Delhi, 4th Edition, 2014.



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U18AEI4201	LOW SPEED AERODYNAMICS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Apply conservation laws to solve incompressible flow regime
CO2: Solve the problems on potential flows
CO3: Apply Joukowski transformation to fluid flow problems.
CO4: Explain airfoil and wing characteristics.
CO5: Apply propeller theory to predict blade performance.
CO6: Measure the aerodynamic forces on various aerodynamic bodies

Pre-requisites : U18AEI3201 / Fluid Mechanics

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M		M										
CO2	S													
CO3	S	M											M	
CO4		S											M	
CO5	S	M												
CO6				S									S	

Course Assessment methods

Direct	
1. Internal Test I 2. Internal Test II 3. Assignment / Tutorial 4. Seminar / Presentation 5. End Semester Exam	1. Lab Workbook 2. Viva-voce 3. Model Practical Exams
Indirect	
1. Course-end survey	

INTRODUCTION TO AERODYNAMICS

7 Hours

Importance of Aerodynamics – Aerodynamic forces and moments – Pressure distribution on an airfoil – Types of drag – Flow similarity, Types of flow – Continuity, momentum and energy equations – Incompressible-inviscid flow – Irrotational flow – Circulation and Vorticity – Euler's equation – Bernoulli's Equation – Pitot tube: Measurement of airspeed. Pressure Coefficient.


TWO DIMENSIONAL POTENTIAL FLOWS

7 Hours

Elementary flows – Uniform, Source, Sink, Doublet and Vortex flow, Combination of a uniform flow with a source and sink, Non lifting flow over a circular cylinder, Lifting flow over a cylinder, Kutta Joukowski theorem and Generation of lift, Flow over a flat plate, D'Alembert Paradox, Magnus effect.

CONFORMAL TRANSFORMATION

5 Hours


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Complex potential, Cauchy-Riemann equation, Joukowski transformation and its application to fluid flow problems, Karman-Trefftz Profiles.

AIRFOIL AND WING THEORY

7 Hours

Airfoil Nomenclature – Airfoil characteristics – Kutta condition – Thin airfoil theory and its applications – Aerodynamic Center – Horse shoe vortex, Biot and Savart law – Downwash and induced drag – Helmholtz theorems, Lifting line theory and its limitations.

PROPELLER THEORY

4 Hours

Froude momentum and Blade element theories – Propeller coefficients – Performance of fixed and variable pitch propeller.

REFERENCES


1. Anderson, J.D., 'Fundamentals of Aerodynamics', Sixth Edition, McGraw-Hill Education, 2016.
2. Clancy, L.J., 'Aerodynamics', Shroff, 2006.
3. Ethirajan Rathakrishnan, 'Theoretical Aerodynamics', Wiley; First Edition, 2013.
4. A.M. Kuethe and C-Y Chow, 'Foundations of Aerodynamics: Bases of Aerodynamic Design', Wiley India Pvt Ltd, Fifth edition, 2009.
5. Theodore A. Talay, 'NASA's Flight Aerodynamics Introduction', NASA, 2013.
6. Kunal Ghosh, 'Low Speed Aerodynamics', PHI Learning Private Limited, 2017.
7. Charles E. Dole, and James E. Lewis, 'Flight Theory and Aerodynamics: A Practical Guide for Operational Safety', Wiley India Pvt Ltd, Second edition, 2009.
8. E. L. Houghton, P. W. Carpenter, Steven H. Collicott, and Daniel T. Valentine, 'Aerodynamics for Engineering Students', Seventh Edition, Butterworth-Heinemann, 2016.
9. Alan Pope, 'Basic Wing and Airfoil Theory', Dover Publications, 2009.
10. John J. Bertin and Russell M. Cummings, 'Aerodynamics for Engineers', Sixth Edition, Pearson, 2013.
11. Ira H. Abbott and Albert E. Von Doenhoff, 'Theory of Wing Sections', Dover Publications Inc., 1960.

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1. [https://nptel.ac.in/courses/101105059/Introduction to Aerodynamics](https://nptel.ac.in/courses/101105059/Introduction%20to%20Aerodynamics)
2. <https://www.edx.org/course/introduction-to-aerodynamics>
3. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005/>
4. <https://www.class-central.com/tag/aerodynamics>
5. <https://ocw.tudelft.nl/course-lectures/1-fundamentals-aerodynamics/>

LIST OF EXPERIMENTS


1. Pressure distribution over smooth cylinder.
2. Pressure distribution over rough cylinder
3. Pressure distribution over symmetrical airfoil.
4. Pressure distribution over cambered airfoil.
5. Force measurement on symmetrical airfoil.
6. Force measurement on cambered airfoil.
7. Flow visualization over a flat plate/ airfoil at different angles of attack.
8. Flow visualization studies in low speed flows over cylinders.
9. Determination of Aerodynamic coefficients of airfoils using analysis tools
10. Determination of Aerodynamic parameters using FoilSim


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LIST OF EQUIPMENT

S. No.	Name of the equipment	Quantity Required
1	Subsonic Wind Tunnel	1 No.
2	Airfoil sections (Symmetrical and cambered airfoils)	4 Nos.
3	Cylinder models (Rough and Smooth)	2 Nos.
4	Wind Tunnel balances (3 or 6 components)	1 No.
5	Smoke Generator	1 No.
6	Water flow channel	1 No.
7	Flat plate, Cylinder & Airfoil models for flow visualization	3 Nos

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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 Signature of BOS chairman, AE

U18AEI4202	AUTOMATIC CONTROL SYSTEMS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students will be able to

CO 1: Determine the transfer function of mechanical and electrical systems.

CO 2: Analyse the time response of various control systems.

CO 3: Design compensators for control systems in MATLAB.

CO 4: Analyse the behaviour of autopilot systems in MATLAB.

CO 5: Explain the processes involved in CNC machines and the purpose of CAD/CAM software for CNC machines.

Pre-requisite(s): -**CO-PO and CO-PSO Mapping:**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M	-	-	-	-	-	-	-	-	-	-	M	-
CO 2	-	S	-	-	-	-	-	-	-	-	-	-	S	W
CO 3	-	-	M	-	S	-	-	-	-	-	-	-	S	S
CO 4	-	S	-	-	S	-	-	-	-	-	-	-	S	S
CO 5	-	-	-	-	M	-	-	-	-	-	-	-	-	M

Course Assessment Methods

Direct Assessment
1. Internal Tests
2. Assignments
3. Practical Exams
4. End Semester Exam
Indirect Assessment
Course exit survey

Theory Component:**INTRODUCTION****6 Hours**

Control System and its Components, Open-loop and Closed-loop (Feedback) Control systems, Feedback and its Effects, Types of Feedback Control Systems, Servo mechanism, Mathematical Modeling and Transfer Functions.

TIME-DOMAIN ANALYSIS OF CONTROL SYSTEMS**6 Hours**


Test Signals for Time Response of Control Systems, Unit-step Response and Time-Domain Specifications, Transient Response of First-order and Second-order Systems, Steady-state Error, Time Response of Positional Control System.

CONTROL SYSTEMS DESIGN**6 Hours**

Root Locus Analysis, Lag Compensation, Lead Compensation, Proportional-Integral Control, Proportional-Derivative Control, Proportional-Integral-Derivative Control.

AUTOMATIC FLIGHT CONTROL SYSTEMS**6 Hours**

Introduction to Autopilot, Longitudinal displacement autopilot, Yaw orientation control system with Dutch roll damper and Sideslip elimination, Velocity (Airspeed) Control System, Altitude Hold Mode, Automatic Flare Control.



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CNC MACHINES**6 Hours**

Role of NC/CNC in CAM, Applications, Benefits and Limitations of CNC, Basic Components of CNC system, Machine control unit, Interpolators, Programming with Basic functions, Part programming and Machine Tool.

Lab Component:**List of Experiments/Exercises**

1. Analysis of Time Response of First-order and Second-order Systems in MATLAB.
2. Design of compensators for given specifications for control systems in MATLAB.
3. Analysis of longitudinal displacement autopilot for conventional transport aircraft in MATLAB.
4. Analysis of velocity (airspeed) control system (Auto-throttle) in MATLAB.
5. Analysis of Altitude hold mode of flight control system in MATLAB.
6. Analysis of coordination turn with Dutch roll damper and Sideslip elimination in MATLAB.
7. Analysis of Automatic Flare Control System in MATLAB.
8. CNC Lathe programs – Step turning and Taper Turning.
9. CNC Milling Programs – Linear and Circular Interpolation.
10. CNC Drilling operations.
11. Measuring various aircraft components using Coordinate-measuring machine.

List of Equipment:

1. CNC vertical machining center
2. CNC horizontal machining center
3. Coordinate-measuring machine (CMM)
4. Desktop computer with MATLAB software installed


Theory: 30 Hours	Tutorial: 0	Practical: 30 Hours	Project: 0	Total: 60 Hours
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REFERENCES

1. Norman S. Nise, 'Control Systems Engineering', Sixth Edition, John Wiley and Sons, 2011.
2. Farid Golnaraghi and Benjamin C. Kuo, 'Automatic Control Systems', Ninth Edition, John Wiley and Sons, 2010.
3. Donald McLean, 'Automatic Flight Control Systems', Prentice Hall International, 1990.
4. John H. Blakelock, 'Automatic Control of Aircraft and Missiles', Second Edition, John Wiley and Sons, 1991.
5. Koren Y, 'Computer Control of Manufacturing Systems', McGraw Hill, 1986.
6. Reinbold U, Blume C and Dilmann R, 'Computer Integrated Manufacturing Technology and Systems', Marcel Dekker, 1985.

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1. NPTEL Lecture Notes on Control Engineering:
<https://nptel.ac.in/courses/108102043/>
2. Fundamentals of CNC Machining - A Practical Guide for Beginners:
https://academy.titansofcnc.com/files/Fundamentals_of_CNC_Machining.pdf



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U18AET4003	AIRCRAFT STRUCTURES-I	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify statically determinate and indeterminate structures.

CO2: Analyze the response of statically indeterminate structures under various loading conditions.

CO3: Determine the reactions of structures using strain energy concept.

CO4: Identify different numerical methods available to solve a single structural problem.

CO5: Examine the structural failures using failure theories.

Pre-requisites :

1. U18AEI3203 / Mechanics of Solids

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M											S	
CO 2		S		M									M	
CO 3		S	M										S	
CO 4	S			M									M	
CO 5	M												S	

Course Assessment methods

Direct

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

Indirect

1. Course-end survey

STATICALLY DETERMINATE STRUCTURES

9 Hours

Analysis of plane truss – Method of joints – 3D (Space) Truss – Matrix Displacement method for Trusses.

STATICALLY INDETERMINATE STRUCTURES

9 Hours

Composite beam – Clapeyron's Three Moment Equation – Moment Distribution Method.

ENERGY METHODS


9 Hours

Strain Energy due to axial, bending and torsional loads – Castigliano's theorem for displacements and moments – Maxwell's reciprocal theorem, Unit load method – Application to beams, trusses, frames, rings, etc.

COLUMNS

9 Hours

Columns with various end conditions – Euler's Column curve – Rankine's formula – Column with initial curvature – Eccentric loading – Beam column.


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FAILURE THEORIES**9 Hours**

Maximum Stress theory – Maximum Strain Theory – Maximum Shear Stress Theory – Distortion Theory – Maximum strain energy theory – Application to aircraft structural problems.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Howard D. Curtis, “Fundamentals of Aircraft Structural Analysis”, McGraw Hill Higher Education Group, 1996.
2. Megson, T.H.G., “Aircraft Structures for Engineering Students”, Fifth Edition (Rev.), Butterworth-Heinemann, 2012.
3. David J. Peery, “Aircraft Structures (Dover Books on Aeronautical Engineering)”, Dover Publications, 2013.
4. Timoshenko, S., “Strength of Materials”, Vol. II, CBS Publishers, 2002.
5. S. S. Bhavikatti, “Strength of Materials”, Third Edition, Vikas Publishing House Pvt. Ltd, 2009.

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1. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-solid-mechanics-fall-2004/index.htm>
2. <http://nptel.ac.in/courses/112106141/>
3. <https://www.edx.org/course/introduction-to-aerospace-structures-and-materials>
4. <https://cosmolearning.org/courses/introduction-aerospace-structures/>
5. <https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006/index.htm>



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U18AET4004	UAV SYSTEM DESIGN	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1:** Discuss the configuration, performance parameters, and design aspects of unmanned aerial vehicle (UAV).
- CO 2:** Compare the sensors, payloads and actuators suitable for various UAVs.
- CO 3:** Explain the working of UAV propulsion systems.
- CO 4:** Discuss the communication and navigation systems in UAV.
- CO 5:** Explain the practical limitations in the design and development of an UAV.

Pre-requisite(s):-**CO-PO and CO-PSO Mapping:**

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	-	W	-	-	-	-	-	-	-	-	-	M	-
CO 2	M	-	-	-	-	-	-	-	-	-	-	-	S	-
CO 3	W	-	-	-	-	-	-	-	-	-	-	-	W	-
CO 4	M	-	-	-	-	-	-	-	-	-	-	-	W	-
CO 5	-	-	W	-	-	-	S	-	-	-	-	-	W	-

Course Assessment methods

Direct Assessment
1. Internal Tests
2. Assignments
3. End Semester Exam
Indirect Assessment
Course exit survey

INTRODUCTION**6 Hours**

Overview of UAV Systems, Classes of UAVs, Configuration of UAVs, Introduction to System Design, UAV Performance parameters, Introduction to Selection of UAV systems, System design aspects.

SENSORS AND ACTUATORS**9 Hours**


Position and Motion sensors, Altitude sensors, Airspeed sensors, Attitude sensors, Electronic Speed Controllers, Servomotors.

PAYLOADS**6 Hours**

Electro-optic payloads, Radar Imaging payloads, Dispensable payloads, Payload actuators, Payload Control.

PROPULSION AND POWER-PLANTS**6 Hours**

Thrust generation, Internal Combustion engines, Rotary engines, Gas turbine engines, Electric Motors, Batteries, Solar cells.

COMMUNICATIONS AND CONTROL**9 Hours**


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Communication Media, Radio Communication, Data Link, Mission Planning and Control Station, Modes of UAV Control, Flight Control loops, Autopilot, Autonomy.

NAVIGATION

9 Hours

GPS, Differential GPS, Navigation with Inertial Sensors, Radio Tracking, Way-point Navigation, Laser Range Finder.

Theory: 45 Hours	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Thomas James Gleason and Paul Gerin Fahlstrom, 'Introduction to UAV Systems', Fourth Edition, John Wiley and Sons, 2012.
2. Reg Austin, 'Unmanned Aircraft Systems: UAVs Design, Development, and Deployment', John Wiley and Sons, 2010.
3. Mohinder S. Grewal, Lawrence R. Weill and Angus P. Andrews, 'Global Positioning Systems, Inertial Navigation, and Integration', Second Edition, John Wiley and Sons, 2007.
4. K. Nonami, F. Kendoul, S. Suzuki, W. Wang, and D. Nakazawa, 'Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles', Springer Science, 2010.

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2. http://batteryuniversity.com/learn/article/what_is_the_c_rate
3. <http://www.modelaviation.com/inside-esc>
4. <http://rcstate.com/how-electronic-speed-control-esc-works/>
5. <http://www.stefanv.com/electronics/escprimer.html>
6. https://hobbyking.com/en_us/news/brushed-brushless-electronic-speed-controllers-work?store=en_us
7. <http://www.rclab.info/2013/02/the-basics-of-electric-power-escs.html>
8. <http://www.hooked-on-rc-airplanes.com/servo-tutorial.html>
9. http://electronoobs.com/eng_circuitos_tut4.php
10. <http://learningrc.com/motor-kv/>



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U18AET4005	AIRCRAFT HARDWARE AND MATERIALS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

CO 1: Analyze the properties of different aircraft materials.

CO 2: Identify the various types of composite and non-metallic materials for aircraft construction.

CO 3: Apply suitable hardware materials for different parts of the aircraft.

CO 4: Identify the appropriate cables and connectors for various aircraft applications.

Pre-requisites : -**CO-PO and CO-PSO Mapping:**

COs	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
	Program Outcomes(POs) and Program Specific Outcomes (PSOs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1		S											M
CO2		S											M
CO3	S												M
CO4		S											M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II.
2. Journal paper review, Assignment, Group Presentation
3. End Semester Examination.
Indirect
1. Course-end survey


Theory Component Contents**FERROUS , NON-FERROUS MATERIALS AND CORROSION****12 Hours**

Characteristics, properties and identification of common alloy steels and non-ferrous materials used in aircraft-Heat treatment and application of alloy steels and non-ferrous materials -Testing of ferrous materials and non-ferrous materials for hardness, tensile strength, fatigue strength and impact resistance. Formation by, galvanic action process, microbiological, stress-Types of corrosion and their identification-Causes of corrosion - Material types, susceptibility to corrosion.

COMPOSITE AND NON- METALLIC MATERIALS**9 Hours**

Characteristics, properties and identification of common composite , wood, glue, types of fabrics, and other non-metallic used in aircraft-Sealant and bonding agents-The detection of defects/deterioration in composite, wood, types of fabric and other non-metallic -Construction methods of wooden airframe structures-Preservation and maintenance of wooden structure-Repair of wooden structure, fabric covering, composite and other non-metallic material.

