AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY
School of Engineering

(AMRITAPURI, BANGALORE, COIMBATORE, CHENNAI)

DEPARTMENT OF AEROSPACE ENGINEERING

B.Tech. in AEROSPACE ENGINEERING(BTC-AES)

CURRICULUM AND SYLLABI
(2019)

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM

Cat	-	Category
L	-	Lecture
T	-	Tutorial
P	-	Practical
Cr	-	Credits
ENGG	-	Engineering Sciences (including General, Core and Electives)
HUM	-	Humanities (includingLanguages and others)
SCI	-	Basic Sciences (includingMathematics)
PRJ	-	Project Work (includingSeminars)

AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering - Artificial Intelligence
BIO	-	Biology
CCE	-	Computer and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CVL	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
HUM	-	Humanities
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics

Course Outcome (CO) – Statementsthatdescribewhatstudents are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behaviourthatstudentsacquire in theirprogressthrough the course.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

PROGRAM OUTCOMES FOR ENGINEERING

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

Aerospace Engineering graduates will be able to:

- Confidently pursue higher studies and research.
- Work in core aerospace industry, which covers diverse technology domains
- Become an entrepreneur confidently.
- Meet societal/ national requirements.
- Perform well in any field allied to fundamentals of Aerospace engineering.

Program Specific Outcomes

After successful completion of the program, the graduates will be able to:

- Understand governing principles and apply them in the fundamental disciplines of Aerospace Engineering (aerodynamics, guidance & control, propulsion and structures).
- Use methodology and tools pertaining to fundamental design of aircraft and rockets.
- Function in multidisciplinary teams in the Aerospace Engineering domain.

SEMESTER I

Cat.	Code	Title	Credit
HUM	19ENG111	Technical Communication	3
SCI	19MAT101	Single Variable Calculus	1
SCI	19MAT102	Matrix Algebra	2
ENGG	19CSE100	Problem Solving and Algorithmic Thinking	4
SCI	19PHY102/ 19CHY101	Engineering Physics - B /Engineering Chemistry - A	3
SCI	19PHY182/ 19CHY181	Engineering Physics Lab - B / Engineering Chemistry Lab – A	1
ENGG	19EEE100	Basic Electrical and Electronics Engineering	3
ENGG	19AEE101	Introduction to Aerospace Engineering	1
ENGG	19MEE100	Engineering Graphics – CAD	3
HUM	19CUL101	Cultural Education – I	2
		TOTAL	23

SEMESTER II

Cat.	Code	Title	Credit
SCI	19MAT111	Multivariable Calculus	2
SCI	19MAT106	Ordinary Differential Equations	2
SCI	19PHY102/ 19CHY101	Engineering Physics - B /Engineering Chemistry - A	3
SCI	19PHY182/ 19CHY181	Engineering Physics Lab - B / Engineering Chemistry Lab - A	1
ENGG	19CSE102	Computer Programming	4
ENGG	19MEE111	Engineering Mechanics	4
ENGG	19MEE181	Manufacturing Practice	1
ENGG	19AEE111	Introduction to Aerospace Technology	3
ENGG	19EEE181	Basic Electrical and Electronics Engineering Lab	1
HUM	19CUL111	Cultural Education - II	2
		TOTAL	23

SEMESTER III

Cat	Code	Title	Cr
HUM		Free Elective I**	2
HUM	19AVP201	Amrita Values Program I	1
SCI	19MAT206	Laplace Transforms	2
SCI	19MAT203	Partial Differential Equations	1
ENGG	19AEE201	Mechanics of Fluids	4
ENGG	19AEE203	Mechanics of Materials	3
ENGG	19AEE204	Materials for Aviation and Space	3
ENGG	19AEE202	Introduction to Thermodynamics	3
ENGG	19AEE281	Measurement and Instrumentation Lab.@	1
ENGG		Professional Elective I*	3
HUM	19MNG300	Disaster Management	P/F
		Total	23

SEMESTER IV

Cat	Code	Title	Cr
HUM		Free Elective II**	2
HUM	19AVP211	Amrita Values Program II	1
SCI	19MAT211	Numerical Computing	3
ENGG	19AEE211	Aerodynamics I	3
ENGG	19AEE212	Compressible Fluid Flow	3
ENGG	19AEE213	Aerospace Structures I	3
ENGG	19AEE214	Introduction to Control Theory	3
ENGG	19AEE282	Mechanics of Fluids Lab.	1
ENGG	19AEE283	Materials Testing Lab.@	1
HUM	19SSK211	Soft Skills I	2
HUM	19ENV300	Environmental Science	P/F
		Total	22

SEMESTER V

Cat	Code	Title	Cr
SCI	19MAT112	Linear Algebra	3
ENGG	19AEE301	Aerodynamics II	3
ENGG	19AEE302	Aerospace Propulsion	3
ENGG	19AEE303	Aerospace Structures II	3
ENGG	19AEE304	Avionics	3
ENGG		Professional Elective II*	3
ENGG	19AEE381	Aero-structures Lab.@	1
ENGG	19AEE382	Avionics Lab.@	1
HUM	19SSK301	Soft Skills II	2
ENGG	19LIV390	[Live-in –Labs]***	[3]
HUM	19LAW300	Indian Constitution	P/F
		Total	22 +[3]

SEMESTER VI

Cat	Code	Title	Cr
ENGG	19AEE311	Finite Element Methods for Aerospace	3
ENGG	19AEE312	Flight Mechanics	3
ENGG		Professional Elective III*	3
ENGG		Professional Elective IV*	3
ENGG	19AEE383	Propulsion Lab.@	1
ENGG	19AEE384	Low-speed Aerodynamics Lab.@	1
ENGG	19AEE385	Innovations Lab.	1
HUM	19SSK311	Soft Skills III	2
ENGG	19LIV490	[Live-in –Labs]***	[3]
		Total	17+[3]

SEMESTER VII

Cat	Code	Title	Cr
ENGG	19AEE401	Computational Fluid Dynamics for Aerospace	3
ENGG	19AEE402	Aero Design	5
ENGG	19AEE403	Flight Dynamics & Control	3
ENGG		Professional Elective V*	3
ENGG		Professional Elective VI*	3
ENGG	19AEE481	Flight testing lab.	1
PRJ	19AEE495	Project Phase 1	2
		Total	20

SEMESTER VIII

Cat	Code	Title	Cr
ENGG		Professional Elective VII*	3
ENGG		Professional Elective VIII*	3
PRJ	19AEE499	Project Phase II	10
		Total	16

		Total Credits		166

@'Hands-on' Project-based Lab.

***Professional Elective - Electives categorised under Engineering, Science, Mathematics, Live-in-Labs, and NPTEL Courses. Student can opt for such electives across departments/campuses. Students with CGPA of 7.0 and above can opt for a maximum of 2 NPTEL courses with the credits not exceeding 8.**

**** Free Electives - This will include courses offered by Faculty of Humanities and Social Sciences/ Faculty Arts, Commerce and Media / Faculty of Management/Amrita Darshanam -(International Centre for Spiritual Studies).**

***** Live-in-Labs - Students undertaking and registering for a Live-in-Labs project, can be exempted from registering for an Elective course in the higher semester.**

PROFESSIONAL ELECTIVES			
PROFESSIONAL ELECTIVE II			
Cat	**Code**	**Title**	**Cr**
ENGG	**19AEE331**	**Fundamentals Heat Transfer**	**3**
ENGG	**19AEE332**	**Manufacturing Processes**	**3**
ENGG	**19AEE333**	**Vibration Analysis**	**3**
ENGG	**19AEE334**	**Computational Methods for Engineers**	**3**

PROFESSIONAL ELECTIVE IV			
Cat	**Code**	**Title**	**Cr**
ENGG	**19AEE341**	**Experimental Aerodynamics**	**3**
ENGG	**19AEE342**	**Composite Materials and Mechanics**	**3**
ENGG	**19AEE343**	**Advanced Avionics**	**3**
ENGG	**19AEE344**	**Hypersonic Flow Theory**	**3**
ENGG	**19AEE345**	**Aero-Elasticity**	**3**