FASTENERS, PIPES AND UNIONS**7 Hours**


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Screw threads-Bolts, Nuts, studs and screws-Locking devices-Aircraft rivets- Types of rigid and flexible pipes and their connectors used in aircraft- Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air system pipes.

SPRINGS, BEARINGS AND TRANSMISSIONS

7 Hours

Types of springs, bearings and gears- materials, characteristics and their applications-Purpose of bearings, loads, construction-Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns-Belts and pulleys, chains and sprockets.

CONTROL CABLES, ELECTRICAL CABLES AND CONNECTORS

10 Hours

Types of control cables-End fittings, turn buckles and compensation devices-Pulleys and cable system components-Bowden cables-Aircraft flexible control systems- Electrical cable types, construction and their characteristics-High tension and co-axial cables-Crimping. Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes.


Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. George Francis Titterton, 'Aircraft Material and Processes', Fifth Edition, Sterling Book House, Mumbai, 1998.
2. Lalit Gupta, 'Aircraft General Engineering', Sixth Reprint, Himalayan Books, New Delhi, 2010.
3. Earl R. Parker, 'Materials for Missiles and Spacecraft', McGraw-Hill, 1963.
4. C G Krishnadas Nair, 'Handbook of Aircraft Materials', First Edition, Interline Publishers, Bangalore, 1993.

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- 1 http://avstop.com/ac/Aviation_Maintenance_Technician_Handbook_General/ch5.html
- 2 <http://www.flight-mechanic.com/aircraft-materials-processes-and-hardware/>


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U18INI4600	ENGINEERING CLINIC - IV	L	T	P	J	C
		0	0	4	2	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify a practical problems and find a solution

CO2: Understand the project management techniques

CO3: Demonstrate their technical report writing and presentation skills

Pre-requisites : U18INI3600 - Engineering Clinic - III

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Program Outcomes(POs) and Program Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	
CO2											S		W	
CO3										S			W	

Course Assessment methods

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:


The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the IV semester, students will focus primarily on Reverse engineering project to improve performance of a product

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total: 90 Hours


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U18VEP4504	PROFESSIONAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Develop the ethical values in both professional and personal life

CO2: Develop ability to take decision to reinforce professional life

CO3: Rational in professional skills required for diverse society

CO4: Excel in ingenious attitude to congregate professional life

CO5: Research into the professional stand

CO6: Spruce an Individual with decorum to achieve professional life

Pre-requisites :

1. U18VEP1501 / Personal Values
2. U18VEP2502 / Interpersonal Values
3. U18VEP3503 / Family Values

CO-PO and CO-PSO Mapping:

CO/PO Mapping															
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak															
COs	Programme Outcomes(POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1								S					-	-	
CO2				M									-	-	
CO3			S										-	-	
CO4												S	-	-	
CO5								M					-	-	
CO6										M			-	-	

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment
2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:


1.Professional skills With Values: Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence

2.Building Innovative work cultures: Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making

3.Professional Work Ethics: Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility

4.Engineering Ethics: Engineering Council of India - Objectives - Code of Ethics - Social responsibility -Professional Quality - Ethical issues - Effects - Strategy – Corruption, Consequences, Cures

5.Case studies in engineering ethics: Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property


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Workshop mode

REFERENCES

1. Learning To Do Sourcebook 3 - Unesco-Unevoc -Pdf
[Www.Unevoc.Unesco.Org/Fileadmin/User_Upload/Pubs/Learningtodo.Pdf](http://www.Unevoc.Unesco.Org/Fileadmin/User_Upload/Pubs/Learningtodo.Pdf)
2. Declaration Of Professional Values And Ethical Standards
Www.Garda.Ie/Documents/User/Declarationvalues.Pdf
3. Karma Yoga - Swami Vivekananda
Www.Vivekananda.Net/Pdfbooks/Karmayoga.Pdf
4. Professional Ethics In Engineering - Sasurie College Of Engineering
ww.Sasurieengg.Com/.../Ge2025%20professional%20ethics%20in%20engineering
5. Engineering Ethics Case Study; Challenger
Www.Ucc.Ie/En/Processeng/Staff/Academic/Ebyrne/.../Pe1006pptnoteslect7.Pdf



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SEMESTER V



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U18AET5101	HIGH SPEED AERODYNAMICS	L	T	P	J	C
		2	1	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

- CO 1: Use Basic Principles of the compressible gas flows.
 CO 2: Calculate the parameters of compressible flow through variable area duct.
 CO 3: Solve the Problems on one dimensional flow with Normal Shock, Rayleigh and Fanno flows and apply method of characteristics
 CO 4: Examine the flow with Oblique shocks and Expansion waves
 CO 5: Apply Linearized flow theory for streamlined bodies

Pre-requisite(s): 1. U18AEI4201 / Low Speed Aerodynamics

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping													
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Program Outcomes (POs) and Program Specific Outcomes (PSOs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO 1	S	M											M
CO 2	S	S											M W
CO 3	S	S	M	M									M W
CO 4	S	S	M	M									S W
CO 5		S											M

Course Assessment Methods:

Direct
1. Internal Test I
2. Internal Test II
3. Assignment (Written and Experimental)
4. Tutorial
5. Seminar / Presentation
6. End Semester Exam
Indirect
1. Course end survey

REVIEW OF BASIC PRINCIPLES

6+3 Hours

Aerodynamics variables and flow physics – Surface pressure and surface shear stress – Brief Review of Thermodynamics – Governing equations – Definition of compressible flow – Adiabatic steady state flow equations – Equation of State – Speed of sound and Mach Number, Area-velocity relation – Choked flow – Numerical Problems.


COMPRESSIBLE FLOW

6+3 Hours

Integral form of continuity, momentum and energy equations – Euler's equations, Integral forms of the conservation equations for inviscid flows – Alternative forms of energy equations – Quasi-one dimensional flow – Isentropic flow of a calorically perfect gas through variable-area ducts.

ONE DIMENSIONAL FLOW

6+3 Hours


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One dimensional flow equations – Normal Shock relations – Prandtl relation for normal shocks – Hugoniot equation – One dimensional flow with heat transfer and friction – Rayleigh and Fanno Flow – Flow physics of shock waves, Pitot static tube, Compressibility correction, Supersonic flow through nozzles, Supersonic wind tunnel, Introduction to Shock tube, Open jet, Shadowgraph techniques – Numerical Problems using gas tables.

OBLIQUE SHOCK AND EXPANSION WAVES

6+3 Hours

Source of Oblique waves – Introduction of Oblique shock waves – Oblique shock relations – Comparison between the wave angle and the Mach angle – Attached and detached shocks – Supersonic flows over wedges and cones, Prandtl-Meyer expansion wave, Introduction to viscous flow, Introduction to boundary-layers.

LINEARIZED FLOW

6+3 Hours

Small perturbation potential theory – Perturbation-velocity potential equation – Linearized pressure coefficient – Compressibility corrections– Critical Mach number, Lower and upper critical Mach numbers, Lift and drag divergence, Characteristics of swept wings, Transonic area rule, Tip effects, Supersonic airfoils, Introduction to hypersonic flows.


Theory: 30	Tutorial: 15	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. John D. Anderson, 'Modern Compressible Flow: With Historical Perspective', Third Edition, McGraw-Hill Book Co., New York, 2012.
2. Yahya S.M., 'Fundamentals of Compressible Flow', Sixth Edition, New Age International, 2018.
3. Shapiro, A.H., 'Dynamics and Thermodynamics of Compressible Fluid Flow', Ronold Press, 1982.
4. Zucrow, M.J. and Anderson, J.D., 'Elements of Gas Dynamics', McGraw-Hill Book Co., New York, 1989.
5. Barnes W. McCormick, 'Aerodynamics, Aeronautics and Flight Mechanics', Second Edition, John Wiley, New York, 1994.
6. Rathakrishnan, E., 'Gas Dynamics', Prentice Hall of India, 2017.
7. Kuethe, A.M., and Chow, C.Y., 'Foundations of Aerodynamics', John Wiley and Sons, 1982.

WEBSITES

1. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-120-compressible-flow-spring-2003/>
2. <https://ocw.mit.edu/courses/mechanical-engineering/2-26-compressible-fluid-dynamics-spring-2004/>
3. <https://nptel.ac.in/courses/112104118/38>


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U18AEI5202	AIRCRAFT STRUCTURES-II	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO1:** Analyze the response of structures due to unsymmetrical bending.
CO2: Analyze bending, shear and torsion of open and closed thin-walled sections.
CO3: Analyze the failure modes occur in thin walled plates structures.
CO4: Analyze behavior of aircraft structural components under various types of loads.
CO5: Determine the stress fringe value for photo-elastic materials

Pre-requisites :

1. U18AET4003/ Aircraft Structures-I

CO-PO and CO-PSO Mapping:

COs	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
	Program Outcomes(POs) and Program Specific Outcomes (PSOs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1		S		S									M
CO2		S		S									M
CO3		S											M
CO4		S											M
CO5				S									M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component). 2. Assignment, Group Presentation 3. Pre/Post - Experiment Test/Viva; Experimental Report for each experiment (lab component). 4. Model examination (lab component) 5. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

UNSYMMETRICAL BENDING

6 Hours

Bending stresses in beams of unsymmetrical sections (K-method, Neutral axis method and Principal axis Method) – Bending of symmetric sections with skew loads.

SHEAR FLOW IN OPEN SECTIONS

7 Hours

Thin walled beams – Concept of shear flow – Shear centre – Elastic axis – One axis of symmetry – Wall effective and ineffective in bending – Unsymmetrical beam sections.


SHEAR FLOW IN CLOSED SECTIONS

7 Hours

Bredt-Batho formula – Single and Multi-cell structures – Shear flow in single, multi-cell structures under torsion – Shear flow in single and multi-cell under bending with walls effective and ineffective.

BUCKLING OF PLATES

5 Hours


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Rectangular sheets under compression – Local buckling stress of thin walled sections – Crippling stresses by Needham's and Gerard's methods– Sheet stiffener panels – Effective width – Inter rivet and sheet wrinkling failures.

STRESS ANALYSIS IN WING AND FUSELAGE

5 Hours

Tension field web beams (Wagner Beam) –Loads on aircraft structural components – Lift distribution – V-n diagram.

Lab component:

List of Experiments

1. Unsymmetrical bending of cantilever beam.
2. Shear centre location for open section.
3. Shear centre location for closed section.
4. Determination of stresses of constant strength beam.
5. Stresses in circular disc using photo elastic model.
6. Stresses in rectangular beam using photo elastic model.
7. Determination of Stress concentration factor for a flat plate with hole using photoelasticity.
8. Vibration of a cantilever beam.
9. Flexibility matrix of a cantilever beam.
10. Fabrication of composite laminate.

List of Equipments:

1. Photoelastic apparatus
2. Vibration Beam Setup
3. Vacuum Bagging Layup setup


Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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REFERENCES

1. Bruhn. E.H., 'Analysis and Design of Flight vehicles Structures', Tri-state off set company, USA, 1985.
2. Megson, T.H.G., 'Aircraft Structures for Engineering Students', Fifth Edition (Rev.), Butterworth-Heinemann, 2012.
3. Bruce K. Donaldson., 'Analysis of Aircraft Structures', Second Edition, Cambridge University Press., 2008.
4. Peery, D.J., and Azar, J.J., 'Aircraft Structures', Second Edition, McGraw-Hill, 1993.
5. G. Lakshmi Narasaiah, 'Aircraft Structures', CRC Press, 2011.
6. C T Sun, 'Mechanics of Aircraft Structures', Second Edition, Wiley publisher, April 2006.

WEBSITE REFERENCES

- 1 https://ocw.mit.edu/courses/mechanical-engineering/2-080j-structural-mechanics-fall-2013/course-notes/MIT2_080JF13_Lecture11.pdf
- 2 https://www.youtube.com/watch?v=jwTrStB_8Lg
- 3 <https://www.youtube.com/watch?v=WCEsOI9m97o&t=542s>



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U18AET5003	COMPUTATIONAL FLUID DYNAMICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the fluid modeling approaches.

CO2: Develop grids for different fluid flow applications.

CO3: Analyze fluid flow problems using panel methods

CO4: Make use of advanced simulation techniques to solve engineering applications using CFD codes such as Fluent, CFX, ROTCFD etc.,

CO5: Apply appropriate schemes to solve fluid flow problems.

CO6: Examine the CFD simulation results with validation.

Pre-requisites : U18AEI4201 – Low Speed Aerodynamics

CO-PO and CO-PSO Mapping:

CO/PO/PSO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Program Outcomes(POs) and Program Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2				M										
CO3						M							S	
CO4		S			S	S								S
CO5			S				S							
CO6				W			S		S					

Course Assessment methods

Direct
1. Continuous Assessment Test I, II
2. Assignment / project presentation
3. End Semester Examination
Indirect
1. Course-end survey

FUNDAMENTAL CONCEPTS**10 Hours**

Introduction – Basic Equations of Fluid Dynamics-conservative & non-conservative forms – Introduction to governing equations usage in CFD codes with suitable examples.


DISCRETIZATION, TRANSFORMATION AND GRIDS**10 Hours**

Introduction to different types of grid generation schemes - Finite Difference Method – Finite Element Method & Finite Volume Method. Introduction to transformations basics in CFD. The Lax-Wendroff method, MacCormack's Method basics - examples of the specific methods in CFD codes.

PANEL METHODS**5 Hours**

Introduction to – Source panel method using examples (Non-lifting flows). Introduction to Vortex panel method using examples (Lifting flows)

BOUNDARY LAYER EQUATIONS – STABILITY PROPERTIES**10 Hours**


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Introduction to Boundary layer Equations, Implicit time dependent methods, Concept of numerical dissipation, Stability properties of explicit and implicit methods, Conservative upwind discretization for hyperbolic systems, Leapfrog scheme. Application of these schemes in CFD codes using suitable examples

INTRODUCTION TO SIMPLE, PESO SCHEMES & EXAMPLE PROBLEMS

10 Hours

Introduction to Flux splitting schemes, pressure correction solvers – SIMPLE, PISO – Introduction to turbulence modeling. Application of these schemes in CFD codes using suitable examples


Theory: 45 Hours	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. T. J. Chung, “Computational Fluid Dynamics”, Second Edition, Cambridge University Press, 2014.
2. Suhas V. Patankar, “Numerical Heat Transfer and Fluid Flow”, CRC Press, 1980.
3. John D Anderson Jr., ‘Computational Fluid Dynamics – The Basics with Applications’, McGraw-Hill Education, New York, 1995.
4. Fletcher, C.A.J., “Computational Techniques for Fluid Dynamics”, Vol. 1 and Vol. 2, Second Edition, Springer-Verlag, Berlin, 2013.
5. Charles Hirsch, “Numerical Computation of Internal and External Flows”, Vols. 1 and 2, Second Edition, John Wiley and Sons, New York, 2007.
6. John F. Wendt (Editor), “Computational Fluid Dynamics: An Introduction”, Third Edition, Springer-Verlag, Berlin, 2008.
7. Joel H. Ferziger and Milovan Peric, “Computational Methods for Fluid Dynamics”, Third Edition, Springer, 2002.
8. Pieter Wesseling, “Principles of Computational Fluid Dynamics”, Springer, 2001.
9. Klaus A. Hoffmann and Steve T. Chiang, “Computational Fluid Dynamics”, Vol. 1, Fourth Edition, Engineering Education System, 2000.
10. Klaus A. Hoffmann and Steve T. Chiang, “Computational Fluid Dynamics for Engineers”, Vol. 2, Engineering Education System, 1993.
11. ANSYS Help manual
12. ROTCFD Help manual

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1. <http://nptel.ac.in/courses/101106045/1>
2. <http://nptel.ac.in/courses/112107080/>
3. <http://nptel.ac.in/courses/103106073/>
4. <http://nptel.ac.in/courses/112105045/>
5. <https://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical-fluid-mechanics-spring-2015/index.htm>
6. <https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules>


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U18AEI5204	AIRCRAFT SYSTEMS AND INSTRUMENTS				L	T	P	J	C
					2	0	2	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1: Interpret the construction and working principle of conventional aircraft systems.
 CO 2: Illustrate the performance characteristics of various aircraft engine control systems.
 CO 3: Explain the functions of various types of aircraft instruments and avionics systems.
 CO 4: Demonstrate the operation of aircraft and engine system..
 CO 5: Describe the inspection procedure and troubleshooting on aircraft.

Pre-requisite(s): -

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	M	-	-	-	-	-	-	-	-	-	-	-	W	-
CO 2	S	-	-	-	-	-	-	-	-	-	-	-	S	-
CO 3	-	-	M	-	-	-	-	-	-	-	-	-	M	-
CO 4	-	-	-	-	M	-	-	-	-	-	-	-	-	M
CO 5	-	-	-	-	S	-	-	-	-	-	-	-	-	S

Course Assessment Methods

Direct Assessment
1. Internal Tests 2. Assignments 3. Practical Exams 4. End Semester Exam
Indirect Assessment
Course exit survey

Theory Component:

CONVENTIONAL AIRCRAFT SYSTEMS

7 Hours

Conventional flight control system, Hydraulic and Pneumatic systems, Electrical Power generation and distribution system, Environmental control system, De-icing and anti-icing systems, Landing gear system, and Aircraft fuel systems.

CONVENTIONAL ENGINE CONTROL SYSTEMS

6 Hours

Fuel systems of Piston engine and Jet engine, Main engine components and functions of jet engines, Engine lubrication systems, Engine starting system, Thrust reversing and Thrust vector control.

AVIONIC SYSTEMS


5 Hours

Autopilot systems, Advanced flight control systems, Flight Management System, Communication and Navigation systems, Full Authority Digital Engine Control (FADEC) system.

AIRCRAFT INSTRUMENTS

6 Hours

Flight instruments, Navigation and Communication instruments, Gyroscope, Airspeed indicator, Multi-Function Display, Attitude director indicator, Primary Flight Display, Engine instruments and display, Operation and principles, Flight Data Recorder (FDR), Cockpit Voice Recorder (CVR).


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COCKPIT LAYOUT**6 Hours**

Ergonomic layout, Controls and Indications, Display systems, Self-test and Built-In Test Equipment (BITE), Cockpit air-conditioning and pressurization, Challenges posed by cockpit to the designer, Failure warning system.

Lab Component:**List of Experiments/Exercises**

1. Inspection of primary and secondary control of Cessna 172 Aircraft.
2. Demonstrate and testing of aircraft hydraulic system.
3. Demonstrate and testing of aircraft pneumatic system.
4. Demonstrate and testing of aircraft electrical system.
5. Dismantling and assembly of aircraft piston engine.
6. Dismantling and assembly of jet engine.
7. Inspection of aircraft instruments and its function in Cessna 172 aircraft.
8. Troubleshoot various systems of aircraft.

Theory: 30 Hours	Tutorial: 0	Practical: 30 Hours	Project: 0	Total: 60 Hours
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List of Equipment


1. Aircraft hydraulic test rig
2. Aircraft pneumatic test rig.
3. Aircraft electrical test rig.
4. Piston engine.
5. Cut section of jet engine.

REFERENCES

1. E. H. J. Pallett, 'Aircraft Instruments – Principles and Applications', Second Edition, Longman House, 1981.
2. E. H. J. Pallett and S. Coyle, 'Automatic Flight Control', Fourth Edition, Blackwell Science Ltd, 1993.
3. Irwin Treager, 'Aircraft Gas Turbine Engine Technology', Third Edition, McGraw Hill, 1997.
4. James Powell, 'Aircraft Radio Systems', Shroff Publishers, 2006.
5. Ian Moir and Allan Seabridge, 'Aircraft Systems – Mechanical, electrical and avionics subsystems integration', Second Edition, Professional Engineering Publishing Limited, 2001.
6. Ian Moir, Allan Seabridge and Malcolm Jukes, 'Civil Avionics Systems', Second Edition, Wiley, 2013.
7. 'General Hand Book of Airframe and Powerplant Mechanics', U.S. Dept. of Transportation, Federal Aviation Administration, English Book Store, New Delhi, 1995.

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1. <https://www.princeton.edu/~stengel/MAE331Lecture10.pdf>
2. <http://okigihan.blogspot.com/2017/04/aircraft-hydraulic-system.html>
3. <http://okigihan.blogspot.com/2017/06/aircraft-pneumatic-systems.html>
4. home.iitk.ac.in/~mohite/Basic_construction.pdf
5. <https://science.ksc.nasa.gov>
6. Pilot's Handbook of Aeronautical Knowledge:



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- https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/
7. MIT Open Courseware lectures notes on Aircraft Systems Engineering:
<https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-885j-aircraft-systems-engineering-fall-2004/lecture-notes/>
 8. NPTEL Online course materials on Aircraft Maintenance:
<https://nptel.ac.in/courses/101104071/>



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U18AEI5205	AIRCRAFT PROPULSION	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Analyze overall performance of an aircraft engines.
CO2: Explain the relation between area ratio and external deceleration ratio for diffuser.
CO3: Describe the combustion mechanisms of gas turbine engine.
CO4: Calculate the operating characteristics of compressors, turbines and nozzles.
CO5: Experiment the performance of aircraft engine components.

Pre-requisites :

1. U18AEI3202 / Engineering Thermodynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S											S	
CO2		S											M	
CO3	M	S											M	
CO4		S											M	
CO5			M										S	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component). 2. Assignment, 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component). 4. Model examination (lab component) 5. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

FUNDAMENTALS OF AIR-BREATHING ENGINES


5 Hours

Operating principles of piston engines – Classification of piston engines – Working principle of gas turbine engine – Thrust equation – Factors affecting thrust – Effect of atmospheric air on engine – Methods of thrust augmentation – Comparison of turboprop, turbofan and turbojet engines – Numerical problems.

INLETS

5 Hours

Internal compressible flow through subsonic inlets – Boundary layer separation – Relation between minimum area ratio and external deceleration ratio – Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – Mode of inlet operation.


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COMPRESSORS**6 Hours**

Compressible flow over moving vanes-Velocity diagram- Work done –working principle of Axial and Centrifugal compressors –Diffuser vane design considerations – Concepts of prewhirl, Rotation stall –Degree of reaction –Performance characteristics-Numerical problems.

COMBUSTION CHAMBERS**5 Hours**

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

TURBINES**6 Hours**

Principle of operation of axial flow turbines – Limitations of radial flow turbines – Performance characteristics– Turbine blade cooling methods – Basic blade profile design considerations – Matching of compressor and turbine-Numerical problems

NOZZLES**3 Hours**


Theory of flow in isentropic nozzles – Convergent / Convergent - divergent nozzles – Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under-expanded nozzles – Thrust reversal.

BOOK REFERENCES

1. Philip Hill and Carl Peterson, 'Mechanics and Thermodynamics of Propulsion', Second Edition, Pearson Education, 2009.
2. Saravanamuttoo, H.I.H., Paul Straznicky, Henry Cohen and Gordon Rogers, 'Gas Turbine Theory', Seventh Edition, Pearson Education, 2008.
3. Jack D. Mattingly, 'Elements of Propulsion: Gas Turbines and Rockets', AIAA Education Series, 2016.
4. V. Ganesan, 'Gas Turbines', Third Edition revised, Tata McGraw-Hill, 2017.
5. Saeed Farokhi, 'Aircraft Propulsion', Second Edition, John Wiley and Sons, 2014.
6. C. Jaganathan and S.K Jain, "Jet Engines", Yes Dee, First edition, 2016.

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2. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-50-introduction-to-propulsion-systems-spring-2012/>
3. <https://www.grc.nasa.gov/www/k-12/UEET/StudentSite/engines.html>
4. <https://www.rolls-royce.com/products-and-services/civil-aerospace.aspx>
5. <https://nptel.ac.in/syllabus/101104018/>
6. <https://www.geaviation.com/commercial/engines>



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Lab component:**List of Experiments**

1. Effect of varying back pressure on mass flow rate and performance in convergent nozzle.
2. Performance analysis of propeller.
3. Performance analysis of free jet and wall jet.
4. Determination of flame speed for various air fuel ratios.
5. Performance analysis of diffuser.
6. Demonstration of ramjet
7. Study of an aircraft piston engines.
8. Study of an aircraft jet engines.

List of Equipment

1. Nozzle pressure distribution and performance Test Rig.
2. Propeller performance Test Rig.
3. Free jet and Wall jet Test setup.
4. Flame propagation Test Rig.
5. 2D-Diffuser setup.
6. Ram jet setup
7. Piston engine cut section
8. Jet engine cut section

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours
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U18INT5000	CONSTITUTION OF INDIA (Mandatory course)	L	T	P	J	C
		2	0	0	0	0

Course Outcomes:

After successful completion of this course, the students will be able to:

- CO1:** Gain Knowledge about the Constitutional Law of India
CO2: Understand the Fundamental Rights and Duties of a citizen
CO3: Apply the concept of Federal structure of Indian Government
CO4: Analyze the Amendments and Emergency provisions in the Constitution
CO5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites :-**CO-PO and CO-PSO Mapping:**

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M			W			S	-	-
CO2						S		S				M	-	-
CO3									M	S		W	-	-
CO4								W	M			M	-	-
CO5						M		M				S	-	-

Course Assessment methods

Direct
1. Group Activity / Quiz/ Debate / Case studies 2. Class test / Assignment
Indirect
Surveys

THEORY COMPONENT:**MODULE.1: INTRODUCTION TO INDIAN CONSTITUTION****4 Hours**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - characteristics of the Constitution of India

Module.2: Fundamental Rights**8 hours**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation


Module.3: Federal Structure**8 hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4: Amendment to Constitution**6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Module.5: Emergency Provisions**4 hours**


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National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India

Theory: 30	Tutorial: 0	Practical: 0	Project: 0	Total: 30 hours
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1. [Constitution of India - Ministry of Law & Justice](http://awmin.nic.in/coi/coiason29july08.pdf) – PDF format
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2. [**Introduction to the Constitution of India by Durgadas Basu**](#)
3. The Constitution of India – Google free material -
www.constitution.org/cons/india/const.html
4. [Parliament of India](#) – PDF format download.nos.org/srsec317newE/317EL11.pdf
5. The Role of the President of India – By Prof.Balkrishna
6. Local Government in India – E Book - [Pradeep Sachdeva](#)
https://books.google.com/books/.../Local_Government_in_In...



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U18INI5600	ENGINEERING CLINIC - V	L	T	P	J	C
		0	0	4	2	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify a practical problems and find a solution

CO2: Understand the project management techniques

CO3: Demonstrate their technical report writing and presentation skills

Pre-requisites : U18INI4600 - Engineering Clinic - IV

CO-PO and CO-PSO Mapping:

CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs) and PSOs													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	S	
CO2											S		W	
CO3										S			W	

Course Assessment methods

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:


The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the V semester, students will focus primarily on Design and developing a prototype

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total: 90 Hours


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U18VEP5505	SOCIAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

- CO 1:** Understand the transformation from self to society
CO 2: Acquire knowledge about disparity among Human Beings
CO 3: Realize the new ethics in creating a more sustainable Society
CO 4: Develop skills to manage challenges in social issues
CO 5: Acquire the skills for Management of Social work & Holistic Society
CO 6: Validate the social liabilities at dissimilar situations

Pre-requisites :

1. U18VEP1501 / Personal Values
2. U18VEP2502 / Interpersonal Values
3. U18VEP3503 / Family Values
4. U18VEP4504 / Professional Values

CO-PO and CO-PSO Mapping:


CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S							-	-
CO2							S						-	-
CO3								M					-	-
CO4											S		-	-
CO5												S	-	-
CO6									M				-	-

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment
2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values Through Practical Activities:

- 1. Self and Society:** Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society
- 2. Social Values:** Tolerance – Responsibility – Sacrifice – Sympathy - Service – peace-nonviolence - right conduct- Unity – forgive – dedication – Honest
- 3. Social issues:** Disparity among Human beings- Poverty-Sanitation -corruption- un employment-superstition – religious intolerance & castes – terrorism.
- 4. Emerging Ethics for Sustainable Society:** Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society- Effect of Social Media in society - development of Education and Science in the Society


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5. Social Welfare: Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of Holistic Society

Workshop mode

REFERENCES

1. Social Problems In India - Forumias.Com – Pdf Discuss.Forumias.Com/Uploads/File Upload/.../711b18f321d406be9c79980b179932.Pd...
2. Investing In Cultural Diversity And Intercultural Dialogue: Unesco ...
Www.Un.Org/En/Events/Culturaldiversityday/Pdf/Investing_In_Cultural_Diversity.Pdf
3. Indian Society And Social Change - University Of Calicut
Www.Universityofcalicut.Info/Sde/Ba_Sociology_Indian_Society.Pdf
4. Culture, Society And The Media - E- Class
Www.Eclass.Uoa.Gr/.../Media164/.../%5btony_Bennett,_James_Curran,_Michael_G
5. Social Welfare Administration - Ignou
Www.Ignou.Ac.In/Upload/Bswe-003%20block-2-Unit-6-Small%20size.Pdf



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SEMESTER VI



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U18AET6001	FLIGHT DYNAMICS	L	T	P	J	C
		4	0	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Calculate atmospheric properties at various altitudes.
CO2: Calculate the performance of an airplane for non-accelerating flight conditions.
CO3: Solve accelerated performance equations to get Take-off and landing distances.
CO4: Estimate Longitudinal static stability and trim requirements for an aircraft.
CO5: Assess lateral and directional stability requirements for an aircraft

Pre-requisites :

1. U18AEI4201 / Low Speed Aerodynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S			M							M	
CO2			M										M	
CO3			M										M	
CO4				W									M	
CO5			M										M	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Assignment 3. End Semester Examination
Indirect
1. Course-end survey

PRINCIPLES OF FLIGHT


10 Hours

Physical properties and structure of the atmosphere – International Standard Atmosphere – Temperature, Pressure and Altitude relationship – Forces and Moments acting on a flight vehicle – Equilibrium conditions – Equation of motion of a rigid flight vehicle - Measurement of speed – True, Indicated, Calibrated and Equivalent Air Speed – Streamlined and bluff bodies – Various Types of drag in airplanes, Drag polar, Methods of drag reduction of airplanes.

AIRCRAFT PERFORMANCE IN LEVEL, CLIMBING AND GLIDING FLIGHT

12 Hours

Straight and level flight, Thrust required and available, Power required and available, Effect of altitude on thrust and power, Conditions for minimum drag and minimum power required, Gliding and Climbing flight – Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide, Range and Endurance.


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ACCELERATING FLIGHT**10 Hours**

Take-off and Landing performance, Turning performance, Horizontal and vertical turn, Pull up and pull down, maximum turn rate, minimum turn radius, V-n diagram.

LONGITUDINAL STABILITY AND CONTROL**15 Hours**

Degrees of freedom of an aircraft, Static and Dynamic stability, Static longitudinal stability, Contribution of individual components, Neutral point, Static margin, Hinge moment, Elevator control effectiveness, Power effects, Elevator angle to trim, Stick force gradient, Aerodynamic balancing, Aircraft Equations of motion, Stability derivatives, Stability quartic, Phugoid motion.

LATERAL, DIRECTIONAL STABILITY AND CONTROL**13 Hours**

Yaw and side-slip, Dihedral effect, Contribution of various components, Lateral control, Aileron control power, Strip theory, Aileron reversal, Weathercock stability, Directional control, Rudder requirements, Dorsal fin, One engine inoperative condition, Dutch roll, Spiral and directional divergence, Autorotation and spin.


Theory: 60	Tutorial: 0	Practical: 0	Project: 0	Total: 60 Hours
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REFERENCES

1. John D. Anderson Jr., 'Aircraft Performance and Design', Tata - McGrawHill First edition, 2011
2. Robert C. Nelson, 'Flight Stability and Automatic Control', Second Edition, McGraw-Hill, 2007.
3. Bandu N. Pamadi, 'Performance, Stability, Dynamics, and Control of Airplanes', Third Edition, AIAA Education Series, 2015.
4. H H Hurt Jr 'Aerodynamics for Naval Aviators' FAA 2012 Second edition
5. Courtland D. Perkins and Robert E. Hage, 'Airplane Performance, Stability and Control', John Wiley and Sons, 1966.
6. Bernard Etkin and Lloyd Duff Reid, 'Dynamics of Flight: Stability and Control', Third Edition, John Wiley and Sons, 1996.
7. Martin E. Eshelby, "Aircraft Performance Theory and Practice", Elsevier, First edition, 2012.

Web References:

1. <https://nptel.ac.in/courses/101106041/>
2. <https://nptel.ac.in/courses/101106043/>
3. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-333-aircraft-stability-and-control-fall-2004/>
4. <http://www.princeton.edu/~stengel/MAE331Lectures.html>



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U18AET6002	FINITE ELEMENT METHOD	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Identify the mathematical model for simple and complex engineering problems using FEM approach.
- CO2:** Calculate stress, strain, and displacement value of simple 1-D problems.
- CO3:** Solve complex axisymmetric problems under various boundary conditions.
- CO4:** Apply finite element concept to Isoperimetric Element.
- CO5:** Analyse heat transfer and torsional problems.

Pre-requisites :

1. U18AET4003/Aircraft Structures I

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	S											S	M
CO2		S											S	M
CO3		S											S	M
CO4		M												S
CO5		S												S

Course Assessment methods

Direct
<ol style="list-style-type: none"> 1. Continuous Assessment Test I, II. 2. Assignment. 3. End Semester Examination.
Indirect
<ol style="list-style-type: none"> 1. Course-end survey

INTRODUCTION

7 Hours

Review of various approximate methods – Rayleigh Ritz's, Galerkin and finite difference methods – Governing equation and convergence criteria of finite element method.

DISCRETE ELEMENTS


10 Hours

Bar element with uniform section and varying section – Mechanical and thermal loading – Truss analysis – Beam element – Problems for various loading and boundary conditions – Use of local and natural coordinates.

CONTINUUM ELEMENT

10 Hours

Plane stress, Plane strain and axisymmetric problems – Constant strain Triangular elements- Stiffness matrix -Introduction to Linear strain triangular element – Axisymmetric load vector.


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ISOPARAMETRIC ELEMENT**9 Hours**

Introduction to isoparametric elements – Shape function for 4, 8 and 9 nodal quadrilateral elements – Stiffness matrix and consistent load vector – Gaussian Integration.