PROFESSIONAL ELECTIVE V			
Cat	**Code**	**Title**	**Cr**
ENGG	**19AEE431**	**Air Breathing Engines**	**3**
ENGG	**19AEE432**	**Engineering Fracture Mechanics**	**3**
ENGG	**19AEE433**	**Helicopter Theory**	**3**

PROFESSIONAL ELECTIVE VI			
Cat	**Code**	**Title**	**Cr**
ENGG	**19AEE441**	**Rocket and Spacecraft Propulsion**	**3**
ENGG	**19AEE442**	**Advanced Composite Structures**	**3**
ENGG	**19AEE443**	**State Space Techniques**	**3**

PROFESSIONAL ELECTIVE VII			
Cat	**Code**	**Title**	**Cr**
ENGG	**19AEE451**	**Turbulent Flows**	**3**
ENGG	**19AEE452**	**Space Flight Mechanics**	**3**
ENGG	**19AEE453**	**Multidisciplinary Design Optimization**	**3**

PROFESSIONAL ELECTIVE VIII			
Cat	**Code**	**Title**	**Cr**
ENGG	**19AEE461**	**Advanced Computational Fluid Dynamics**	**3**
ENGG	**19AEE462**	**Surface Engineering, Coating and Joining Technologies**	**3**
ENGG	**19AEE463**	**Principles of Airport Management**	**3**

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY			
Cat.	**Code**	**Title**	**Credit**
SCI	**19CHY243**	**Computational Chemistry and Molecular Modelling**	**3**
SCI	**19CHY236**	**Electrochemical Energy Systems and Processes**	**3**
SCI	**19CHY240**	**Fuels and Combustion**	**3**
SCI	**19CHY232**	**Green Chemistry and Technology**	**3**
SCI	**19CHY239**	**Instrumental Methods of Analysis**	**3**
SCI	**19CHY241**	**Batteries and Fuel Cells**	**3**
SCI	**19CHY242**	**Corrosion Science**	**3**
PHYSICS			
SCI	**19PHY340**	**Advanced Classical Dynamics**	**3**
SCI	**19PHY342**	**Electrical Engineering Materials**	**3**
SCI	**19PHY331**	**Physics of Lasers and Applications**	**3**
SCI	**19PHY341**	**Concepts of Nanophysics and Nanotechnology**	**3**
SCI	**19PHY343**	**Physics of Semiconductor Devices**	**3**
SCI	**19PHY339**	**Astrophysics**	**3**
MATHEMATICS			
SCI	**19MAT341**	**Statistical Inference**	**3**
SCI	**19MAT342**	**Introduction to Game Theory**	**3**
SCI	**19MAT343**	**Numerical Methods and Optimization**	**3**

FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM			
Cat.	**Code**	**Title**	**Credit**
HUM	19MNG331	Financial Management	3
HUM	19MNG332	Supply Chain Management	3
HUM	19MNG333	Marketing Management	3
HUM	19MNG334	Project Management	3
HUM	19MNG335	Enterprise Management	3
HUM	19MNG338	Operations Research	3
HUM	19MEE401	Industrial Engineering	3
HUM	19MEE346	Managerial Statistics	3
HUM	19MEE347	Total Quality Management	3
HUM	19MEE342	Lean Manufacturing	3
HUM	19CSE358	Software Project Management	3
HUM	19CSE359	Financial Engineering	3
HUM	19CSE360	Engineering Economic Analysis	3
HUM	19CSE362	Information Systems	3

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS			
Cat.	**Code**	**Title**	**Credit**
HUM	19CUL230	Achieving Excellence in Life - An Indian Perspective	2
HUM	19CUL231	Excellence in Daily Life	2
HUM	19CUL232	Exploring Science and Technology in Ancient India	2
HUM	19CUL233	Yoga Psychology	2
HUM	19ENG230	Business Communication	2
HUM	19ENG231	Indian Thought through English	2
HUM	19ENG232	Insights into Life through English Literature	2
HUM	19ENG233	Technical Communication	2
HUM	19ENG234	Indian Short Stories in English	2
HUM	19FRE230	Proficiency in French Language (Lower)	2
HUM	19FRE231	Proficiency in French Language (Higher)	2
HUM	19GER230	German for Beginners I	2
HUM	19GER231	German for Beginners II	2

HUM	**19GER232**	**Proficiency in German Language (Lower)**	**2**
HUM	**19GER233**	**Proficiency in German Language (Higher)**	**2**
HUM	**19HIN101**	**Hindi I**	**2**
HUM	**19HIN111**	**Hindi II**	**2**
HUM	**19HUM230**	**Emotional Intelligence**	**2**
HUM	**19HUM231**	**Glimpses into the Indian Mind - the Growth of Modern India**	**2**
HUM	**19HUM232**	**Glimpses of Eternal India**	**2**
HUM	**19HUM233**	**Glimpses of Indian Economy and Polity**	**2**
HUM	**19HUM234**	**Health and Lifestyle**	**2**
HUM	**19HUM235**	**Indian Classics for the Twenty-first Century**	**2**
HUM	**19HUM236**	**Introduction to India Studies**	**2**
HUM	**19HUM237**	**Introduction to Sanskrit Language and Literature**	**2**
HUM	**19HUM238**	**National Service Scheme**	**2**
HUM	**19HUM239**	**Psychology for Effective Living**	**2**
HUM	**19HUM240**	**Psychology for Engineers**	**2**
HUM	**19HUM241**	**Science and Society - An Indian Perspective**	**2**
HUM	**19HUM242**	**The Message of Bhagwad Gita**	**2**
HUM	**19HUM243**	**The Message of the Upanishads**	**2**
HUM	**19HUM244**	**Understanding Science of Food and Nutrition**	**2**
HUM	**19JAP230**	**Proficiency in Japanese Language (Lower)**	**2**
HUM	**19JAP2313**	**Proficiency in Japanese Language (Higher)**	**2**
HUM	**19KAN101**	**Kannada I**	**2**
HUM	**19KAN111**	**Kannada II**	**2**
HUM	**19MAL101**	**Malayalam I**	**2**
HUM	**19MAL111**	**Malayalam II**	**2**
HUM	**19SAN101**	**Sanskrit I**	**2**
HUM	**19SAN111**	**Sanskrit II**	**2**
HUM	**19SWK230**	**Corporate Social Responsibility**	**2**
HUM	**19SWK231**	**Workplace Mental Health**	**2**
HUM	**19TAM101**	**Tamil I**	**2**
HUM	**19TAM111**	**Tamil II**	**2**

SYLLABUS

SEMESTER I

19ENG111	TECHNICAL COMMUNICATION	L-T-P-C: 2- 0- 3- 3

Course Objectives

- To introduce the students to the elements of technical style
- To introduce the basic elements of formal correspondence
- To introduce technical paper writing skills and methods of documentation
- To improve oral presentation skills in formal contexts

Course Outcomes

CO1: Understand and use the basic elements of formal correspondence and methods of documentation.
CO2: Learn to edit technical content for grammatical accuracy and appropriate tone and style
CO3: Use the library and Internet recourses for research purposes
CO4: Demonstrate the ability to communicate effectively through group mock-technica presentations and other activities

CO-PO Mapping

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

Syllabus

Unit 1
Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers
General Reading and Listening comprehension - rearrangement & organization of sentences

Unit 2
Different kinds of written documents: Definitions- descriptions- instructions-recommendations- user manuals - reports – proposals
Formal Correspondence: Writing formal Letters
Mechanics of Writing: impersonal passive & punctuation
Scientific Reading & Listening Comprehension

Unit 3

Technical paper writing: documentation style - document editing – proof reading - Organising and formatting
Mechanics of Writing: Modifiers, phrasal verbs, tone and style, graphical representation
Reading and listening comprehension of technical documents
Mini Technical project (10 -12 pages)
Technical presentations

References

Hirsh, Herbert. L "Essential Communication Strategies for Scientists, Engineers and Technology Professionals". II Edition. New York: IEEE press, 2002

Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt Brace College Publication, 2003

Strunk, William Jr. and White. EB. "The Elements of Style" New York. Alliyan& Bacon, 1999.

Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.

Michael Swan. '' Practical English Usage'', Oxford University Press, 2000

Evaluation Pattern

Assessment	Internal	External
Periodical 1	20	
Periodical 2	20	
Continuous Assessment (Lab) (CAL)	40	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19MAT101	SINGLE VARIABLE CALCULUS	L-T-P-C: 1- 0 - 0 -1

Course Objectives

- Understand the various functions and their graphs.
- Understand the basic concept of continuous function and find the extreme values of the continuous functions.
- Understand the definite integral and various integration techniques.

Course Outcomes

CO1: To understand the concepts of single variable calculus.
CO2: To sketch graphs for functions using the concepts of single variable calculus and apply the fundamental theorem of calculus to evaluate integrals.

CO-PO Mapping

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

Syllabus

Unit 1

Calculus
Graphs: Functions and their Graphs. Shifting and Scaling of Graphs. (1.5)

Unit 2
Limit and Continuity**:** Limit (One Sided and Two Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity. (2.1, 2.6)

Unit 3
Graphing :Extreme Values of Functions, Concavity and Curve Sketching, (4.1, 4.4).

Unit 4
Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques. (5.2 - 5.3, 8.1 – 8.5)

Text Book

Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.

Reference
'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002

Evaluation pattern

At the end of the course, a two-hour test will be conducted for 50 marks. The marks will be converted to 100 for grading.

19MAT102	MATRIX ALGEBRA	L-T-P-C: 2- 0 -0- 2

Course Objectives

- Understand basic concepts of eigen values and eigen vectors.
- Apply eigen values and eigen vectors for diagonalization and quadratic form.
- Apply various iterative techniques to solve the system of equations.

Course Outcomes

CO1: Understand the notion of eigenvalues and eigenvectors, analyse the possibility of diagonalization and hence compute a diagonal matrix, if possible.
CO2: Apply the knowledge of diagonalization to transform the given quadratic form into the principal axes form and analyse the given conic section.
CO3: Understand the advantages of the iterative techniques and apply it to solve the system of equations and finding eigenvectors.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	2	3	1									
CO3	3		1									

Syllabus

Unit 1
Review: System of linear Equations, linear independence.
Unit 2
Eigen values and Eigen vectors: Definitions and properties. Positive definite, negative definite and indefinite
Unit 3
Diagonalization and Orthogonal Diagonalization. Properties of Matrices. Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal matrices.
Unit 4
Numerical Computations: L U factorization, Gauss Seidal and Gauss Jacobi methods for solving system of equations. Power Method for Eigen Values and Eigen Vectors.

Text Book
Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.

Reference Books
Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.
Engineering Mathematics', Srimanta Pal and Subhodh C Bhunia, John Wiley and Sons, 2012, Ninth Edition.

Evaluation Pattern

Assessment	Weightage
Class Test/Assignment/Tutorial	30
End of course Test (2hrs)	70

19CSE100	PROBLEM SOLVING AND ALGORITHMIC THINKING	L-T-P-C: 2- 1- 3- 4

Course Objectives

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides foundation for developing computational perspectives of one's own discipline.

Course Outcomes

CO 1: Apply algorithmic thinking to understand, define and solve problems
CO 2: Design and implement algorithm(s) for a given problem
CO 3: Apply the basic programming constructs for problem solving
CO 4: Understand an algorithm by tracing its computational states, identifying bugs and correcting them

CO-PO Mapping

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

Syllabus

Unit 1
Problem Solving and Algorithmic Thinking Overview – problem definition, logical reasoning; Algorithm – definition, practical examples, properties, representation, algorithms vs programs.
Unit 2
Algorithmic thinking – Constituents of algorithms – Sequence, Selection and Repetition, input-output; Computation – expressions, logic; algorithms vs programs, Problem Understanding and Analysis – problem definition, input-output, variables, name binding, data organization: lists, arrays etc. algorithms to programs.
Unit 3
Problem solving with algorithms – Searching and Sorting, Evaluating algorithms, modularization, recursion. C for problem solving – Introduction, structure of C programs, data types, data input, output statements, control structures.

Text Book(s)
Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27.

Reference(s)
Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.
Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19PHY102	ENGINEERING PHYSICS - B (Aerospace, Civil, Mechanical and Chemical)	L-T-P-C: 2- 1- 0- 3

Course Objectives

- To enable the student to apply fundamental principles of mechanics, optics, modern physics including elements of quantum mechanics and its role in materials with specific focus on engineering problems.

Course outcomes

CO1: Apply Newton's formulation to dynamical system including central force problem and conservation laws.
CO2: Understand the elements of optics including phenomena of interference, diffraction and polarization.
CO3: Be exposed to the Einstein's theory of matter radiation interaction and different types of lasers.
CO4: Be familiar with basic idea of quantum mechanics and its application to particle in a box and tunnelling.
CO5: Be introduced to crystal physics – free electron theory and the concept of energy band and fermi energy.

CO-PO Mapping

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

Syllabus

Unit 1
Mechanics
Newton's laws of motion – forces, frictional forces, dynamics of uniform circular motion, work, kinetic energy, work-energy theorem, potential energy, conservation of energy, Newton's law of gravitation, motion in uniform gravitational field, centre of mass, conservation of linear and angular momentum.

Unit 2
Waves and Optics
Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's Rings, Michelson interferometer.
Fraunhofer diffraction from single slit and circular aperture, Rayleigh criterion for limit of resolution and its application to vision, diffraction gratings and their resolving power.
Polarization: Unpolarized, polarized and partially polarized lights, polarization by reflection, double refraction by uniaxial crystals, Polaroid, half wave and quarter wave plates.

Unit 3
Lasers
Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (Ruby, Neodymium), dye lasers.

Unit 4

Quantum Mechanics

De Broglie waves, wave functions, wave equation, Schrodinger wave equation: time dependent and time independent form, operators – Eigen functions and Eigen values, uncertainty principle, particle in a finite potential one -dimensional box, tunnelling effect (Qualitative).

Unit 5

Introduction to Solids

Crystal systems – Miller indices, crystal planes and directions, packing fraction, Classification of solids: Metals, semiconductors and insulators (qualitative), free electron theory of metals, Fermi level, Density of states, Kronig-Penney model and origin of energy bands.

Text Books

Halliday, Resnick, Jearl Walker, "Principles of Physics", 10th Edition, Wiley,2015.
Ajay Ghatak, "Optics", 6th Edition, McGraw Hill Education India Private Limited, 2017.
Eugene Hecht, A R Ganesan, "Optics", 4th Edition, Pearson Education, 2008.
Arthur Beiser, ShobhitMahajan, S RaiChoudhury"Concepts of Modern Physics" McGraw Hill Education India Private Limited, 2017.
Charles Kittel, "Introduction to Solid State Physics" 8th Edition, Wiley, 2012.

Reference Books

David Kleppner, Robert Kolenkow, "An Introduction to Mechanics", 1st Edition, McGraw Hill Education, 2017.
F A Jenkins, H E White, "Fundamental of Optics", 4thEdition,McGraw Hill Education India Private Limited, 2017.
David J Griffiths, "Introduction to Quantum Mechanics",2nd Edition, Pearson Education,2015
M A Wahab, "Solid State Physics", 3rd Edition, Narosa Publishing House Pvt. Ltd., 2015.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CHY101 ENGINEERING CHEMISTRY - A L-T-P-C: 2-1-0-3
(Aerospace, Mechanical, Civil and Chemical Engineering)

Course Objectives

- The main objective of the course is to impart knowledge on the fundamentals concepts of chemistry involved in application of several important engineering materials that are used in the industry/day-to day life

Course Outcomes

CO1: Understand the basic principles behind the properties of engineering materials through sound knowledge in Chemical bonding, photochemistry and electrochemistry**.**
CO2: Apply the chemistry concepts to assess and justify the choice of materials for industrial applications.
CO3: Evaluate the physical and chemical parameters for the selection of suitable materials for industrial processes and Applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-									
CO2	3	3	2									
CO3	2	3	2									

Syllabus

Unit 1
Atomic Structure and Chemical Bonding
Fundamental particles of atom – their mass, charge and location – atomic number and mass number – Schrondinger equation. Significance of ψ and ψ^2 – orbital concept – quantum numbers - electronic configuration. Periodic properties. Formation of cation and anion by electronic concept of oxidation and reduction – theories on bonding- octet, Sidgwick and Powell, VSEPR and VBT-MOT. Formation of electrovalent, covalent and coordination compounds. Chemistry of weak interactions – van der Waals force and hydrogen bonding.