FIELD PROBLEMS**9 Hours**

One dimensional Heat transfer problems – Steady state heat transfer in fin – Derivation of element matrices for two dimensional problems – Torsion problems.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Tirupathi.R. Chandrupatla and Ashok D. Belegundu, 'Introduction to Finite Elements in Engineering', Fourth Edition, Prentice Hall India, 2012.
2. Robert D Cook, David S Malkus, and Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', Fourth Edition, John Wiley and Sons, Inc., 2008.
3. Reddy J. N., 'An Introduction to Finite Element Method', 4 edition, 2018.
4. Larry J. Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wiley and Sons, Inc., 1985.
5. Daryl L. Logan, 'A First Course in the Finite Element Method', Seventh Edition, Cengage Learning, 2017.
6. H.V. Lakshminarayana and S.R. Srivatsa, "Finite Element Modelling for Engineering Analysis", Yes Dee, First edition, 2017.

WEBSITE REFERENCES

1. <https://nptel.ac.in/courses/112104115/>
2. http://homepage.usask.ca/~ijm451/finite/fe_resources/fe_resources.html
3. <https://nptel.ac.in/courses/112104116/>
4. <https://www.coursera.org/learn/finite-element-method>
5. <https://www.class-central.com/tag/finite-element-method>
6. <https://www.open.edu/openlearn/science-maths-technology/introduction-finite-element-analysis>.



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U18AET6003	VIBRATIONS AND AEROELASTICITY	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1:** Explain the concept and types of vibration.
CO 2: Determine the natural frequencies and mode shapes of the vibrating system.
CO 3: Solve the equations of motion for multi degree-of-freedom systems.
CO 4: Determine the natural frequency of continuous systems of free-vibration.
CO 5: Identify the effects of vibrations on aircraft structures and the static and dynamic aeroelastic effects.

Pre-requisites :

1. U18AEI5202/ Aircraft Structures II

CO-PO and CO-PSO Mapping:

	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M											M	
CO2		M											M	
CO3		S											M	
CO4		S											M	
CO5		M											M	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II. 2. Journal paper review, Assignment, Group Presentation 3. End Semester Examination.
Indirect
1. Course-end survey

Theory Component contents**SINGLE DEGREE OF FREEDOM SYSTEMS – FREE****10 Hours****VIBRATION**


Terminologies – Simple harmonic motion – Newton's Law – D' Alembert's principle – Energy Methods – Free vibrations – Damped vibrations.

SINGLE DEGREE OF FREEDOM SYSTEMS – FORCED**10 Hours****VIBRATION**

Forced Vibrations – With and without damping – Support excitation – Vibration measuring instruments.

MULTI DEGREES OF FREEDOM SYSTEM**7 Hours**

Two degrees of freedom systems – Static and Dynamic couplings – Vibration absorber – Principal co-ordinates – Principal modes and orthogonal condition – Eigen value problems – Hamilton's principle – Lagrangian equation and application.



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CONTINUOUS SYSTEMS**8 Hours**

Vibration of elastic bodies – Vibration of strings – Longitudinal, Lateral and Torsional vibrations – Approximate methods – Rayleigh and Holzer Methods to find natural frequencies.

ELEMENTS OF AEROELASTICITY**10 Hours**

Concepts – Collar's triangle – Aero elastic instabilities and their prevention – Basic ideas on wing divergence – Loss and reversal of aileron control – Flutter and its prevention.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Singiresu S. Rao, 'Mechanical Vibrations', Fifth Edition, Prentice Hall, 2011.
2. V. P. Singh, 'Mechanical Vibrations', Fourth Edition, Dhanpat Rai and Co., 2014.
3. Leonard Meirovitch, 'Fundamentals of Vibrations', Tata McGraw Hill, 2001.
4. Tse. F.S., Morse, I.F., and Hunkle, R.T., 'Mechanical Vibrations', Prentice Hall, New York, 1984.
5. Bisplinghoff R.L., Ashley H and Hogman R.L., 'Aero elasticity', Addison Wesley Publication, New York, 1983.
6. Fung Y.C., 'An Introduction to the Theory of Aero elasticity', John Wiley and Sons, New York, 1995.

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1. <https://nptel.ac.in/courses/112103111/>
2. <https://www.youtube.com/watch?v=pi5hAK0FdWA&t=2571s>
3. <https://www.youtube.com/watch?v=j-zczJXSxmw>



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U18AET6104	ROCKET PROPULSION	L	T	P	J	C
		2	1	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1: Illustrate the Basic principles and parameters of rockets.
 CO 2: Differentiate and interpret the ignition systems of rocket
 CO 3: Analyze the performance of solid-core nuclear thermal rockets, arc jets, and ion thrusters.
 CO 4: Analyze the performance of Liquid Propellant Rockets
 CO 5: Interpret the advanced propulsion techniques of a rocket

Pre-requisite(s):

U18AEI5205 / Aircraft Propulsion

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping (S/M/W indicates strength of correlation)										S-Strong, M-Medium, W-Weak				
COs	Programme Outcomes (POs) and Programme Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M											M	
CO 2	S	S											M	
CO 3	S	S	M										M	
CO 4	S	S	M										S	
CO 5		S											M	

Course Assessment Methods

Direct
1. Internal Test I 2. Internal Test II 3. Assignment 4. Tutorial 5. End Semester Exam
Indirect
Course end survey

DEFINITIONS AND FUNDAMENTALS

6+3 Hours

Operating principle of chemical rockets – Definitions: Rocket thrust, Exhaust velocity, Specific Impulse, Characteristic velocity, Thrust coefficient, Rocket nozzle classifications. – Numerical Problems.

IGNITION SYSTEMS IN ROCKETS


9+0 Hours

Types of solid propellant rocket igniters – Pyrotechnic igniters and pyrogen igniters – Igniter Design Considerations, Deflagration and Detonation, Hypergolic ignition.

SOLID PROPELLANT ROCKETS

6+3 Hours

Selection criteria of solid propellants – Important hardware components of solid rockets – Propellant grain design considerations – Burn rate – Internal ballistics, Erosive burning – Rocket performance considerations – Staging of rockets – Thrust vector control – Numerical problems.


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LIQUID PROPELLANT ROCKETS**6+3 Hours**

Liquid propellant rocket engine fundamentals – Liquid propellants – Propellant feed systems – Selection of liquid propellants, Injectors, combustion chamber and nozzle, Combustion Instability, Secondary injection thrust vector control in liquid rockets – Cooling in liquid rockets – Numerical Problems.

ADVANCED PROPULSION TECHNIQUES**9+0 Hours**

Hybrid rockets, Cryogenic rockets, Electric rockets, Nuclear rockets, Satellite thrusters, Ion propulsion techniques, Solar sail, Anti-matter propulsion, Nozzle less propulsion, Interplanetary missions.

Theory: 36 Hours	Tutorial: 9 Hours	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. George P. Sutton and Oscar Biblarz, 'Rocket Propulsion Elements', 8th Edition, John Wiley and Sons Inc., New York, 2017.
2. Kou. K. K and Summerfield. M., "Fundamental Aspects of Solid Propellant Rockets", Progress in Astronautics and Aeronautics, AIAA, Vol. 90, 1982.
3. Norazila Othman, Subramaniam Krishnan, and Wan Khairuddin Wan Ali, 'Design and Development of Hydrogen Peroxide Monopropellant Thruster: Basic Theory and Performance Calculations', Lambert Academic Publishers, 2011.
4. Barrere. M, 'Rocket Propulsion', Elsevier Publishing Company, New York, 1960.
5. Hill, P.G. and Peterson, C.R., 'Mechanics and Thermodynamics of Propulsion', Second Edition, Pearson Education, 1999.
6. Gordon Oates, 'Aero Thermodynamics of Gas Turbine and Rocket Propulsion', AIAA Education Series, New York, 1989.
7. J. W. Cornelisse, H. F. R. Schoyer, and K. F. Wakker, 'Rocket Propulsion and Spaceflight Dynamics', Pitman, London, 1979.

WEBSITES

1. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-512-rocket-propulsion-fall-2005/>
2. <https://nptel.ac.in/courses/101104019/>



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U18AEP6505	DESIGN AND SIMULATION LABORATORY					L	T	P	J	C
						0	0	2	0	1

Course Outcomes

After successful completion of this course, the students will be able to

CO1: Analyze the structural behaviour of different elements.

CO2: Evaluate the apparent stress distribution over a structural component.

CO3: Analyze the nonlinearity condition problems over a structural element.

CO4: Construct grids for various geometries using commercial meshing codes like ICEMCFD, ANSYS Workbench.

CO5: Predict fluid flow properties using commercial codes like ANSYS Fluent, CFX, RotCFD.

CO6: Choose the suitable modeling approaches for turbo-machinery components.

Pre-requisite(s): U18AET5003 / Computational Fluid Dynamics

CO-PO and CO-PSO Mapping:

CO / PO / PSO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs) / Programme Specific Outcomes (PSO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1					S									S
CO 2		M			S				M		W			S
CO 3	M				S									S
CO 4					S									S
CO 5	M			M	S									S
CO 6		W	S		M		S		M					M


Course Assessment Methods

Direct	Indirect
1. Lab Exercises 2. Lab Observation / Record 3. Viva-voce / Model Practical Exams 4. End Semester Exam	Course end survey

LIST OF EXERCISES

1. Static Analysis of a Stepped Composite Bar Element
2. Coupled Structural / Thermal Analysis
3. Comparative Nonlinear analysis of a Beam Element
4. Stress Analysis of an Axisymmetric component
5. Estimation of Crippling load in column.
6. Impact analysis of Bullet using Explicit Dynamics
7. Computing flow in a process of 3-D injection mixing pipe using ANSYS CFX
8. External flow analysis on the Automotive vehicle using Ansys CFX
9. Structural grid generation and Computing flow analysis in the Convergent - Divergent Nozzle using ANSYS Fluent
10. Structured grid generation and multiphase simulation of flow through Can Combustor using ANSYS Fluent
11. Computational Analysis of Flow and Acoustics around a turbo machinery components using ANSYS Fluent
12. Transient Analysis in the turbo machinery components using ANSYS Fluent [MRF approach]

Theory: 0	Tutorial:	Practical: 30 Hours	Project: 0	Total: 30 Hours
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U18AEP6506	AIRFRAME AND AERO ENGINE MAINTENANCE LABORATORY	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

After successful completion of this course, the students will be able to

CO1: Apply various types of welding for different parts of an aircraft.

CO2: Remove and install aircraft wings and empennage required for maintenance.

CO3: Remove and install the undercarriage of an aircraft required for maintenance.

CO4: Identify the defects in an aircraft's piston engine and jet engine.

CO5: Start the piston and jet engines of an aircraft with the help of user manuals.

Pre-requisite(s):

CO-PO and CO-PSO Mapping:

CO / PO / PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs) / Programme Specific Outcomes (PSO)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	M		S											S
CO 2			M											S
CO 3			M											S
CO 4	S													S
CO 5			M											S

Course Assessment Methods

Direct	Indirect
1. Lab Exercises 2. Lab Observation / Record 3. Viva-voce / Model Practical Exams 4. End Semester Exam	Course end survey

LIST OF EXERCISES

AIRFRAME MAINTENANCE

1. Welded patch repair by TIG, MIG and Riveting.
2. Removal and fitment of wings.
3. Removal and fitment of Empennage.
4. Removal and fitment of undercarriage.
5. Brake unit Removal and fitment.

AERO ENGINE MAINTENANCE

6. Stripping of a piston engine and reassembly.
7. Piston Engine - cleaning, visual inspection, and NDT checks.
8. Piston Engine Components - dimensional checks.
9. Propeller Pitch Setting and balancing.
10. Jet Engine – Identification of components and defects.
11. Piston and Jet Engine starting procedure.


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LIST OF EQUIPMENTS

1. Stand for empennage.
2. Piston Engine.
3. Jet Engine.
4. Standard tools for dismantling and assembly.
5. Non-destructive Testing equipment.

Theory: 0	Tutorial:	Practical: 30 Hours	Project: 0	Total: 30 Hours
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U18VEP6506	NATIONAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Acquire knowledge on the Essence of Indian Knowledge Tradition

CO2: Know the great Indian personalities and follow their trail

CO3: Understand the specialty of democracy

CO4: Disseminate our Nation and its values to propagate peace

CO5: Contribute with their energy and effort for a prosperous India

CO6: Propagate the youth and the contribution for development of our Nation

Pre-requisites :

1. U18VEP1501 / Personal Values
2. U18VEP2502 / Interpersonal Values
3. U18VEP3503 / Family Values
4. U18VEP4504 / Professional Values
5. U18VEP5505 / Social Values

CO-PO and CO-PSO Mapping:

CO/PO Mapping														
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S							-	-
CO2									M				-	-
CO3							M						-	-
CO4								S					-	-
CO5											S		-	-
CO6												M	-	-

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment
2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition


Values Through Practical Activities:**1. Essence of Indian Knowledge Tradition:**

Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System
 - Yoga and Holistic Health care - Case studies - Philosophical Tradition -
 Indian Linguistic Tradition - Indian Artistic Tradition.

2. Great Indian Leaders: Ancient rulers - Freedom fighters - Social reformers -Religious and Spiritual leaders - Noble laureates -Scientists – Statesman.

3. Largest Democracy: Socialist -Secular - Democratic and Republic – special features of Indian constitution – Three pillar of Indian democracy - Fundamental rights – Duties of a citizen – centre state relationship.

4. India's Contribution to World peace: Nonaligned Nation – Principle of Pancha Sheela – Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO -Yoga India's gift to the world.


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5. Emerging India: World's largest young work force - Stable Economic development - Labor market & Achievement in space technology – Value based Social structure. Emerging economic superpower.

Workshop mode

REFERENCES

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Www.Scert.Kerala.Gov.In/Images/2014/Hsc.../35_Gandhian_Studies_Unit-01.Pdf
3. Learning To Do: Values For Learning And Working Together - Unesco
Www.Unesdoc.Unesco.Org/Images/0014/001480/148021e.Pdf
4. India After Gandhi.Pdf - Ramachandra Guha - University Of Warwick
Www2.Warwick.Ac.Uk/Fac/Arts/History/Students/Modules/Hi297/.../Week1.Pdf
5. India's Contribution To The Rest Of The World - Yousigma
Www.Yousigma.Com/Interesting_Facts/Indiasgifttotheworld.Pdf
6. India As An Emerging Power - International Studies Association
Web.Isanet.Org/Web/Conferences/.../11353cac-9e9b-434f-A25b-A2b51dc4af78.Pdf



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SEMESTER VII



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U18AEI7201	AIRCRAFT DESIGN	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Conduct trade-off between the conflicting demands of different disciplines by performing a detailed preliminary design of a complete aircraft
- CO2:** Decide mission specific wing loading for the aircraft.
- CO3:** Select appropriate design and dimensional parameters for wing, fuselage and Empennage.
- CO4:** Identify the constraints in a mission and select the power plant for the aircraft.
- CO5:** Estimate the performance parameters and size the control surfaces
- CO6:** Estimate loads on different aircraft components.

Pre-requisites :

1. U18AET6001/ Flight Dynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M			M			S				W	
CO2	S		S						S				S	
CO3			S						S				S	
CO4			S						S				S	
CO5			S						S				S	
CO6			W						S				S	

Course Assessment methods:

Direct
1. Continuous Assessment Test I, II
2. Assignment, Group Project.
3. End Semester Examination
Indirect
1. Course-end survey

CONCEPTUAL AIRCRAFT DESIGN**8 Hours**


Design process, flow chart, survey of various types of airplanes, over-view of design process – Airplane configuration description - Initial Airplane layout – Three view drawings – Take-off weight – Preliminary Estimate – Spread sheet approach.

PRELIMINARY AERODYNAMIC DESIGN**8 Hours**

Selection of wing loading – Arrangement of surfaces, balance diagram – Wing loading effect on take-off, landing, climb, acceleration, range, combat, flight ceiling, and glide rate – Spread sheets.

DESIGN OF WING, FUSELAGE AND TAIL**9 Hours**

Main plane: Airfoil cross-section shape, taper ratio selection, sweep angle selection, wing drag estimation – Spread sheet for wing design. Fuselage: Volume consideration, quantitative shapes, air inlets, wing attachments – Aerodynamic considerations and drag estimation – Spread sheets. Tail arrangements: Horizontal and vertical tail sizing – Tail planform shapes – Airfoil selection type – Tail placement – Spread sheets for tail design



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DESIGN OF PROPULSION SYSTEM**7 Hours**

Propulsion selection, thrust to weight ratio, number of engines, engine rating, turbo-jet engine sizing – Installed thrust corrections, spread sheets – Propeller propulsive systems – Propeller design for cruise, static thrust – Turboprop propulsion – Propeller spread sheets.

PERFORMANCE ESTIMATION**8 Hours**

Take-off phases, minimum take-off specification, climb gradients – Balanced field length – Landing approach – Free roll and braking – Spread sheet for take-off and landing distance – Enhance lift considerations – passive lift enhancement, trailing edge flap configuration – Active lift enhancement Control surface sizing – Aileron sizing, Rudder area sizing.

STRUCTURAL DESIGN**5 Hours**

Estimation of loads on complete aircraft components – Structural design of fuselage, wings – Materials for modern aircraft

REFERENCES

1. Thomas C Corke, 'Design of Aircraft', Pearson Education, Second edition.,2003
2. Snorri Gudmundsson, 'General Aviation Aircraft Design: Applied Methods and Procedures' first edition ,Elsevier, 2013
3. Darrol Stinton D. 'The Design of the Aeroplane', Second Edition, Black Well Science, 2001.
4. Daniel P. Raymer, 'Aircraft Design: A Conceptual Approach', Fifth Edition, AIAA Education Series, 2012.
5. John P Fielding, 'Introduction to Aircraft Design', second edition Cambridge University Press, 2017.
6. Jane's All the World's Aircraft 2010 - 2011 (IHS Jane's All the World's Aircraft) 2010-2011 Edition
7. Mohammad H. Sadraey 'Aircraft Design: A Systems Engineering Approach' 2012 first edition


WEBSITE REFERENCE:

1. <http://www.aircraftdesign.com>
2. <http://airfoiltools.com/>
3. <https://www.airliners.net/>
4. <https://nptel.ac.in/courses/101106035/>

List of Experiments

1. Comparative configuration study of different types of airplanes study on specification and performance details.
2. Comparative graphs preparation and selection of main parameters for the design.
3. Preliminary weight estimation.
4. Design point calculation to find wing loading and Thrust/Power loading
5. Power plant selection, Aerofoil selection, Wing and tail design.
6. Detailed performance calculations and stability estimates.
7. Construction of V-n diagram and Gust envelope.
8. Estimation of loads on wings and fuselage.
9. Design of wings and fuselage components.
10. Preparation of a detailed design report with CAD drawings

Theory: 45	Tutorial: 0	Practical: 30	Project: 0	Total: 75 Hours
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U18AET7002	AVIATION LOGISTICS AND SUPPLY CHAIN MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

Course Outcomes:

After successful completion of this course, the students will be able to

- CO 1: Describe the role of logistics in a market-oriented society.
 CO 2: Explain the objectives, types, drivers, and other important factors of supply chain management.
 CO 3: Discuss the types of airport and demonstrate supply chain management and its relevance to today's global business decision making.
 CO 4: Describe the role of cargo handling agents and cold chain business.
 CO 5: Recognize the role of cargo security, risks involved, trends and technology in aviation logistics.

Pre-requisite(s): -**CO-PO and CO-PSO Mapping:**

COs	Programme Outcomes(POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1											S	M		M
CO2								M	S	S	S	M		M
CO3											S	M		M
CO4											S	M		M
CO5											S	M		M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Assignment; Written & Group Presentation. 3. End Semester Examination
Indirect Assessment
Course exit survey

LOGISTICS AND COMPETITIVE STRATEGY**9 Hours**


Logistics management and Supply Chain management - Definition, Evolution, Importance. The concepts of logistics. Logistics relationships. Functional applications – HR, Marketing, Operations, Finance, IT. Logistics Organization - Logistics in different industries

SUPPLY CHAIN MANAGEMENT**9 Hours**

Supply Chain definition – Objectives – Types – Various definitions – Drivers – Need for SCM – SCM as a profession – SCM decisions and skills – Strategy formulation in SCM – Value in Supply Chain – Tradeoffs – CRM Strategy relationship matrix

AVIATION LOGISTICS AND AIRPORT CONNECTIONS**9 Hours**

Air cargo evolution- the growth of air freight- Globalization- Airport Types- Integrators- Regulations and agreements.

CARGO HANDLING AGENTS AND COOL LOGISTICS**9 Hours**


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History- change factor- Role of general handling agent- Cool chain business- Case study- Changes in trading pattern.

CARGO SECURITY- RISK AND FUTURE

9 Hours

Role of cargo security- Risks - Environmental issues- Innovation and trends in air logistics- Regulation bodies

Theory: 45 Hours	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Aviation Logistics: The Dynamic Partnership of Air Freight and Supply Chain, By Michael Sales, 2016.
2. Logistics & Supply Chain Management, By Martin Christopher, fifth edition, 2015
3. Mohanty R.P, S.G Deshmuki “Supply Chain Management” Biztantra, New Delhi
4. Bowersox, Logistical Management, Mc-Graw Hill, 2000
5. Sahay B S, Supply Chain Management for Global Competitiveness, Macmillan India Ltd., New Delhi.
6. Reguram G, Rangaraj N, Logistics and Supply Chain Management Cases and Concepts, Macmillan India Ltd., New Delhi, 1999.

WEBSITE REFERENCES

1. <http://dgca.nic.in/licencing/syl-ind.htm>
2. <https://www.mro-network.com/supply-chain-logistics/supply-chain-logistics>
3. <http://gmcstream.com/articles-on-aerospace-defense-technology-%7C-gmc-stream/aerospace-logistics-supply-chain-management.html>
4. <https://www.mdpi.com>



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U18AEI7203	AVIONICS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1: Demonstrate the working of simple digital circuits using logic gates.
 CO 2: Create assembly language programs with microprocessor for simple applications.
 CO 3: Demonstrate the integration of avionic systems with data buses.
 CO 4: Explain the working of aircraft communication and navigation systems.
 CO 5: Discuss the autopilot systems in aircraft.
 CO 6: Describe the components and working of aircraft landing systems.

Pre-requisite(s): U18EEI3202 / Aircraft Electrical and Electronics Systems

CO-PO and CO-PSO Mapping:

CO-PO and CO-PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	-	-	-	S	-	-	-	-	-	-	-	M	-
CO 2	-	-	W	-	M	-	-	-	-	-	-	-	M	-
CO 3	M	-	-	-	M	-	-	-	-	-	-	-	W	-
CO 4	M	-	-	-	-	-	-	-	-	-	-	-	W	-
CO 5	-	-	-	-	W	-	-	-	-	-	-	-	-	M
CO 6	M	-	-	-	-	-	-	-	-	-	-	-	W	-

Course Assessment methods

Direct Assessment
1. Internal Tests 2. Assignments 3. Practical Exams 4. End Semester Exam
Indirect Assessment
Course exit survey

Theory Component:

INTRODUCTION TO AVIONICS

5 Hours

Avionics for Civil Aviation, Tactical Avionics, Typical Aircraft Avionics Systems, Avionics System Requirements, Avionics Systems Integration, Digital computers and its electronics, Architecture of Microprocessors.

AIRBORNE AND ONBOARD COMMUNICATIONS

6 Hours

Basics of communication, Frequency Band for Aviation, Radio signals, Modulation, VHF communication, HF communication, SATCOM, ATC communications, SELCAL, Databuses: MIL-STD-1553B, ARINC 429 and 629, Ethernet.

SURVEILLANCE SYSTEMS


3 Hours

Primary Radar, Secondary Radar, Transponder and its modes, TCAS, ADS-B, Weather Radar.

NAVIGATION SYSTEMS

6 Hours

VOR/DME, LORAN, RNAV, Doppler and Inertial Navigation Systems, Satellite Navigation Systems.


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FLIGHT CONTROL AND AUTOPILOT SYSTEMS**6 Hours**

Primary and Secondary Flight controls, Control Systems and Servos, Fly-by-Wire FCS, Autopilot Systems: Height control, Attitude control, Heading control, Airspeed control, Automatic Landing System.

TERRESTRIAL LANDING AIDS**4 Hours**

Instrument Landing System, Microwave Landing System, Radar Altimeter, Ground Proximity Warning Systems.

Lab Component:**List of Experiments/Exercises**

1. Design and implementation of 4-bit adder/subtractor circuit.
2. Design and implementation of 4-to-1 multiplexer circuit.
3. Design and implementation of Encoder and Decoder circuits.
4. Design and implementation of 4-bit shift register with D-flip flops using IC 7474.
5. Assembly language program to add two 8-bit and two 16-bit numbers.
6. Assembly language program to arrange an array of data in ascending and descending order.
7. Demonstration of data transfer with MIL-STD-1553B data bus.
8. Demonstration of data transfer with ARINC 429 data bus.
9. Design and analysis of autopilot systems with MATLAB for flight control.

List of Equipment:

1. Bread board trainer kit
2. 8085 Microcomputer
3. 1553B data bus with interface card
4. ARINC 429 data bus with interface card
5. Desktop computer with MATLAB software installed

Theory: 30 Hours	Tutorial: 0	Practical: 30 Hours	Project: 0	Total: 60 Hours
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REFERENCES

1. Albert Helfrick, 'Principles of Avionics', Ninth Edition, Avionics Communications Inc., 2015.
2. Ramesh S. Gaonkar, 'Microprocessor Architecture, Programming and Applications with the 8085', Sixth Edition, Penram International Publishers, 2013.
3. R. P. G. Collinson, 'Introduction to Avionics Systems', Third Edition, Springer Science, London, 2011.
4. Myron Kayton and Walter R. Fried, 'Avionics Navigation Systems', Second Edition, John Wiley and Sons, 1997.
5. Cary R. Spitzer (Ed.), Uma Ferrell (Ed.) and Thomas Ferrell (Ed.), 'Digital Avionics Handbook', Third Edition, CRC Press, 2014.
6. Cary R. Spitzer, 'Digital Avionics Systems: Principles and Practice', Second Edition, The Blackburn Press, 2001.
7. Ian Moir, Allan Seabridge and Malcolm Jukes, 'Civil Avionics Systems', Second Edition, Wiley, 2013.
8. John H. Blakelock, 'Automatic Control of Aircraft and Missiles', Second Edition, John Wiley and Sons, 1991.
9. Mike Tooley and David Wyatt, 'Aircraft Communications and Navigation Systems: Principles, Maintenance and Operation', Butterworth-Heinemann's Series, 2007.


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1. Advanced Avionics Handbook:
https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/advanced_avionics_handbook/
2. Programs for 8085 Microprocessor Level 2:
<http://scanftree.com/microprocessor/Programs-For-8085-Microprocessor-Trainees>
3. Digital Circuits Tutorial:
https://www.tutorialspoint.com/digital_circuits/digital_arithmetic_circuits.htm



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U18VEP7507	GLOBAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to:

- CO1:** Aware of the concept of Universal Brotherhood and support the organizations which are working for it
- CO2:** Follow the path of Ahimsa in every aspect of their life
- CO3:** Uphold the Universal declaration of Human Rights
- CO4:** Understand the unequal distribution of wealth in the World and bestow their effort towards inclusive growth
- CO5:** Sensitize the environmental degradation and work for the sustainable development
- CO6:** Amalgamate harmony through Non-violence and edify the nation headed for upholding development

Pre-requisites :

1. U18VEP1501 / Personal Values
2. U18VEP2502 / Interpersonal Values
3. U18VEP3503 / Family Values
4. U18VEP4504 / Professional Values
5. U18VEP5505 / Social Values
6. U18VEP6506 / National Values

CO-PO and CO-PSO Mapping:


CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							M						-	-
CO2								S					-	-
CO3									M				-	-
CO4						S							-	-
CO5											M		-	-
CO6												S	-	-

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment
2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values Through Practical Activities:

1. Universal Brotherhood : Meaning of Universal Brotherhood- Functioning of Various organization for Universal human beings -Red Cross, UN Office for Humanitarian Affairs – Case study on humanitarian problems and intervention - Active role of Students/Individual on Universal Brotherhood.


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2. Global Peace, Harmony and Unity : Functions of UNO - Principal Organizations - Special organization – Case study relating to disturbance of world peace and role of UNO – Participatory role of Students/Individual in attaining the Global peace and Unity.

3. Non-Violence : Philosophy of nonviolence- Nonviolence practiced by Mahatma Gandhi – Global recognition for nonviolence - Forms of nonviolence - Case study on the success story of nonviolence– Practicing nonviolence in everyday life.

4. Humanity and Justice: Universal declaration of Human Rights - Broad classification - Relevant Constitutional Provisions– Judicial activism on human rights violation - Case study on Human rights violation– Adherence to human rights by Students/Individuals.

5. Inclusive growth and sustainable development : Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality –Protection of environment – Case study on inequality and environmental degradation and remedial measures.

Workshop mode

REFERENCES

1. Teaching Asia-Pacific Core Values Of Peace And Harmony – Unicef
www.unicef.org/.../Pdf/Teaching%20asia-Pacific%20core%20values.Pdf
2. Three-Dimensional Action For World Prosperity And Peace- Iim Indore -
www.iimdr.ac.in/.../Three-Dimensional-Action-For-World-Prosperity-And-Peace-Glo...
3. My Non-Violence - Mahatma Gandhi
www.mkgandhi.org/Ebks/My_Nonviolence.Pdf
4. Human Rights And The Constitution Of India 8th ... - India Juris
www.indiajuris.com/uploads/.../Pdf/L1410776927qhuman%20rights%20080914.Pdf
5. The Ethics Of Sustainability – Research Gate
www.researchgate.net/File.Postfileloader.html?Id...Assetkey..



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PROFESSIONAL ELECTIVES



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U18AEE0001	EXPERIMENTAL AERODYNAMICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

- CO1:** Explain the measurement systems in fluids
CO2: Utilize wind tunnel balance for aerodynamic measurements.
CO3: Demonstrate flow visualization techniques
CO4: Measure pressure, velocity and temperature of fluid flows.
CO5: Analyze the data using data acquisition system

Pre-requisite(s): U18AEI4201 / Low Speed Aerodynamics

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					M									
CO2	M													M
CO3			S	S									S	
CO4			S	S									S	
CO5				S										

Course Assessment methods

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Seminar 5. End Semester Exam	Course end survey

BASIC MEASUREMENTS IN FLUID MECHANICS**7 hours**


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

CHARACTERISTICS OF MEASUREMENTS**10 hours**

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.

FLOW VISUALIZATION AND ANALOGUE METHODS**9 hours**

Principles of Flow Visualization – Hele-Shaw apparatus – Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph – Hydraulic analogy – Hydraulic jumps – Electrolytic tank.

PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS**9 hours**


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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.

SPECIAL FLOWS AND UNCERTAINTY ANALYSIS | **10 hours**

Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers – Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation – Uses of uncertainty analysis.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Ethirajan Rathakrishnan , “Instrumentation, Measurements, and Experiments in Fluids,” CRC Press – Taylor & Francis, Second Edition, 2018.
2. Justin D. Pereira, ‘Wind Tunnels: Aerodynamics, Models and Experiments’, Nova Science Publishers, 2013.
3. Pope, A., and Goin, L., “High Speed Wind Tunnel Testing”, John Wiley, 1985.
4. Robert B Northrop, “Introduction to Instrumentation and Measurements”, Third Edition, CRC Press, Taylor & Francis, 2017.
5. Rae, W.H. and Pope, A., ‘Low Speed Wind Tunnel Testing’, Third Edition, Wiley India Pvt Ltd, 2010.
6. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01 April 1998
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2. [https://nptel.ac.in/courses/101106040/Experimental Gas/Aerodynamics](https://nptel.ac.in/courses/101106040/Experimental%20Gas/Aerodynamics)
3. <https://engineering.purdue.edu/AAE/academics/course-descriptions/AAE520>
4. <https://ame.nd.edu/undergrad-programs/courses/ame-30333-aerodynamics-laboratory>
5. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-100-aerodynamics-fall-2005/>



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U18AEE0002	VISCOUS FLOW THEORY	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

- CO1: Interpret ideal and Real fluid flows on boundary layer perspective.
 CO2: Examine laminar incompressible and compressible viscous flows.
 CO3: Summarize transition phenomenon in incompressible and compressible flows
 CO4: Apply the statistical mechanics to predict the turbulent flow behavior

Pre-requisite(s): U18AET5001 / High Speed Aerodynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	S				W					S		S	
CO 2	S	S				W					S		S	
CO 3	S	S				W					S		S	
CO 4	S	S				W					S		S	

Course Assessment Methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment/Seminar/Project 5. End Semester Exam	Course end survey

INTRODUCTION**10 Hours**


Real and ideal fluids, Boundary layer concept, Boundary layer on an airfoil, Boundary layer separation, Derivation of the Equations of Motion: Review of Cartesian tensor notation – Review of thermodynamics – Heat transfer – Derivation of the full compressible viscous Newtonian equations – Conservation of mass, momentum, energy – Vorticity and entropy equations – Kelvin's theorem – Introduction to Non-Newtonian fluids.

LAMINAR INCOMPRESSIBLE VISCOUS FLOW**10 Hours**

Exact solutions: stagnation point flow, Jeffrey-Hamel flow, Stokes problems – Low Reynolds number flow – Introduction to perturbation theory – Boundary layer theory – Effects of pressure gradient and curvature – Boundary layer integral equations – Thwaites method – Laminar separation, separation bubbles.

LAMINAR COMPRESSIBLE VISCOUS FLOW**8 Hours**

Exact solutions: compressible Couette flow, flow through a shock wave – Compressible boundary layers – Introduction to shock-boundary layer interaction and hypersonic effects: dissociation, heating, and non-equilibrium thermodynamics.

TRANSITION TO TURBULENCE**7 Hours**


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Linear transition theory – Introduction to nonlinear theory and numerical methods – Introduction to experimental results in bounded and free shear flows, both incompressible and compressible – Effects of roughness, turbulence, vibration, noise, curvature, etc – Transition-separation interactions in boundary layers.