Unit 2
Electrochemical energy system
Faradays laws, origin of potential, electrochemical series, reference electrodes, Nernst equation, introduction to batteries – classification – primary, secondary and reserve (thermal) batteries. Characteristics – cell potential, current, capacity and storage density, energy efficiency. Construction, working and application of Leclanche cell-Duracell, Li-MnO_2 cell, lead acid batteries. Ni-Cd battery, Lithium ion batteries. Fuel cell - construction and working of PEMFC.

Unit 3
Photochemistry and solar energy
Electromagnetic radiation. Photochemical and thermal reactions. Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram - photophysical and photochemical processes, photosensitization, photo-polymerization and commercial application of photochemistry.

Solar energy - introduction, utilization and conversion, photovoltaic cells – design, construction and working, panels and arrays. Advantages and disadvantages of PV cells. DSSC (elementary treatment).

Unit 4

Corrosion control and metal finishing

Introduction, causes and different types of corrosion and effects of corrosion, theories of corrosion – chemical corrosion, Pilling Bed-worth ratio, electrochemical corrosion and its mechanism, factors affecting corrosion – galvanic series. Corrosion control methods – cathodic protection, sacrificial anode, impressed current cathode. Surface coatings - galvanizing, tinning, electroplating of Ni and Cr, organic surface coatings – paints, constituents and functions. Anodising and electroplating of aluminium.

Unit 5

Water Technology

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA. Numerical problems – boiler troubles (scale and sludge). Treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning). External treatment – Reverse Osmosis, ion exchange process.

Text Books:

Vairam and Ramesh "Engineering Chemistry", Wiley, 2012Amrita Vishwa Vidyapeetham, Department of sciences, "Chemistry Fundamentals for Engineers", McGraw Hill Education, 2015.

Reference Books:

Jain and Jain, "Engineering Chemistry", DhanpatRai Publishing company, 2015
Puri, Sharma and Patania, " Principles of Physical chemistry", Vishal Publishing Co., 2017.
Atkins, "Physical Chemistry", OUP, Oxford, 2009

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19PHY182	ENGINEERING PHYSICS LAB - B	L-T-P-C: 0- 0-3- 1
(Aerospace, Civil, Mechanical and Chemical)		

Course Objective

- To introduce experiments for testing the understanding of physics concepts in the areas of mechanics, optics, solid state and quantum mechanics and electricity and magnetism.
- To make the student to acquire practical skills in finding properties of mater, optical properties, electrical characteristics of semiconductor materials and quantum behavior of materials

.

Course Outcomes

CO1: Be able to perform experiment to study elastic properties of materials.
CO2: Be able to design, perform experiments on dispersion, interference and diffraction.
CO3: Be able to design; perform experiments to measure semiconducting properties.
CO4: Perform experiment to study atomic spectrum of H_2 atom and quantum nature of light.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1									
CO2	3	1	1									
CO3	3	1	1									
CO4	3	1	1									

List of Experiments:

1. Young's modulus - non-uniform bending. [CO 1]
2. Rigidity modulus – moment of inertia of the disc and rigidity modulus of the wire using torsional oscillation. [CO 1]
3. Spectrometer- dispersive power of the material of prism. [CO 2]
4. Radius of curvature of given convex lens- Newton's rings method. [CO 2]
5. Laser- wavelength of diode laser and mean size of Lycopodium particles. [CO 2]
6. Band gap of a semiconductor. [CO 3].
7. Solar cell - determining efficiency and fill factor. [CO 3].
8. Photoelectric effect - Planck's constant and work function of the given metal. [CO 4]
9. Experiment to verify the quantum nature of hydrogen atom by measuring the wavelengths of spectral lines in Balmer series. [CO 4].

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA-Basic principles of experiment, skill, result analysis and viva

19CHY181	ENGINEERING CHEMISTRY LAB - A (Aerospace, Mechanical, Civil and Chemical Engineering)	L-T-P-C: 0-0-3-1

Course Objective

- The objective of the laboratory sessions is to enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

Course Outcomes

CO1: Estimate the quantity of chemical substance in the given sample by electrochemical methods
CO2: Determine the water quality parameters using titrimetric analysis for domestic and industrial applications.
CO3: Examine the physical and chemical parameters of materials for engineering applications.
CO4: Examine the separation of components and analyze the sample by spectrophotometry.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2	1									
CO 3	3	2										
CO4	3	2										

Lab

1. Estimation of alkalinity in given water samples
2. Adsorption of acetic acid by charcoal
3. Potentiometric titration – acid-base/redox
4. Conductometric titration
5. Estimation of hardness by ion-exchange method
6. Determination of kinematic viscosity by Redwood Viscometer
7. Anodisation of Aluminium – Relation between current and thickness
8. Determination of acid value of an oil
9. Separation techniques – TLC, Column chromatography
10. Verification of B-L law by UV-spectrophotometer

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

* CA – Principles of experiment, skill, result analysis and report

19EEE100	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Aerospace, Civil, Mechanical, ECE,CCE and Chemical)	L-T-P-C: 3-0-0-3

Course Objectives

- To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits.
- To understand the construction and working principle of DC and AC machines.
- To facilitate understanding of basic electronics and operational amplifier circuits.

Course Outcomes

CO 1: Understand the basic electric and magnetic circuits
CO 2: Analyse DC and AC circuits
CO 3: Interpret the construction and working of different types of electrical machines
CO 4: Analyse basic electronic components and circuits.

CO-PO Mapping

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

Syllabus

Unit 1
Introduction to Electrical Engineering, Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power – Series parallel combination of R, L, C components, Voltage Divider and Current Divider Rules – Super position Theorem, Network Analysis – Mesh and Node methods- Faraday's Laws of Electro-magnetic Induction, Magnetic Circuits, Self and Mutual Inductance, Generation of sinusoidal voltage, Instantaneous, Average and effective values of periodic functions, Phasor representation. Introduction to 3-phase systems, Introduction to electric grids.

Unit 2
Electrical Machines: DC Motor: Construction, principle of operation, Different types of DC motors, Voltage equation of a motor, significance of back emf, Speed, Torque, Torque-Speed characteristics, Output Power, Efficiency and applications. Single Phase Transformer: Construction, principle of operation, EMF Equation. Regulation and Efficiency of a Transformer. Induction Machine: Three Phase Induction Motor: Construction and Principle of Operation, Slip and Torque, Speed Characteristics. Stepper motor: Construction, principle and mode of operation.

Unit 3
PN Junction diodes, VI Characteristics, Rectifiers: Half wave, Full wave, Bridge. Zener Diode- characteristics, Optoelectronic devices. BJT – characteristics and configurations, Transistor as a Switch. Junction Field Effect Transistors - operation and characteristics, Thyristor – Operation and characteristics. Fundamentals of DIAC and

TRIAC. 555 Timer, Integrated circuits. Operational Amplifiers – Inverting and Non-inverting amplifier – Instrumentation amplifiers.

Text Books

Edward Hughes. "Electrical and Electronic Technology", 10th Edition, Pearson Education Asia, 2019.
D. P. Kothari, I J Nagrath, "Electric Machines", 5th Edition, Tata McGraw Hill, 2017.
A. P. Malvino, "Electronic Principles", 7th Edition, Tata McGraw Hill, 2007.