TURBULENT FLOW

10 Hours

Introduction to Turbulent Flow: Reynolds averaged equations of motion – Introduction to statistics and correlations – Kolmogorov scale – 5/3 law for inertial range self-similarity – Law of the wall in the turbulent boundary layer – Introduction to experimental results for various fundamental turbulent flows – Bluff bodies, internal flows, free shear flows – Introduction to far field self-similarity theories – Introduction to compressible-boundary layer flow.

Theory: 45 Hrs	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hrs
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1. Frank M. White, 'Viscous Fluid Flow', Third Edition, Tata McGraw Hill Pvt Ltd., New Delhi, 2011.
2. H.Schlichting and K.Gersten, 'Boundary Layer Theory', Ninth Edition, Springer, 2017.
3. Richard Courant and Kurt Otto Friedrichs, 'Supersonic Flow and Shock Waves', Springer Science and Business Media, 1976.
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6. Carl M. Bender and Steven A. Orszag, 'Advanced Mathematical Methods for Scientists and Engineers I: Asymptotic Methods and Perturbation Theory', Springer-Verlag, New York, 2013.
7. Rutherford Aris, 'Vectors, Tensors and the Basic Equations of Fluid Mechanics', Dover Publications, 2012.

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1. <https://ocw.mit.edu/courses/mechanical-engineering/2-25-advanced-fluid-mechanics-fall-2013/equations-of-viscous-flow/>
2. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-13-aerodynamics-of-viscous-fluids-fall-2003/>
3. https://nptel.ac.in/courses/Webcourse-contents/Iit-Kanpur/Fluid Mechanics/Ui/Course_Home-8.Htm


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U18AEE0003	HYPERSONIC AERODYNAMICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

CO1: Explain shock wave and expansion wave relations of inviscid hypersonic flows

CO2: Explain the solution methods for hypersonic inviscid flows

CO3: Analyze the hypersonic boundary layers

CO4: Explain the viscous interaction in hypersonic flows

CO5: Analyze chemical and temperature effects in hypersonic flow

Pre-requisite(s): U18AET5001/ High Speed Aerodynamics

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					M									
CO2	M													M
CO3			S	S									S	
CO4			S	S									S	
CO5				S										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Seminar 5. End Semester Exam	Course end survey

FUNDAMENTALS OF HYPERSONIC AERODYNAMICS 9 Hours

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.


SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS 9 Hours

Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.

VISCOUS HYPERSONIC FLOW THEORY 9 Hours

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self-similar boundary layers – solution methods for non self-similar boundary layers – aerodynamic heating and its adverse effects on airframe.

VISCOUS INTERACTIONS IN HYPERSONIC FLOWS 9 Hours


 Signature of BOS chairman, AE

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

HIGH TEMPERATURE EFFECTS in HYPERSONIC FLOWS 9 Hours

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb’s free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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1. John D. Anderson, Jr, ‘Hypersonic and High Temperature Gas Dynamics’, Second Edition, AIAA Education Series, 2006.
2. John D. Anderson., ‘Modern Compressible Flow’, Third Edition, Tata McGraw-Hill, New Delhi, 2012.
3. John D Anderson, Jr., ‘Fundamentals of Aerodynamics’, Chapter 14, Sixth Edition, McGraw-Hill Education, 2016.
4. Vinh, N.X, A. Busemann, and R. D Culp, ‘Hypersonic and Planetary Entry Flight Mechanics’, University of Michigan Press, Ann Arbor, 1980.
5. Hayes, W.D, and R.F Probst, ‘Hypersonic Flow Theory’, Second Edition, Academic Press, New York, 1966.

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1. <https://nptel.ac.in/courses/101103003/> hypersonic aerodynamics
2. <https://www.grc.nasa.gov/www/BGH/index.html>
3. https://www.aem.umn.edu/teaching/curriculum/syllabi/Grad/AEM_5245_syllabus.shtml
4. <https://web.stanford.edu/~jurzay/ME356/> Hypersonic Aerothermodynamics
5. <https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-885j-aircraft-systems-engineering-fall-2005/video-lectures/lecture-7/>



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U18AEE0004	CRYOGENIC ENGINEERING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Apply classical thermodynamics principles to various cryogenics systems.

CO2: Solve unique problems of heat transfer in cryogenic applications.

CO3: Explain about thermo-physical properties of cryogenic system.

CO4: Identify typical cryogenic insulation system for space propulsion.

CO5: Illustrate general safety principles to various cryogenics systems.

Pre-requisites :

1. U18AEI3202 /Engineering Thermodynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												M	
CO2		S											M	
CO3		S											W	
CO4		S											M	
CO5	S				M								M	

Course Assessment methods

Direct
1.Continuous Assessment Test I, II
2.Assignment, Group Presentation
3.End Semester Examination
Indirect
1. Course-end survey

BASIC PRINCIPLES

8 Hours

Introduction to Cryogenics and superconductivity – Applications of Cryogenics – Common Cryogens and their properties – Cryogenic rockets – Thermodynamic analysis of low-temperature systems – Basic principles of low temperature heat transfer, Cryogenic liquefaction process.

CRYOGENIC HEAT TRANSFER


10 Hours

Basic modes of heat transfer: Conduction, Convection and Radiation in cryogenic systems in steady and unsteady conditions – Temperature dependent thermal conductivity, Boiling and two phase flow, Pool and film boiling of cryogenic fluids – Thermal contact resistance: Unique problems of heat transfer in cryogenic applications.

THERMO-PHYSICAL PROPERTIES OF CRYOGENIC SYSTEM

10 Hours

PVT behavior of a pure substance – Mechanical properties of materials used in cryogenic systems –Transport properties of solids – thermal properties, emissivity, absorptivity and reflectivity, electrical properties and superconductivity – Prediction of thermodynamic properties, ultra-low temperature refrigerators, Cryocoolers.


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CRYO INSULATION AND DEVICES**10 Hours**

Storage vessel, thermal shields and insulation, effect of size and shape of storage vessel on heat in-leak, vapour shielding, vacuum insulation, evacuated porous insulation, solid foams, multilayer insulation, composite insulation, critical radius of insulation – Micro-sphere insulation, typical insulation systems for space propulsion, aerogel beds, light density Mylar, comparison of insulations.

Cryogenic Instrumentation: Strain, displacement and position, pressure, flow, liquid level, density and temperature for cryogenic applications.

Cryogenic Equipments: Introduction of Compressors, pumps, expansion engines, valves, and heat exchangers for cryogenic applications.

SAFETY WITH CRYOGENIC SYSTEMS**7 Hours**

Introduction – Physiological hazards, explosions and flammability, excessive pressure gas, suitability of materials and construction techniques, safety considerations for liquid hydrogen and liquid oxygen – General safety principles.


Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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BOOK REFERENCES

1. Thomas M. Flynn, 'Cryogenic Engineering', Second Edition, CRC Press, Taylor and Francis Inc., 2009.
2. Barron, R., 'Cryogenic Systems', Second Edition, Oxford University Press, New York, 1985.
3. Barron, R.F, 'Cryogenic Heat Transfer', Philadelphia, PA: Taylor and Francis Publishers, second edition, 2016.
4. Augustynowicz, S.D. and Fesmire, J.E., "Cryogenic Insulation System for Soft Vacuum", Advances on Cryogenic Engineering, Vol. 45, Kluwer Academic / Plenum Publishers, pp. 1691-1698, 2000.
5. Mamata Mukhopadhyay, 'Fundamentals of Cryogenic Engineering', Prentice Hall India Pvt. Ltd., New Delhi, 2010.

WEBSITE REFERENCE

1. <https://trc.nist.gov/cryogenics/>
2. https://cryogenicsociety.org/resources/cryogenic_references/
3. <https://cryo.gsfc.nasa.gov/Biblio/AdvCryoEnr.html>
4. <https://nptel.ac.in/downloads/112101004/>
5. <https://www.docsity.com/en/cryogenic-engineering-2/4110192/>
6. <https://web.uvic.ca/calendar2018-09/CDs/MECH/445.html>



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U18AEE0005	PRINCIPLES OF COMBUSTION	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Apply the basic thermodynamics concepts to various engineering systems.

CO2: Calculate adiabatic flame temperatures of multi-component gas mixtures.

CO3: Identify the types of chemical reaction takes place during combustion process.

CO4: Estimate the flame speed and flame structure using classical laminar flame theories.

CO5: Describe about Gaseous Jet diffusion flame.

Pre-requisites :

1.U18AEI3202 / Engineering Thermodynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S											M	
CO2		S											S	
CO3		S											M	
CO4	M												M	
CO5		M											M	

Course Assessment methods

Direct
1.Continuous Assessment Test I, II 2.Assignment 3. End Semester Examination.
Indirect
1. Course-end survey

INTRODUCTION

4 Hours

Introduction to combustion, Applications of combustion, Types of fuel and oxidizers, Characterization of fuel, Various combustion mode, Scope of combustion.

THERMODYNAMICS OF COMBUSTION

7 Hours

Thermodynamics properties, Laws of thermodynamics, Stoichiometry, Thermochemistry, adiabatic temperature, chemical equilibrium.

CHEMISTRY OF COMBUSTION

7 Hours

Basic Reaction Kinetics, Elementary reactions, Chain reactions, Multistep reactions, simplification of reaction mechanism, Global kinetics.


PHYSICS OF COMBUSTION

7 Hours

Fundamental laws of transport phenomena, Conservations Equations, Transport in Turbulent Flow.

PREMIXED FLAME

10 Hours


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One dimensional combustion wave, Laminar premixed flame, Burning velocity measurement methods, Effects of chemical and physical variables on Burning Velocity, Flame extinction, Ignition, Flame stabilizations, Turbulent Premixed flame.

DIFFUSION FLAME

10 Hours

Gaseous Jet diffusion flame, Liquid fuel combustion, Atomization, Spray Combustion, Solid fuel combustion.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45Hours
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BOOK REFERENCES

1. Kenneth Kuan-yun Kuo, 'Principles of Combustion', Second Edition revised, ISBN: 978-0-471- 04689-9, January 2005.
2. D. P. Mishra, Fundamentals of Combustion, first edition revised, Prentice Hall of India, New Delhi, 2008.
3. Strehlow R A., "Combustion fundamentals" Krieger Pub Co; Reprint edition (1) 1993.
4. John Heywood "Internal Combustion Engine Fundamentals "McGraw-Hill Education; 1 edition, 1988.

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1. <https://nptel.ac.in/courses/101106037/>
2. <https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/>
3. <http://www.forbrf.lth.se/english/education/courses/fundamental-combustion/>
4. [https://www.journals.elsevier.com/combustion-and-flame.](https://www.journals.elsevier.com/combustion-and-flame)
5. <http://www.combustioninstitute-indiansection.com/>



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U18AEE0006	HEAT AND MASS TRANSFER	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO 1:** Apply steady state heat conduction problems for composite systems and fins.
CO 2: Solve transient heat conduction problems.
CO 3: Solve problems in natural and forced convection for internal and external flows.
CO 4: Calculate the effectiveness of heat exchanger using LMTD and NTU methods.
CO 5: Illustrate radiation shape factors for various geometries.
CO 6: Explain the phenomenon of diffusion and convective mass transfer.

Pre-requisites :

1. U18AEI3202 - Engineering Thermodynamics

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	M
CO2	M	S												
CO3			M										M	
CO4	S		M											
CO5		M											M	
CO6		M											M	

Course Assessment Methods

Direct
1. Continuous Assessment Test I, II (Theory component). 2. Assignment (Theory component). 3. End Semester Examination (Theory component).
Indirect
1. Course-end survey

CONDUCTION**9 Hours**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – Fourier Law of Conduction - General Differential Conduction equation in Cartesian and Cylindrical Coordinate systems – One Dimensional Steady State Heat Conduction through Plane Wall, Cylindrical and Spherical systems – Composite Systems – Critical thickness of insulation - Conduction with Internal Heat Generation – Extended Surfaces – Numerical Methods of One dimensional Heat conduction- Unsteady Heat Conduction – Lumped Analysis, Infinite and semi Infinite solids using Heislers Chart.

CONVECTION**9 Hours**

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar, Turbulent and Combined flows – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical, Horizontal and Inclined Plates, Cylinders and Spheres.


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PHASE CHANGE AND HEAT EXCHANGERS**9 Hours**

Nusselts theory of condensation - Regimes in boiling - Correlations in condensation and boiling - Types of Heat Exchangers- compact heat exchanger – Overall Heat Transfer Coefficient – Fouling Factors - LMTD and Effectiveness – NTU methods of Heat Exchanger Analysis.

RADIATION**9 Hours**

Basic Concepts, Laws of Radiation – Black Body Radiation – Grey body radiation – radiation shield - Shape Factor Algebra (Plates, parallel, perpendicular, parallel circular disc) – Gas radiations (qualitative study).

MASS TRANSFER**9 Hours**

Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45Hours
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REFERENCES

1. Holman J.P, “Heat Transfer” Tata Mc Graw Hill,2007.
2. Yunus Cengel, “Heat and Mass Transfer”, Tata McGraw Hill,2008.
3. Ozisik M.N, “Heat Transfer”, McGraw-Hill Book Co,2001.
4. Nag P.K, “Heat Transfer”, Tata McGraw-Hill, New Delhi, 2002.
5. Eckert, E.R.G, ‘Heat and mass transfer “ Mc Graw hill, 1959.
6. Frank P. Incropera and David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, March 2006.
7. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International,2008.

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2. <https://www.coursera.org/>
3. <https://ocw.mit.edu/courses>
4. <http://nptel.ac.in/courses/>
5. www.mechanicalbooster.com
6. [heat transfer.asmedigitalcollection.asme.org](http://heattransfer.asmedigitalcollection.asme.org)
7. hyperphysics.phy-astr.gsu.edu



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U18AEE0007	COMPOSITE MATERIALS AND STRUCTURES	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO1:** Identify the properties of fiber and matrix materials used in commercial composite materials.
- CO2:** Determine the material properties of composites.
- CO3:** Apply the conventional failure theories to composite materials.
- CO4:** Design a laminate for a given load condition.
- CO5:** Identify the most appropriate manufacturing process for fabricating composite components based on its requirement.

Pre-requisites : -**CO-PO and CO-PSO Mapping:**

COs	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M											M	
CO2		S											M	
CO3			S										M	
CO4	S												M	
CO5			M										M	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II. 2. Journal paper review, Assignment, Group Presentation 3. End Semester Examination.
Indirect
1. Course-end survey

Theory Component contents**STRESS-STRAIN RELATION****6 Hours**

Introduction – Advantages, disadvantages and application of composite materials, reinforcements and matrices – Generalised Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

METHODS OF ANALYSIS**12 Hours**


Micromechanics – Mechanics of materials approach, Elasticity approach to determine material properties – Macro mechanics – Stress-Strain relations with respect to natural axis and arbitrary axis – Experimental characterization of lamina.

LAMINATED PLATES**10 Hours**

Governing differential equation for a general laminate, symmetric, balanced, angle ply and cross ply laminates – Failure theory for composites.

SANDWICH CONSTRUCTIONS**10 Hours**

Basic design concepts of sandwich construction – Materials used for sandwich construction – Failure modes of sandwich panels – Flexural rigidity of Sandwich beams and plates.



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FABRICATION PROCESS**7 Hours**

Various open and closed mould processes – Manufacture of fibres – Types of resins and properties and applications – Netting analysis – Environmental effects on composites.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0
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Total: 45 Hours

REFERENCES

1. Autar K. Kaw, 'Mechanics of Composite Materials', Second Edition, First Indian Reprint, CRC Press, 2009.
2. Jones, R.M., 'Mechanics of Composite Materials', McGraw-Hill, Kogakusha Ltd., Tokyo, 1999.
3. Lalit Gupta, 'Advanced Composite Materials', Revised Edition, Fourth Reprint, Himalayan Books, 2007.
4. Alan Baker, Stuart Dutton, and Donald Kelly, 'Composite Materials for Aircraft Structures', Second Edition, AIAA, 2004.
5. Krishan K. Chawla, 'Composite Materials: Science and Engineering', Third Edition, Springer, 2013.
6. Ever J. Barbero, "Introduction to Composite Materials Design", CRC Press, Second Edition 2010.

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1. <https://nptel.ac.in/courses/101104010/>
2. <http://www.ae.iitkgp.ac.in/ebooks/chapter1.html>
3. https://www.youtube.com/watch?v=0kB0G6WKhKE&list=PLSGws_74K01-bdEEUElQ9-obrujIKGEhg



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U18AEE0008	THEORY OF ELASTICITY	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1: Apply the equations compatibility conditions and equations of equilibrium for stress and strain.
- CO 2: Solve the elasticity problems using Airy stress function expressed as biharmonic function.
- CO 3: Solve plane strain and plane stress problems in Cartesian and polar coordinates.
- CO 4: Analyze the torsional problems in non-circular cross sections.

Pre-requisites :

1.U18AEI5202/ Aircraft Structures-II

CO-PO and CO-PSO Mapping:

CO/PO and CO/PSO Mapping:														
	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs) and PSOs													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M											M	
CO2		M											M	
CO3		S											M	
CO4		S											M	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II.
2. Assignment, Group Presentation
3. End Semester Examination.
Indirect
1. Course-end survey

Theory Component contents**ASSUMPTIONS IN ELASTICITY****7 Hours**


Definitions – Notations and sign conventions for stress and strain Strain-displacement relations – Stress-strain relations – Lamé's constant – cubical dilation – Compressibility of material – Bulk modulus – Shear modulus- Equations of equilibrium.

BASIC EQUATIONS OF ELASTICITY**10 Hours**

Compatibility equations for stresses and strains - Principal stresses and principal strains – Mohr's circle – Saint Venant's principle.

PLANE STRESS AND PLANE STRAIN PROBLEMS**10 Hours**

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

POLAR COORDINATES**10 Hours**


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Equations of equilibrium – Strain displacement relations – Stress-strain relations – Airy's stress function – Axisymmetric problems – Kirsch-Michell's and Boussinasque problems.

TORSION

8 Hours

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.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Timoshenko, S. P., and Goodier, J. N., 'Theory of Elasticity', Third Edition, McGraw-Hill Ltd., Tokyo, 1970.
2. Enrico Volterra and J.H. Caines, 'Advanced Strength of Materials', Prentice Hall New Jersey, 1991.
3. Wang, C.T., 'Applied Elasticity', McGraw-Hill Co., New York, 1993.
4. Sokolnikoff, I.S., 'Mathematical Theory of Elasticity', McGraw-Hill, New York, 1978.
5. P.N Chandramouli., 'Theory of Elasticity', Yes Dee Publishing, 2017.

WEBSITE REFERENCES

- 1 https://onlinecourses.nptel.ac.in/noc18_ce18/unit?unit=5&lesson=19
- 2 <http://micro.stanford.edu/~caiwei/me340/>
3. <https://www.youtube.com/watch?v=eICv1p8WjgI&list=PLbRMhDVUMngcbhsZgRWuYCi2kKQwQ0Av1>



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U18AEE0009	FATIGUE AND FRACTURE MECHANICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

CO1: Interpret the results from stress – strain behavior of the materials under fatigue load.

CO2: Explain the physical phases in a fatigue life of a component.

CO3: Identify different Fracture Mechanics involved in the propagation of cracks during fracture in a material.

CO4: Infer the details from variable amplitude fatigue loadings using simple counting techniques.

CO5: Explain the fatigue based design philosophies and classify the materials based on their fatigue life.

Pre-requisite(s):

U18AEI3203 - Mechanics of Solids

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		M											S	
CO 2		S											M	
CO 3		M											M	
CO 4	S												S	
CO 5		M											S	

Course Assessment Methods:

Direct
1. Continuous Assessment Test I, II 2. Assignment; Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

FATIGUE OF STRUCTURES – STRESS LIFE**7 Hours**

S.N. curves – Endurance limits – Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams –Modifying Factors of Fatigue life.


FATIGUE OF STRUCTURES – STRAIN LIFE**7 Hours**

Monotonic Stress-Strain Behavior – Cyclic Stress-strain Behavior – Transient Behavior – Strain-Life Curve – Mean stress effects.

PHYSICAL ASPECTS OF FATIGUE**6 Hours**

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

FRACTURE MECHANICS**10 Hours**


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Introduction – LEFM (Linear Elastic Fracture Mechanics) & EPFM (Elastic Plastic Fracture Mechanics) – Potential energy and surface energy – Griffith’s theory – Irwin-Orwin extension of Griffith’s theory to ductile materials.

VARIABLE AMPLITUDE LOADING

7 Hours

Linear and Nonlinear damage theories – Cycle counting Techniques-Level crossing Counting, Peak Counting, Rain flow Counting.

FATIGUE DESIGN AND TESTING

8 Hours

Fatigue Design philosophies –Importance of Fracture Mechanics in aerospace structures.

Theory: 45	Tutorial: 15	Practical: 0	Project: 0	Total: 60 Periods
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REFERENCES

1. Julie A. Bannantine, “Fundamentals of Metal Fatigue Analysis” 1st Edition, Pearson Education (US), 1990.
2. R. W. Hertzberg, “Deformation and Fracture Mechanics of Engineering Materials”, John Wiley and Sons, 1996.
3. C. R. Brooks and A. Choudhury, “Failure Analysis of Engineering Materials”, McGraw-Hill, 2002.
4. Barrois W and Ripely, E.L., “Fatigue of Aircraft Structure”, Pergamon Press, 1983.
5. R. J. Sanford., “Principles of Fracture Mechanics”, Pearson Education (US),2003.

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1. <https://ocw.mit.edu/courses/materials-science-and-engineering/3-35-fracture-and-fatigue-fall-2003/lecture-notes/>
2. <https://www.cranfield.ac.uk/courses/short/aerospace/introduction-to-fatigue-and-fracture-analysis>
3. <https://online-learning.tudelft.nl/courses/fatigue-of-structures-and-materials/>
4. <https://nptel.ac.in/courses/112106065/>



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U18AEE0010	EXPERIMENTAL STRESS ANALYSIS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Identify the parameters that control the behavior and response of a measurement system.
- CO2:** Measure the change in length of the solid materials using suitable extensometers.
- CO3:** Analyze the strain gauge data under various loading condition by using gauge rosette method.
- CO4:** Apply experimental techniques of stress analysis using photo elasticity and strain gauges.
- CO5:** Identify the location and size of defect in structural materials using NDT

Pre-requisites :

- 1.U18AEI5202/ Aircraft Structures-II

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													CO/PSO Mapping	
COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S											M	
CO2		S		M									S	
CO3		S		M									S	
CO4		S		M									M	
CO5		S		M	M								M	

Course Assessment Methods:

Direct
1.Continuous Assessment Test I, II 2. Assignment, Group Presentation, 3.End Semester Examination
Indirect
1. Course-end survey

MEASUREMENTS

5 Hours

Principles of measurements – Accuracy – Sensitivity and range of measurements.

EXTENSOMETERS

10 Hours

Mechanical – Optical – Acoustical – Electrical extensometers and their uses –Advantages and disadvantages.


STRAIN GAUGES

12 Hours

Strain Measurements: Introduction – Properties of Strain gauge Systems – Types of Strain gauges.

Electrical Resistance Strain Gauge: Introduction – Strain Sensitivity in Alloys – Strain gauge Adhesives – Gauge sensitivity and gauge factor.

Strain Gauge Circuit: Potentiometer and its Application – Wheatstone bridge – Bridge Sensitivity – Null Balance Bridges.


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Analysis of Strain Gauge Data: Two gauge rosette – Rectangular rosette – Delta Rosette, Stress Gage – Plane Shear gage.

PHOTOELASTICITY

10 Hours

Optics related to photo elasticity – Ordinary light – Monochromatic light – Polarized light – Natural and artificial Birefringence – Stress optic law in two dimensions at normal incidence – Material fringe value in terms of stress function – Polariscopes – Plane polariscopes – Circular polariscopes – Effect of stressed model in plane polariscopes – Effect of stressed model in circular polariscopes.

NON-DESTRUCTIVE TESTING (NDT)

8 Hours

Fundamentals of NDT – Radiography – Ultrasonic testing – Magnetic Particle Inspection – Dye Penetrant Technique – Eddy Current Testing – Acoustic Emission Technique – Fundamentals of brittle coating methods – Introduction to Moiré Fringe technique – Holography – Thermography – Fibre optic sensors.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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BOOK REFERENCES

1. Dr. Sadhu Singh, 'Experimental Stress Analysis', Khanna Publications, 2009.
2. Dally, J.W., and Riley, W.F., 'Experimental Stress Analysis', College House Enterprises, New York, Fourth Edition, 2005.
3. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G. Pant B. and Ramachandra, K., 'Experimental Stress Analysis', Tata McGraw-Hill, New Delhi, 1984.
4. J. Srinivas, 'Stress Analysis and Experimental Techniques: An Introduction', Alpha Science International Ltd, 2012.

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1. <http://www.nptelvideos.in/2012/12/experimental-stress-analysis.html>
2. <https://www.sanfoundry.com/best-reference-books-stress-analysis/>
3. <https://nptel.ac.in/courses/112106068/>
4. <https://nptel.ac.in/courses/112106198/>


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U18AEE0011	SPACE MECHANICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO1:** Apply the concepts of orbital mechanics to find the trajectory/orbit of a space vehicle or a satellite.
- CO2:** Discuss the perturbation of satellite orbits and its mathematical background.
- CO3:** Calculate the delta-v required for transferring a spacecraft from one orbit to another.
- CO4:** Design an approximate trajectory for interplanetary and lunar spacecraft.
- CO5:** Apply the concepts of orbital mechanics to free flight phase of ballistic missiles.

Pre-requisite(s): -

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
Cos	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO 1	S	-	-	-	-	-	-	-	-	-	-	-	S	-
CO 2	-	M	-	-	-	-	-	-	-	-	-	-	M	-
CO 3	S	-	-	-	-	-	-	-	-	-	-	-	M	-
CO 4	S	M	-	-	-	-	-	-	-	-	-	-	S	-
CO 5	S	-	-	-	-	-	-	-	-	-	-	-	W	-

Course Assessment methods

Direct Assessment
1. Internal Tests
2. Assignments
3. End Semester Exam
Indirect Assessment
Course exit survey

INTRODUCTION

6 Hours

Celestial sphere, Ecliptic, Right ascension and Declination, Vernal equinox, Solar time and Sidereal time, Kepler's laws of planetary motion, Keplerian Orbital elements.

TWO-BODY PROBLEM AND ORBIT PERTURBATIONS

12 Hours

Two-body problem, Orbit equation, Orbital velocity and Orbital energy, Kepler's equation and Time of flight, Orbit perturbations, Special and General Perturbation methods.

ORBITAL MANEUVERS


9 Hours

Orbit transfer, In-plane orbit changes, Hohmann transfer, Bi-elliptic transfer, Out-of-plane orbit changes, Delta-v requirement and propellant mass for maneuvers.

INTERPLANETARY AND LUNAR TRAJECTORIES

9 Hours

Sphere of Influence, Patched conic approximation with simplified example, Realistic interplanetary mission, Locating the planets, Design of departure and arrival trajectories, Gravity-assist maneuvers, Design of departure and arrival lunar trajectories.


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APPLICATION OF ORBITAL MECHANICS TO BALLISTIC MISSILES

9 Hours

General ballistic missile problem, Geometry of ballistic missile trajectory, Free flight range, Flight-path angle, Maximum range trajectory, Time of free flight, Effect of launching errors, Influence coefficients, Effect of earth rotation.

Theory: 45 Hours	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Charles D. Brown, 'Elements of Spacecraft Design', First Edition, AIAA Education Series, 2002.
2. Roger R. Bate, Donald D. Mueller, and Jerry E. White, 'Fundamentals of Astrodynamics', Dover Publications Inc., 1971.
3. Vladimir A. Chobotov, 'Orbital Mechanics', Third Edition, AIAA Education Series, 2002.
4. Howard D. Curtis, 'Orbital Mechanics for Engineering Students', Third Edition (Revised), Butterworth-Heinemann, 2013.
5. David A. Vallado and James Wertz (Ed.), 'Fundamentals of Astrodynamics and Applications', Fourth Edition, Microcosm Press, 2013.

WEBSITE

1. Online Lecture notes on An Introduction to Solar System Astronomy - Unit 4: The Physics of Astronomy:
<http://www.astronomy.ohio-state.edu/~pogge/Ast161/Unit4/index.html>
2. Hohmann transfer:
<http://web.mit.edu/12.000/www/finalpresentation/traj/hohman.html>
3. Orbital Mechanics with Example problems:
<http://www.braeunig.us/space/orbmech.htm>



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U18AEE0012	NON-DESTRUCTIVE TESTING	L	T	J	P	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

- CO 1: Identify various methods of Non-destructive testing (NDT) to test the material integrity used in engineering application.
- CO 2: Apply different NDT processes in aerospace industry.
- CO 3: Utilize Thermal inspection, Optical holography NDT methods for aerospace applications.
- CO 4: Distinguish various defect types and select the appropriate NDT methods for better evaluation.

Pre-requisite(s): U18AEI3203/ Mechanics of Solids

CO-PO and CO-PSO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		S											S	
CO 2	M			S	M								M	
CO 3					S								S	
CO 4		S											S	

Course Assessment Methods:

Direct
1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination
Indirect
1. Course-end survey

INTRODUCTION TO NDT

6 Hours

Importance of NDT in quality assurance – Different types of nondestructive techniques to obtain information regarding size, location and orientation of damage or cracks – Visual inspection techniques and coin tapping technique for composite structures and adhesive bonds.

RADIOGRAPHIC INSPECTION


9 Hours

X-ray radiography: Principles of X-ray radiography, equipment – Production of X-rays, Absorption, scattering, X-ray film processing – Industrial radiographic practice, micro-radiography, Gamma ray radiography: Radioactivity, gamma ray sources, film radiography, application, examples – General radiographic procedures – Reading and Interpretation of Radiographs – Defects in welding.

ULTRASONICS

8 Hours

Principle of wave propagation – Ultrasonic equipment – Variables affecting an ultrasound test – Pulse echo technique, pitch-catch technique, through transmission technique, A-scan, B-Scan, C-scan – Determination of elastic constants using Ultrasonic velocity.


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LIQUID PENETRANT TEST**12 Hours**

Basic concept – Test equipment – Test Parameters and Procedure – Safety precautions.

MAGNETIC PARTICLE TEST: Methods of generating magnetic field – Demagnetization of materials – Magnetic particle test: Principles, Test Equipment and Procedure – Interpretation and evaluation.**EDDY CURRENT TEST:** Principles of eddy current – Factors affecting eddy currents – Test system and test arrangement – Standardization and calibration – Application and effectiveness.**OTHER METHODS****10 Hours**

Thermal Inspection: Principles, equipment, inspection methods, applications – Optical Holography: Principles and Applications, Holographic recording interferometer techniques of inspection – Acoustic Emission Inspection: Sources of acoustic emission in composites, Peak amplitude, Rise time during events, Ring-down counts duration of events.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. J Prasad and C G Krishnadas Nair, “Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Publishing Co. Ltd., 2008.
2. P. E. Mix, “Introduction to Non-Destructive Testing”, John Wiley and Sons, 2005.
3. Bray, Don E. and Don McBride, “Nondestructive Testing Techniques”, Chapter 11 (Ultrasonic Testing of Aerospace Materials), John Wiley and Sons, New York, 1992.
4. Baldev Raj, T. Jayakumar, and M. Thavasimuthu, “Nondestructive Testing”, Narosa Publishing House, 1997.
5. C. Hellier, “Handbook of Nondestructive Evaluation”, McGraw-Hill, 1994.

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1. <https://nptel.ac.in/courses/113106070/>
2. <https://www.ndt.net/article/ecndt98/aero/031/031.htm>
3. <https://inspectioneering.com/tag/nondestructive+testing>
4. <http://www.modalshop.com/ndt/Comparison-of-Non-Destructive-Methods%3FID%3D256>
5. <https://www.sgs.com/en/industrial-manufacturing/services-related-to-production-and-products/materials-testing/non-destructive-testing-ndt>



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U18AEE0013	AIRCRAFT MAINTENANCE PRACTICES	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students will be able to

- CO 1:** Identify and maintain the equipment used in welding shop.
- CO 2:** Apply the Inspection and Maintenance procedures for sheet metal, plastics and composite components.
- CO 3:** Apply the Inspection and Maintenance procedures for various aircraft systems.
- CO 4:** Identify the levels of maintenance including overhaul and extent of intervention and critical operations.
- CO 5:** Apply methods of storage and handling of materials in shop floor.
- CO 6:** Identify various trouble shooting processes available in aircraft industry.

Pre-requisite(s):**CO-PO and CO-PSO Mapping:**

COs	Programme Outcomes(POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M												W	
CO2	M												W	
CO3		S											W	
CO4		M											M	
CO5	S												S	
CO6	S												S	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Assignment; Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

WELDING IN AIRCRAFT STRUCTURAL COMPONENTS**4 Hours**

Equipment used in welding shop and their maintenance – Ensuring quality welds – Welding jigs and fixtures – Soldering and brazing.


SHEET METAL REPAIR AND MAINTENANCE**5 Hours**

Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – Nondestructive Testing – Riveted repair design, Damage investigation – Reverse technology.

PLASTICS AND COMPOSITES IN AIRCRAFT**9 Hours**

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.

AIRCRAFT JACKING, ASSEMBLY AND RIGGING**9 Hours**


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Airplane jacking and weighing and Center of Gravity location – Balancing of control surfaces – Inspection and maintenance – Helicopter flight controls – Tracking and balancing of main rotor.

REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM

9 Hours

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

9 Hours

Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs). **SAFETY PRACTICES:** Hazardous materials storage and handling – Aircraft furnishing practices – Equipment – Troubleshooting – Theory and practices.

Theory: 45

Tutorial: 0

Practical: 0

Project: 0

Total: 45 Hours

REFERENCES

1. Kroes, Watkins and Delp, 'Aircraft Maintenance and Repair', McGraw-Hill, New York, 1992.
2. Larry Reithmeir, 'Aircraft Repair Manual', Palamar Books, Marquette, 1992.
3. Brimm D.J. and Bogges H.E., 'Aircraft Maintenance', Pitman Publishing corp., New York, 1940.
4. A&P MECHANICS, 'Aircraft Hand Book', FAA Himalayan Book House, New Delhi, 1996.
5. A&P MECHANICS, 'General Hand Book', FAA Himalayan Book House, New Delhi, 1996.