References

S. K. Bhattcharya, "Basic Electrical and Electronics Engineering", Pearson, 2012.
Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India Private Limited, 2nd Edition, 2003.
David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
Michael Tooley B. A., "Electronic circuits: Fundamentals and Applications", 3rd Edition, Elsevier Limited, 2006.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19AEE101	INTRODUCTION TO AEROSPACE ENGINEERING	L-T-P-C: 0-0-3-1

Course Objectives

- Hands-on exposure to various aircraft components and other equipment through simple experiments.

Course Outcomes

CO1: Understand basics of Wind Tunnel, Visualize flow patterns around bluff bodies
CO2: Identify major components of aircraft propulsion systems.
CO3: Use strain gauges etc. on beams and plates. Understand layered sheets and failures.
CO4: Identify major components of Helicopter, Aircraft, UAV etc. Simulate flying maneuvers.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2			2	1	2		3	3	-	1
CO2	3						2	2	1	2		3	3	-	1
CO3	3							2	1	2		3	3	-	1
CO4	3		1		2			2	1	2		3	3	1	1

Syllabus

Wind Tunnel
Essential parts of the wind tunnel: honey-comb; turbulence damping screens; the converging section; test-section; mounting and traversing mechanism; suction duct and fan.
Flow visualization around bodies: Smoke as the tracer; flow features for blunt and streamlined configurations.
Image processing: Image enhancement utilizing commercial software; Extraction of flow features from the recorded images.

Engines
Different types of aircraft engines; Identification of engines and their parts.
Thrust Generation principle.
Propeller models; Identification on the propeller test bench.

Structures
Measurement of deflections: use of dial gauges and strain gauges on beams and plates.
Effect of bonding strength in layered sheets.
Demonstration of failure mechanisms of different materials.

Aircraft
Ka-25 helicopter**:** Role of helicopters in Defence and Civilian operations; Anti-submarine capability; Helicopter parts: rotors, engine, controls and cockpit instruments.
Mig -23**:** Role of Mig-23 in ground attack; Control surfaces; swept wing and saw tooth leading edge;
Components: spars, ribs etc.; Undercarriage system.
UAV models and their functioning
Remote control aircraft: Servos, BLDC motor, ESC and battery; Sensors: Gyros and accelerometers; Design,

fabrication and flying of a glider.
Flight Simulator

Text Book
Anderson.D, " Introduction to Flight," 7th edition, Mc Graw Hill, 2011.

References
Anderson, D.F and Eberhatdt. S, "Understanding Flight," 2nd edition, Mc Graw, 2009.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19MEE100	ENGINEERING GRAPHICS - CAD (Aerospace, Chemical, CSE, ECE, CCE, EEE and ELC)	L-T-P-C: 2-0-3-3

Course Objectives

- Familiarize with Bureau of Indian Standards (BIS) for creating engineering drawings
- Train the students on proper dimensioning and construction of simple geometries
- Inculcate with the concept of developing orthographic projections and isometric views using CAD drafting package

Note:

1. Drawing practice to be carried out using drafting package (Auto-CAD)
2. First angle projection to be followed

Course Outcomes

CO1: Understand the engineering drawing standards and their usage
CO2: Interpret engineering drawings
CO3: Construct and dimension 2-D geometries using CAD software
CO4: Improve coherent visualization skills
CO5: Inculcate with the concept of developing orthographic projections and isometric views

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	3	1	2	3		3	2	2	2
CO2	3	3	3	3		2	3	1	2	3		3	2	2	2
CO3	3	3	3	3	3	2	3	1	2	3		3	2	2	2
CO4	3	3	3	3		2	3	1	2	3		3	2	2	2
CO5	3	3	3	3	3	2	3	1	2	3		3	2	2	2

Syllabus

Unit 1

Basic principles of engineering drawing, Standards and conventions, lettering and types of lines, Introduction to drafting software, standard tool bar/menus, navigational tools. Co-ordinate system and reference planes. Creation of 2 dimensional drawing environment. Selection of drawing size and scale. Sketching of 2D simple geomentries, editing and dimensioning of 2D geomentries.

Unit 2

Orthographic Projections: Introduction, planes of projection, projection of points in all the four quadrants. Projection of straight lines, Projection of Plane Surfaces, Projection of regular solids, Sectioning of solids

Unit 3

Plan and elevation of simple buildings with dimensions

Text Book

BasantAgarwal and C M Agarwal., "Engineering Drawing", 2e, McGraw Hill Education, 2015

Reference Book(s)

Bhat N.D. and Panchal V.M. , " Engineering Drawing Plane and Solid Geometry , 42e, Charoatar Publishing House , 2010James D. Bethune, "Engineering Graphics with AutoCAD", Pearson Education, 2014
K.R. Gopalakrishna, "Engineering Drawing", 2014, Subhas Publications
Narayan K.L. and Kannaiah P, Engineering Drawing, SciTech Publications, 2003
John K.C., "Engineering Graphics for Degree", 1e, Prentice Hall India, 2009

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CUL101	CULTURAL EDUCATION I	L-T-P-C: 2-0-0-2

Course Objective

- The course is designed as an introductory guide to the variegated dimensions of Indian cultural and intellectual heritage, to enable students to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- It will equip students with concrete knowledge of their country and the mind of its people and instil in them some of the great values of Indian culture.

Course Outcomes

CO1: Be introduced to the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education**.**
CO2: Understand the foundational concepts of Indian civilization like *puruśārtha*-s, law of karma and *varṇāśrama*.
CO3: Gain a positive appreciation of Indian culture, traditions, customs and practices**.**
CO4: Imbibe spirit of living in harmony with nature, and principles and practices of Yoga.
CO5: Get guidelines for healthy and happy living from the great spiritual masters

CO-PO Mapping

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

Syllabus

Unit 1
Introduction to Indian culture; Understanding the cultural ethos of Amrita Vishwa Vidyapeetham; Amma's life and vision of holistic education.

Unit 2
Goals of Life – Purusharthas; Introduction to Varnasrama Dharma; Law of Karma; Practices for Happiness.

Unit 3
Symbols of Indian Culture; Festivals of India; Living in Harmony with Nature; Relevance of Epics in Modern Era; Lessons from Ramayana; Life and Work of Great Seers of India.

Text Book
Cultural Education Resource Material Semester-1

Reference Book(s)

The Eternal Truth (A compilation of Amma's teachings on Indian Culture)
Eternal Values for a Changing Society. Swami Ranganathananda. BharatiyaVidyaBhavan.
Awaken Children (Dialogues with Mata Amritanandamayi) Volumes 1 to 9
My India, India Eternal. Swami Vivekananda. Ramakrishna Mission.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER II

19MAT111	MULTIVARIABLE CALCULUS	L-T-P-C:2- 0-0 -2

Course Objective

- To understand parameterisation of curves and to find arc lengths.
- To familiarise with calculus of multiple variables.
- To use important theorems in vector calculus in practical problems.

Course Outcomes

CO1: Select suitable parameterization of curves and to find their arc lengths
CO2: Find partial derivatives of multivariable functions and to use the Jacobian in practical problems.
CO3: Apply Fundamental Theorem of Line Integrals, Green's Theorem, Stokes' Theorem, of Divergence Theorem to Evaluate integrals.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	---	---	---	---	---	---	---	---	---	---
CO2	1	2	---	---	2	---	---	---	---	---	---	---
CO3	2	2			3							

Syllabus

Unit 1

Functions of severable variables

Functions, limit and continuity. Partial differentiations, total derivatives, differentiation of implicit functions and transformation of coordinates by Jacobian. Taylor's series for two variables.

Unit 2

Vector Differentiation

Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Unit 3

Vector Integration

Line Integral, Line Integrals Independent of Path.

Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem.

Unit 4

Lab Practice Problems:

Graph of functions of two variables, shifting and scaling of graphs. Vector products. Visualizing different surfaces.

Text Book

Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.

Reference Book(s)

Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.

'Engineering Mathematics', Srimanta Pal and Subhodh C Bhunia, John Wiley and Sons, 2012, Ninth Edition.

'Calculus', G.B. Thomas Pearson Education, 2009, Eleventh Edition.

Evaluation Pattern

Assessment	Weightage
Class Test/Assignment/Tutorial	30
End of course Test (2hrs)	70

19MAT106	ORDINARY DIFFERENTIAL EQUATION	L-T-P-C: 2-0-0-2

Course Objective

- To model mechanical systems using differential equations.
- To analyse and solve ordinary differential equations.
- To understand numerical methods for solving ordinary differential equations.

Course Outcomes

CO1: Understand the basic concepts of differential equations
CO2: Solve the ordinary differential equations using variation of parameters, undetermined coefficients and by numerical technique.
CO3: Understand the formation of modelling problems in ordinary differential equations and apply some standard methods to obtain its solutions.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		2	3									
CO3	1	2	2	3								

Syllabus

Unit 1
Ordinary Differential Equations : Linear Differential Equations and Bernoulli Equation. Modelling Problems: Mixing Problem, Electric Circuits and vibration of strings.
Unit 2
Second Order Differential Equations: Euler-Cauchy Equations, Solution by Undetermined Coefficients, Solution by Variation of Parameters. System of ODEs, Basic Concepts and Theory, Homogeneous Systems and Non-homogeneous with Constant Coefficients. System of differential equations.
Unit 3
Computational Methods: Euler's methods, Runge-Kutta method.

Text Book
Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.

Reference Books
'Engineering Mathematics', Srimanta Pal and Subhodh C Bhunia, John Wiley and Sons, 2012, Ninth Edition.
Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.

Evaluation Pattern

Assessment	Weightage
Class Test/Assignment/Tutorial	30
End of course Test (2hrs)	70

19CSE102	COMPUTER PROGRAMMING	L-T-P-C: 3- 0-3- 4

Pre-Requisite(s): 19CSE100 Problem Solving and Algorithmic Thinking

Course Objectives

- This course provides the foundations of programming.
- Apart from the usual mechanics of a typical programming language, the principles and methods will form the main focus of this course.
- Shift from learn to program to programming to learn forms the core of this course.

Course Outcomes

CO 1: Understand the typical programming constructs: data (primitive and compound), control, modularity, recursion etc. thereby to understand a given program
CO 2: Understand and analyze a given program by tracing, identify coding errors and debug them
CO 3: Make use of the programming constructs appropriately and effectively while developing computer programs
CO 4: Develop computer programs that implement suitable algorithms for problem scenarios and applications

CO-PO Mapping

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

Syllabus

Unit 1
Introduction and Review of C language constructs. Functions – inter function communication, standard functions, scope. Recursion – recursive definition, recurivse solution, designing recursive functions, limitations of recursion. Arrays – 1D numeric, searching and sorting, 2D numeric arrays.

Unit 2
Pointers: introduction, compatibility, arrays and pointers, Dynamic memory allocation, arrays of pointers, pointer arithmetic. Strings: fixed length and variable length strings, strings and characters, string input, output, array of strings, string manipulation functions, sorting of strings.

Unit 3
Structures: structure vs array comparison, complex structures, structures and functions, Union. Files and streams, file input output, command line arguments.

Text Book(s)
Forouzan BA, Gilberg RF. Computer Science: A structured programming approach using C. Third Edition, Cengage Learning; 2006.

Reference(s)

Byron Gottfried. Programming With C. Fourth Edition, McGrawHill,; 2018.

Brian W. Kernighan and Dennis M. Ritchie. The C Programming Language. Second Edition, Prentice Hall, 1988.

Eric S. Roberts. Art and Science of C. Addison Wesley; 1995.

Jeri Hanly and Elliot Koffman. Problem Solving and Program Design in C. Fifth Edition, Addison Wesley (Pearson); 2007.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19MEE111	ENGINEERING MECHANICS	L-T-P-C: 3-1-0-4

Course Objectives

- Inculcate the principles of statics and dynamics
- Comprehend and solve engineering mechanics problems using the principles of Coulomb friction
- Familiarize with the concept of the centroid, first moment, second moment of area
- Impart knowledge on the kinematics of particles and rigid bodies in motion

Course Outcomes

CO1: Determine rectangular components of a force
CO2: Derive the equivalent force - couple system
CO3: Analyze the equilibrium state of a particle and rigid body
CO4: Estimate the moment of inertia of composite areas
CO5: Determine the kinematic variables for rigid bodies in general plane motion.

CO-PO Mapping

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

Syllabus

Unit 1
Principles of statics: Introduction to vector approach – free body diagrams- forces in a plane – forces in space – concurrent forces – resolution of forces – equilibrium of particles
Statics of rigid bodies in two and three dimensions: Moment of force about a point – moment of force about an axis – moment of a couple – equivalent force couple system – rigid body equilibrium – support reactions.

Unit 2
Application of statics: Friction – ladder friction – wedge friction – analysis of trusses – method of joints and method of sections.
Centroid and center of gravity: centroid of lines, areas and volumes – composite bodies. Second moment of area – polar moment of inertia – mass moment of inertia – radius of gyration.
Method of virtual work for static equilibrium problems.

Unit 3
Dynamics of particles: kinematics of particles – rectilinear motion – relative motion – relative motion – position, velocity and acceleration calculation in cylindrical coordinates.
Dynamics of rigid bodies: General plane motion – translation and rotation of rigid bodies – Chasle's theorem – velocity and acceleration calculation in moving frames – Corioil's acceleration.

Text Book

Beer,F.P. &Johnston,E.R., "Vector Mechanics for Engineers-Statics and Dynamics", 11/e, McGraw Hill International Book Co., 2017

Reference Books

Hibbeler, R.C., "Engineering Mechanics- Statics and Dynamics", 14/e, Pearson Education Pvt. Ltd., 2017
J.L. Meriam and L.G. Kraige, "Engineering Mechanics - Statics", 7/e, John Wiley & sons, 2013
J.L. Meriam and L.G. Kraige, "Engineering Mechanics - Dynamics", 7/e, John Wiley & sons, 2013
Shames,I.H, "Engineering Mechanics-Statics and Dynamics", 4/e, Prentice-Hall of India Pvt. Ltd., 2005

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1	15	
Periodical 2	15	
*Continues Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

19MEE181	MANUFACTURING PRACTICE	L-T-P-C: 0-0-3-1

Course Objectives

- Introduce basic concepts pertaining to product dismantling and assembly.
- Familiarize with basic pneumatic components and design & validate simple pneumatic circuits.
- Familiarize with sheet metal tools and operations.
- Provide hands-on training on welding and soldering.
- Familiarize with plumbing tools and processes.
- Inculcate and apply the principles of 3D printing to build simple geometries.

Course Outcomes

CO1: Interpret the functionality of various components in a product through dismantling and assembly
CO2: Identify various pneumatic and electro-pneumatic components
CO3: Fabricate simple sheet metal objects using concepts of surface development
CO4: Perform metal joining operations using soldering and arc welding
CO5: Make simple plumbing joints for domestic applications
CO6: Build simple geometries using 3D printing tools

CO-PO MAPPING

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1							2	1		1	1		
CO2	2	2	1		1				2	1		1	1	1	
CO3	2	2							2	1		1	1		
CO4	2	1							2	1		1	1		
CO5	2		2		2							1	1	1	
CO6	2	2	1		1				2	1		1	1	1	

Syllabus

Product Workshop
Disassemble the product of sub assembly-Measure various dimensions using measuring instruments-Free hand rough sketch of the assembly and components-Name of the components and indicate the various materials used-Study the functioning of the assembly and parts-Study the assembly and components design for compactness, processing, ease of assembly and disassembly-Assemble the product or subassembly.

Pneumatic and PLC Workshop
Study of pneumatic elements-Study of PLC and programming. Design and simulation of simple circuits using basic pneumatic elements-Design and simulation of simple circuits using electro-pneumatics.