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U18AEE0014	HELICOPTER AERODYNAMICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

- CO 1: Familiarize on major helicopter components, characteristics and configurations.
 CO 2: Apply Momentum and simple blade element theories to helicopter's rotor blades.
 CO 3: Analyze the power requirements in forward flight.
 CO 4: Understand the stability problems of helicopter.
 CO 5: Analyze the performance of VTOL and STOL aircrafts.
 CO 6: Apply the ground effect concept to ground effect machines.

Pre-requisite(s): U18AEI4201 / Low Speed Aerodynamics

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Program Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	-	W	-	-	-	-	-	-	-	-	-	-	S	-
CO 2	-		-	-	-	-	-	-	-	-	-	-	S	-
CO 3	-	S	-	-	-	-	-	-	-	-	-	-	S	-
CO 4	-	M	-	-	-	-	-	-	-	-	-	-	S	-
CO 5	-	M	-	-	-	-	-	-	-	-	-	-	S	-
CO 6	S	-	-	-	-	-	-	-	-	-	-	-	S	

Course Assessment Methods:

Direct Assessment
1. Internal Tests
2. Assignments
3. End Semester Exam
Indirect Assessment
Course exit survey

ELEMENTS OF HELICOPTER AERODYNAMICS

10 Hours

Configurations based on torque reaction – Jet rotors and compound helicopters – Methods of control – Collective and cyclic pitch changes – Lead-Lag and flapping hinges.

IDEAL ROTOR THEORY

12 Hours

Hovering performance – Momentum and simple blade element theories – Figure of merit – Profile and induced power estimation – Constant chord and ideal twist rotors.

POWER ESTIMATION


8 Hours

Induced, profile and parasite power requirements in forward flight – Performance curves with effects of altitude – Preliminary ideas on helicopter stability.

LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT

8 Hours

Various configuration – Propeller, rotor, ducted fan and jet lift – Tilt wing and vectored thrust – Performance of VTOL and STOL aircraft in hover, transition and forward motion.


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GROUND EFFECT MACHINES**7 Hours**

Types – Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine – Drag of hovercraft on land and water – Applications of hovercraft.

Theory: 45 Hours	Tutorial: 0	Practical: 0 Hours	Project: 0	Total: 45 Hours
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REFERENCES

1. Gessow A and Myers G.C., 'Aerodynamics of the Helicopter', Continuum International Publishing Group Ltd., 1997.
2. Gupta. L, 'Helicopter Engineering', Himalayan Books, 1996.
3. Simon Newman, 'The Foundations of Helicopter Flight', Halsted Press, 1994.
4. John M. Seddon and Simon Newman, 'Basic Helicopter Aerodynamics', Third Edition, AIAA Education Series, 2011.
5. J. Gordon Leishman, 'Principles of Helicopter Aerodynamics', Second Edition, Cambridge University Press, 2006.
6. Philip Terpstra, 'V/STOL Aircraft Design', Third Edition, Spirit Publications, 2005.
7. Barnes W. McCormick, 'Aerodynamics of V/STOL Flight', Academic Press Inc., 1967.
8. Barnes W. McCormick, 'Aerodynamics, Aeronautics and Flight Mechanics', Second Edition, Wiley India Pvt. Ltd., 2009.



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U18AEE0015	HIGH ENERGETIC FUELS AND PROPELLANTS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students would be able to

CO 1: Identify the various types of fuels and propellants used in gas turbine and space propulsion systems.

CO 2: Perform design calculations for solid propellant.

CO 3: Evaluate the combustion characteristics for different types of grains in solid propellant.

CO 4: Perform design calculations for liquid and cryogenic propellants.

CO 5: Analyze the combustion characteristics of liquid propellant.

Pre-requisite(s): U18AET6104 / Rocket Propulsion

CO-PO and CO-PSO Mapping:

CO/PO & PSO Mapping (S/M/W indicates strength of correlation)									S-Strong, M-Medium, W-Weak					
COs	Programme Outcomes (POs) and Programme Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		S											S	
CO 2			S										M	
CO 3				M									S	
CO 4			S										M	
CO 5		S		M									S	

Course Assessment Methods

Direct
1. Internal Test I
2. Internal Test II
3. Assignment
4. Tutorial
5. End Semester Exam
Indirect
Course end survey

INTRODUCTION


7 Hours

Aviation Fuels: Types of jet engine fuels, Properties of fuels commonly used in gas turbine combustors, combustion temperature and fuel-air ratio, Flame propagation, flame speed on fuel air ratio, estimate of TSFC, supersonic combustion – Introduction to biofuels, Green aviation.

SOLID PROPELLANTS

10 Hours

Classification – Double Base, Composite, Composite Modified Double Base, Fuel- rich and Metalized Propellants; Propellant formulations, Mechanical and Ballistic Properties; The Mechanism of Deflagration-to-Detonation Transition (DDT) in high-performance combustors, Factors influencing ignition delay, Binders, burning-rate modifiers, curing agents, energetic and binders plasticizers, additives, Viscoelastic properties of propellants.


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COMBUSTION OF SOLID PROPELLANTS**10 Hours**

Physical and chemical process, ignition process, extinction or thrust termination, combustion instability, vortex-shedding instability, Ignition and flame spread characteristic: Influence of Solid Propellant Grains geometry on ignition and flame spread characteristics. Different types of grains: End Burning, Radial Burning and Non-cylindrical Burning Grains; Segmented Grains; Grain Clustering; Burning Surface Area Evaluation; Design Criteria; Combustion characteristics of radial burning Dual Thrust Motor Grains.

LIQUID PROPELLANTS**10 Hours**

Essential Characteristics of Liquid Propellants, Propellant properties: performance of propellants, Common physical hazards: corrosion, explosion hazards, fire hazards, accidental spills, health hazards, material compatibility, Desirable physical properties: low freezing point, high specific gravity, stability, heat transfer properties, pumping properties, temperature variations, ignition, combustion and flame properties, additive,

COMBUSTION OF LIQUID PROPELLANTS**8 Hours**

Physical and chemical processes in the combustion of liquid propellants: injection, atomization, vaporization, mixing and reaction, Rapid combustion zone, injection/atomization zone, stream tube combustion zone, analysis and simulation, combustion instability: chugging, buzzing or entropy waves, screeching or screaming, pogo instability, Rating techniques and control of instabilities.

Theory: 45 Hours	Tutorial: 0 Hours	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. George P. Sutton and Oscar Biblarz, 'Rocket Propulsion Elements', 8th Edition, John Wiley and Sons Inc., New York, 2017.
2. Philip G. Hill and Carl R. Peterson, 'Mechanics and Thermodynamics of Propulsion', Addison-Wesley Publishing Company, New York, 2009.
3. Kenneth Kuan-yun Kuo, 'Principles of Combustion', Second Edition, Wiley-Interscience, 2012.
4. Gordon Oates, 'Aero Thermodynamics of Gas Turbine and Rocket Propulsion', AIAA Education Series, New York, 1997.
5. Kenneth Kuan-yun Kuo, 'Fundamentals of Solid Propellant Rockets' AIAA Education Series, 1980.
6. F. A. Williams, M. Barrere, and N. C. Huang, 'Fundamental Aspects of Solid Propellant Rocket', 1978.



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U18AEE0016	AIRCRAFT STRUCTURAL ANALYSIS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- CO1:** Apply the basic equations of stress, strain, equilibrium and boundary conditions for structures with different dimensions.
- CO2:** Apply the 3D stress-strain relation for solving engineering problems.
- CO3:** Analyze the given structure for its stability and geometric strength using strain energy method and matrix method.
- CO4:** Analyze the thin structures for their bending strength.
- CO5:** Design and analyze an aircraft component for its bending, shear and torsional resistance.

Pre-requisites : U18AEI5202/ Aircraft Structures II

CO-PO and CO-PSO Mapping:

	CO/PO Mapping													
	(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S			S								M	
CO2	M	S		M									S	
CO3	S				S								S	
CO4		S		M									M	
CO5		S											S	

Course Assessment Methods

Direct
1. Internal Tests
2. Assignments
3. End Semester Exam
Indirect
Course end survey

BASIC ELASTICITY


9 Hours

Stress – Notation for forces and stresses – Equations of equilibrium – Plane stress – Boundary conditions – Determination of stresses on inclined planes – Principal Stresses – Strain – Compatibility equations – Plane strain – Determination of strains on inclined planes – Principal strains – Stress-strain relationships.

ENERGY METHODS

10 Hours

Strain energy and complementary energy – Principle of the stationary value of the total complementary energy – Application to deflection problems – Virtual work Method – Applications of the principle of virtual work.


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MATRIX METHODS**9 Hours**

Stiffness matrix for an elastic spring – Matrix analysis of pin-jointed frameworks – Stiffness matrix for a uniform beam.

ANALYSIS OF THIN PLATE**8 Hours**

Pure bending of thin plates – Plates subjected to bending and twisting – Plates subjected to a distributed transverse load – Combined bending and in-plane loading of a thin rectangular plate.

ANALYSIS OF AIRCRAFT COMPONENTS**9 Hours**

Analysis of Wing spars and box beams – Tapered wing spar – Open and closed section beams – Beams having variable stringer areas – Analysis of Fuselages – Bending – Shear – Torsion.

Theory: 45 Hours	Tutorial: 0 Hours	Practical: 0	Project: 0	Total: 45 Hours
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REFERENCES

1. Megson, T.H.G., 'An Introduction to Aircraft Structural Analysis', Second Edition Butterworth-Heinemann, 2013.
2. Chajes, A., 'Principles of Structural Stability Theory', Prentice Hall, 1987.
3. Auchert, T.R., 'Energy Principles in Structural Mechanics', McGraw Hill, 1989.
4. Howard D.Curtis, 'Fundamentals of Aircraft Structural Analysis', Irwin Publications, 1997.
5. Megson, T.H.G., 'Aircraft Structures for Engineering Students', Fifth Edition (Rev.), Butterworth-Heinemann, 2012.



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U18AEE0017	AUTONOMOUS NAVIGATION	L	T	P	J	C
		3	0	0	0	3

Course Outcomes:

After successful completion of this course, the students will be able to

CO 1: Explain the relation between navigation, guidance and control for autonomous vehicles.

CO 2: Select suitable sensors for autonomous vehicle navigation.

CO 3: Explain the working principle of various navigation sensors.

CO 4: Estimate the states of autonomous vehicles using Kalman filter for navigation.

CO 5: Implement navigation algorithm for autonomous vehicles.

Pre-requisite(s): Nil.

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Program Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	S	M	-	-	-	-	-	-	-	-	-	-	S	-
CO 2	S	S	-	-	-	-	-	-	-	-	-	-	S	-
CO 3	S	M	-	-	-	-	-	-	-	-	-	-	S	-
CO 4	S	S	-	-	-	-	-	-	-	-	-	-	S	-
CO 5	S	S	-	-	-	-	-	-	-	-	-	-	S	-

Course Assessment Methods:

Direct Assessment
1. Internal Tests
2. Assignments
3. End Semester Exam
Indirect Assessment
Course exit survey

INTRODUCTION**9 Hours**

Definition of autonomous navigation, Coordinate systems, Guidance, Navigation and Control loops, Data fusion.

SENSOR SYSTEMS**12 Hours**

Accelerometer, Rate gyros, Pressure sensors, Magnetometers, Inertial measurement units (IMUs), Global positioning systems (GPS), LIDAR, Laser range finder, Ultrasonic sensors, Infrared sensors, Vision sensors.


STATE ESTIMATION**12 Hours**

Introduction to probability and Gaussian distribution, Mean and standard deviation, Kalman filter, State estimation with Kalman filter, Examples.

NAVIGATION METHODS**12 Hours**

GPS aided navigation, Way-point navigation, Path planning and path following algorithms, Mapping, Obstacles detection, Vision guided navigation.

Theory: 45 Hours	Tutorial: 0	Practical: 0 Hours	Project: 0	Total: 45 Hours
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REFERENCES

1. K. Nonami, F. Kendoul, S. Suzuki, W. Wang, and D. Nakazawa, 'Autonomous Flying Robots: Unmanned Aerial Vehicles and Micro Aerial Vehicles', Springer Science, 2010.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, 'Probabilistic Robotics', MIT Press, 2005.
3. Peter S. Maybeck, 'Stochastic Models, Estimation, and Control: Volume 1', Academic Press, 1979.
4. Paul Gerin Fahlstrom and Thomas James Gleason, 'Introduction to UAV Systems', John Wiley and Sons, 2012.
5. Mohinder S. Grewal, Lawrence R. Weill, and Angus P. Andrews, 'Global Positioning Systems, Inertial Navigation, and Integration', John Wiley and Sons, 2007.
6. Steven M. LaValle, 'Planning Algorithms', Cambridge University Press, 2006.



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U18AEE0018	ADDITIVE MANUFACTURING AND TOOLING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes:

After successful completion of this course, the students should be able to:

- CO1:** Classify the concepts and terminologies of additive manufacturing
CO2: Apply the reverse engineering concepts for design development
CO3: Identify the variety of additive manufacturing techniques based on end product applications
CO4: Design and develop newer tooling models
CO5: Familiarise with cutting edge technologies in rapid tooling and manufacturing
CO6: Analyse the cases relevant to Additive manufacturing

Pre-requisite: NIL

CO-PO and CO-PSO Mapping:

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Program Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	S	M				W	M					M		M
CO 2	S	S	S	M	W		S	M				M		S
CO 3	S	M					M							M
CO 4	S	S	S	M	W		S	M	M					S
CO 5	S	M			W		M					M		S
CO 6	S	S	S	M			M	M						S

Course Assessment methods:

Direct Assessment
1. Internal Tests
2. Assignments
3. End Semester Exam
Indirect Assessment
Course exit survey

INTRODUCTION**9 Hours**


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

REVERSE ENGINEERING & CAD MODELING**9 Hours**

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

ADDITIVE MANUFACTURING SYSTEMS**9 Hours**

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


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Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

SINTERING BASED ADDITIVE MANUFACTURING SYSTEMS

9 Hours

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

TOOLING

9 Hours

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

Theory: 45 Hours	Tutorial: 0	Practical: 0 Hours	Project: 0	Total: 45 Hours
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References:

- 1 “Rapid prototyping: Principles and applications”, Chua, C.K., Leong K.F. and Lim C.S., second edition, World Scientific Publishers, 2010.
- 2 Rapid Tooling: Technologies and Industrial Applications, Hilton, P.D. and Jacobs, P.F., CRC press, 2005.
- 3 “Rapid prototyping”, Gebhardt, A., Hanser Gardener Publications, 2003.
- 4 Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
- 5 Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.



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MANDATORY COURSES



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U18AER0001	INTRODUCTION TO AERONAUTICS	L	T	J	P	C
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Course Outcomes

After successful completion of this course, the students would be able to

CO 1: Explain various configurations of the aircraft

CO 2: Explain the functions of all the basic components in the aircraft

CO 3: Explain the process of aerodynamic forces and moments generation in the aircraft

CO 4: Differentiate various aircraft power plants based on its operation and thrust production

CO 5: Identify the various structural elements and understand its functions

Pre-requisite(s):**CO-PO and CO-PSO Mapping:**

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	M												S	
CO 2	M												S	
CO 3	M												S	
CO 4	M												S	
CO 5	M												S	

Course Assessment Methods:

Direct
1. Continuous Assessment Test I, II 2. Assignment; Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

HISTORY OF FLIGHT**5 Hours**


Balloon flight, Ornithopter, Heavier-than-air Flight, Wright Brothers' airplane, Evolution of aircraft design, Developments in aerodynamics, materials, structures and propulsion over the years.

AIRCRAFT CONFIGURATIONS**7 Hours**

Atmosphere and its properties - Different types of flight vehicles - classifications- Basic Components of aircraft- principle of operation and their functions - Different types of Wing and Tail configurations.

INTRODUCTION TO AERODYNAMICS**6 Hours**

Newton's law of motions applied to Aeronautics- Generation of lift, drag and pitching moment, Airfoil lift and drag curve, stall, types of drag, factors affecting lift and drag, Centre of pressure and its significance; aerodynamic center, aspect ratio, Mach number and supersonic flight effects.



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INTRODUCTION TO AIRCRAFT PROPULSION**6 Hours**

Aircraft power plants, classification based on the principle of operation. Piston-Propeller Turboprop, Turbojet, Turbofan, Ramjet engines– use of propeller and jets for thrust production- Comparative merits, performance characteristics.

INTRODUCTION TO AIRCRAFT STRUCTURES**6 Hours**

General types of construction, Monocoque, semi-monocoque constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials.

Theory: 30	Tutorial: 0	Practical: 0	Project: 0	Total: 30 Hours
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REFERENCES

1. Anderson, J.D., “Introduction to Flight”, Seventh Edition, McGraw-Hill, 2013.
2. Kermode, A.C. "Mechanics of Flight ", Pearson Education; Eleventh edition, 2006.
3. Federal Aviation Administration “The pilot's handbook of aeronautical knowledge”, 2016.
4. Dava Newman “Interactive Aerospace Engineering and Design”, McGraw-Hill, 2002.



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