Sheet Metal Workshop
Study of tools and equipment - Draw development drawing of simple objects on sheet metal (cone, cylinder, pyramid, prism, tray etc.)-Fabrication of components using small shearing and bending machines-Riveting practice.

Welding, Soldering and Plumbing Workshops

Study of tools and equipment - Study of various welding & soldering methods

Arc welding practice - fitting, square butt joint and lap joint - Soldering practice. Plumbing tools – Make a piping joint to a simple piping layout (should include cutting, threading and pipe fixing)

3D-Printing Workshop

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19AEE111	INTRODUCTION TO AEROSPACE TECHNOLOGY	L-T-P-C: 3-0-0-3

Course Objective

- To examine the effects of atmosphere and weather on flight
- To know the components of aircraft and their uses through a historical perspective
- Understand the effects of aerodynamic, propulsive and gravitational forces.
- To understand the internal structural elements of airplane and their uses.
- To know the operations of various types of engines.
- To introduce stealth technology and MAVs
- To know the solar system, outer space and their governing laws.

Course Outcome

CO 1: Identify the Atmosphere and its levels; Examine effects of the weather on flight.

CO 2: Remember the historic attempts at flying; major components of flying machines and aerial Navigation

CO 3: Understand Newton's equations of motion of flying vehicles; define various terms: Lift, Drag, Moments, airfoil, monocoque and semimonocoque structures.

CO 4: Categorize and subsume thrust production in various types of engines for flight.

CO 5: Recognize MAVs and the principles of Stealth technology.

CO 6: Apply laws of planetary motion and recognize various orbits.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	3	-	2	1	-	3	-	-	-
CO2	3	-	-	-	-	2	-	-	2	2	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	2	-	-	3	3	3
CO4	3	-	-	2	-	-	2	-	-	3	-	3	3	3	3
CO5	3	-	-	-	-	1	-	-	-	2	-	2	1	-	-
CO6	3	3	-	2	-	-	-	-	-	2	-	3	3	3	-

Syllabus

Unit 1

Visual Content (video) about Atmospheric Dynamics and its Influence on Flying Machines - History of Aviation (visual content) – Types of Flying Machines, Major Components of an Aircraft, and their Functions (visual content) – Aircraft vs Rotorcraft (visual content) – Basic Instruments for Flying (visual content) – Physical Properties and Structure of the Atmosphere: Temperature, Pressure and Altitude Relationships.

Unit 2

Newton's Law of Motions Applied to Aeronautics: Evolution of Lift, Drag and Moment – Aerofoils – General Types of Construction: Monocoque and Semi-monocoque – Typical Wing and Fuselage Structure (visual content) – Basic Ideas about Piston, Turboprop and Jet Engines - Use of Propeller and Jets for Thrust Production (visual content) – Stealth Technology: History and Principles.

Unit 3

History of Spaceflight (visual content) – Major Components of Rocket, Spacecraft and their Functions (visual content) – Principles of Rocket Engines – The Solar System and the Copernican Model - Kepler's Laws – Orbital Motion – Satellite Orbits - Earth's Outer Atmosphere (visual content).

Text Book:

Anderson. J.D, "Introduction to Flight," 7th edition, Mc Graw Hill, 2011.

References:

Anderson, D.F and Eberhatdt. S, "Understanding Flight," 2nd edition, Mc Graw, 2009.
Turner.M.J, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.
Curtis.H.D, "Orbital Mechanics for Engineering Students," 3rd edition, Butterworth-Heinemann, 2013.
Paul A Suhler, "From Rainbow to Gusto: Stealth and the Design of the Lockheed Blackbird," AIAA, 2009.

Evaluation Pattern

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Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19EEE181	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB (Aerospace, Civil, Mechanical, ECE, CCE and Chemical)	L-T-P-C: 0-0-3-1

Course Objective

- To understand the basics of electrical connections and analyse the performance of electrical machines and electronic circuits.

Course Outcome

CO1: To create basic electrical connections for domestic applications
CO2: To measure the various electrical parameters in the circuit
CO3: To Analyse the performance of electrical machines.
CO4: To Analyse basic electronic circuits.

CO-PO Mapping

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

LIST OF EXPERIMENTS:

Electrical

1. a) Wiring practices
   b) Study of Electrical protection systems.
2. Verification of circuit theorem
3. Experiment on DC machine
4. Experiment on single phase Transformer
5. Experiment on induction motor
6. VI characteristics of PN junction and Zener diode
7. Implementation of Half wave and Full wave rectifier using PN junction diode
8. Transistor as a switch
9. Experiment on Thyristor
10. Implementation of inverting and non-inverting amplifier using Op-amp

REFERENCES / MANUALS / SOFTWARE:
Lab Manuals

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CUL111	CULTURAL EDUCATION II	L-T-P-C: 2-0-0-2

Course Objective

- To deepen students' understanding and further their knowledge about the different aspects of Indian culture and heritage.
- To in still into students a dynamic awareness and understanding of their country's achievements and civilizing influences in various fields and at various epochs.

Course Outcome

CO1: Get an overview of Indian contribution to the world in the field of science and literature.
CO2: Understand the foundational concepts of ancient Indian education system.
CO3: Learn the important concepts of Vedas and *Yogasutra*-s and their relevance to daily life.
CO4: Familiarize themselves with the inspirational characters and anecdotes from the *Mahābhārata* and *Bhagavad-Gītā* and Indian history.
CO5: Gain an understanding of Amma's role in the empowerment of women

CO-PO Mapping

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

Syllabus

Unit 1
To the World from India; Education System in India; Insights from Mahabharata; Human Personality. India's Scientific System for Personality Refinement.

Unit 2
The Vedas: An Overview; One God, Many Forms; Bhagavad Gita – The Handbook for Human Life; Examples of Karma Yoga in Modern India.

Unit 3
Chanakya's Guidelines for Successful Life; Role of Women; Conservations with Amma.

Text Book
Cultural Education Resource Material Semester-2

Reference Book(s)

Cultural Heritage of India. R.C.Majumdar. Ramakrishna Mission Institute of Culture.
The Vedas. Swami ChandrashekharaBharati. BharatiyaVidyaBhavan.
Indian Culture and India's Future. Michel Danino. DK Publications.
The Beautiful Tree. Dharmapal. DK Publications.
India's Rebirth. Sri Aurobindo. Auroville Publications.

Evaluation Pattern:

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER III

19AVP201	**AMRITA VALUES PROGRAMME I**	**1 0 0 1**
19AVP211	**AMRITA VALUES PROGRAMME II**	**1 0 0 1**

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Course Outcome

CO1: Understanding the impact of *itihasas* on Indian civilization with a special reference to the *Adiparva* of Mahabharata

CO2: Enabling students to importance offighting*adharma* for the welfare of the society through Sabha and Vanaparva.

CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas.

CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.

CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

CO-PO Mapping

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

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana
Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata
Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads
Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita
Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda
Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India
Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation
The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting
Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability
Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems
Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable

medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

TEXT BOOKS/REFERENCES:

1. Rajagopalachari. C, *The Ramayana*

2. Valmiki, *The Ramayana*, Gita Press

19MAT206LAPLACE TRANSFORMS L-T-P-C:1-0-0-1

Course Objectives

Understand the definition Laplace transform and its properties.
Apply Laplace transform to solve the differential equations.

Course Outcomes

CO1: To understand the Laplace transform and its properties.
CO2: Apply the Laplace transform to solve differential equations.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	---	---	---	---	---	---	---	---	---	---
CO2	1	2	---	---	2	---	---	---	---	---	---	---

Syllabus

Laplace Transforms, Inverse Transforms, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential Equations, Unit Step Function, Second Shifting Theorem, Dirac's Delta Function. Differentiation and Integration of Transforms. Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations. (Sections: 6.1 to 6.7)

Lab Practice: Laplace transform for different functions.

Text Book

Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2018.

Reference Book(s)

'*Engineering Mathematics', Srimanta Pal and Subhodh C Bhunia, John Wiley and Sons, 2012, Ninth Edition.*
Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.

Evaluation pattern

At the end of the course, a two-hour test will be conducted for 50 marks. The marks will be converted to 100 for grading.

19MAT203 PARTIAL DIFFERENTIAL EQUATIONS L-T-P-C:1-0-0-1

Course Objectives

- Understand the Fourier series for periodic functions and determine the Fourier coefficients
- Able to solve one dimensional heat and wave equations using Fourier series.

Course Outcomes

CO1: Understand the periodic functions and obtain the Fourier series for certain functions.
CO2: Understand the formation of partial differential equations and apply some standard methods to obtain its solutions.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	---	---	---	---	---	---	---	---	---	---
CO2	1	2	---	---	2	---	---	---	---	---	---	---

Fourier Series: Fourier series, Half range Expansions, Parseval's Identity, Fourier Integrals, Fourier integral theorem. Sine and Cosine Integrals. (Sections: 11.1 -11.3)

Partial Differential Equations:

Basic Concepts, Modeling; Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series, Heat Equation; Solution by Fourier Series. (Sections: 12.1-12.5)

Text Book
Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2016.

Reference Book(s)
Advanced Engineering Mathematics by Dennis G. Zill and Michael R.Cullen, second edition, CBS Publishers, 2012.
Engineering Mathematics, Srimanta Pal and Subodh c Bhunia, Oxford press, 2015.
Larry C. Andrews and Bhimson. K. Shivamoggi, The Integral Transforms for Engineers, Spie Press, Washington, 1999.

Evaluation pattern

At the end of the course, a two-hour test will be conducted for 50 marks. The marks will be converted to 100 for grading.

19AEE201	MECHANICS OF FLUIDS	L-T-P-C: 3-1-0-4

Course Objectives

The purpose of this subject is to impart basic concepts pertinent to Newtonian fluid flow physics. Thereby, students will acquire and be capable to utilize this fundamental understanding for the characterization of flow domains of relevance in aerospace. In other words, with a strong background in fluid mechanics, aerodynamic optimization of flying machines can be accomplished.

Course Outcome

CO 1: Enables to distinguish fluid from solid.
CO 2: To understand the stability of floating bodies based on hydrostatic force concept.
CO 3: To synthesize conservation principles for mass and momentum for the description of incompressible fluid flow dynamics.
CO 4: To characterize the inherent features of boundary layer development associated with real fluids.
CO 5: The relevance of dimensional analysis and modeling in fluid mechanics to formulate pertinent non-dimensional parameters, and its subsequent utilization for the generation of exact models of a given prototype.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	3	-	3	-	-	-	-	-	-	-	1	3	-	-
CO3	3	3	-	3	-	-	-	-	-	-	-	1	3	-	-
CO4	3	3	-	3	-	-	-	-	-	-	-	1	3	-	-
CO5	-	3	-	-	-	3	-	-	-	-	-	1	-	1	1

Syllabus

Unit 1

Concept of a Fluid: Continuum, Primary Properties, Compressibility of Fluids, Bulk Modulus, Isothermal & Isentropic Processes, Speed of Sound – Secondary Properties: Viscosity, Newton's Law of Viscosity, Sutherland Equation, Andrade Equation, Surface Tension, Capillarity, Vapor Pressure, Boiling, Cavitation – Hydrostatics: Pascal's Law, Hydrostatic Force on Planar and Non-planar Surfaces, Area Moment of Inertia, Archimedes' Principle, Buoyancy, Stability of Floating Bodies.

Unit 2

Fluid Dynamics: Lagrangian& Eulerian Concepts, Reynolds Transport Theorem, Extensive Property, Intensive Property, Continuity Equation (Differential & Integral Forms) – Conservation of Momentum and Energy: Euler Equation of Motion, Stream Function, Velocity Potential, Bernoulli Equation (Inviscid Steady Flow & Potential Steady Flow) – Laminar Flow: Hagen-Poiseuille Flow, Couette Flow, Plane Poiseuille Flow.

Unit 3

Boundary Layer Development: Boundary Layer Thickness, Displacement Thickness, Momentum Thickness – Momentum Equations: von Karman Momentum Integral Equation (zero pressure gradient), Skin-friction Drag on a Surface – Boundary Layer Equations: Prandtl Boundary Layer Equation and Blasius Solution – Dimensional Analysis: Buckingham Pi-theorem, Method of Repeating Variables – Similitude and Modeling: Modeling Laws, Geometric Similarity, Dynamic Similarity, Kinematic Similarity, Applications.

Text Book(s)

Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, "Fundamentals of Fluid Mechanics," 4th edition, John Wiley, 2002.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE203MECHANICS OF MATERIALS	L-T-P-C: 2-1-0-3

Course Objectives

Understand the fundamental concepts of stresses and strains and the relationship between both through the strain-stress equations in order to solve problems for simple elastic solids subjected to axial, bending and torsional loads.

Course Outcome

CO1: Analyse the axial members for stress, strain and deformation.
CO2: Know how to draw SF, BM, and HF Diagrams.
CO3: Obtain stresses in beams.
CO4: Estimate the deflection in beams.
CO5: Analyse the torsional members for stress, strain and deformation.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	2	3	2	-
CO2	3	3	2	1	-	-	-	-	-	-	-	2	3	2	-
CO3	3	3	2	1	-	-	-	-	-	-	-	2	3	2	-
CO4	3	3	2	1	-	-	-	-	-	-	-	2	3	2	-
CO5	3	3	2	1	-	-	-	-	-	-	-	2	3	2	-

Syllabus

Unit 1
Stresses in axial members: Normal stress – St. Venant's principle – normal strain – tension and compression test – stress and strain diagrams – factor of safety – Hooke's law. Axial deformation – principle of superposition – lateral strain – Poisson's ratio – shear stress and strain – shear modulus – volumetric strain – bulk modulus – relation between elastic constants. Stresses in joints – shear and bearing stresses – temperature stress and strain – stress concentration.

Unit 2
Stresses in transverse members: Isolation of beam element – intensity of load, shear force and bending moment relation – shear force and bending moment diagrams – bending stresses in transverse members – Euler – Bernoulli' s simple beam theory – bending stress distribution – shear stresses in transverse members – shear stress distribution.

Unit 3
Deflection in transverse members: Moment-curvature relation – double-integration, Macaulay's – conjugate beam – propped cantilever – fixed beams. Stresses in torsional members: Torsional shear stress – torsion equation for circular section – polar moment of inertia – torsional deformation – stresses due to combined loading.

Text Book(s)
James M Gere, Barry J. Goodno "Mechanics of Materials", 8th Edition, Cengage Learning, USA, 2013.

Reference(s)

Irving H. Shames and James M. Pitarresi, "Introduction to Solid Mechanics" third edition, Prentice-Hall of India Pvt. Ltd. 2006

Egor P. Popov, "Engineering Mechanics of Solids", Second edition, Prentice-Hall of India Pvt. Ltd., 2004

S. H. Crandall and N. C. Dahl, "Introduction to Mechanics of Solids", 3rd Edition, Tata McGraw Hill, India, 2013.

R.C. Hibbeler "Mechanics of Materials",8th Edition, Pearson Prentice Hall, New Jersey, USA, 2011.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE204MATERIALS FOR AVIATION AND SPACE **L-T-P-C: 3-0-0-3**

Course Objectives

- Fundamentals of Material Science
- Clear in-sight of materials for aviation and space
- Basic understanding on necessity of polymer based materials
- Basic understanding of different characterization techniques of materials
- Smart materials for future generation aviation and space

Course Outcome

CO1: Students have learned thermo-mechanical properties of materials in respect of aviation.
CO2: Students will have clarity on mechanical properties of materials such as steel, aluminum and application to aviation.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	1	2	1	2	2	2	2	2	2
CO2	2	1	2	2	1	2	2	2	2	2	1	2	2	1	2

Syllabus

Unit 1
Atomic structure, bonding and crystal structure in materials. Imperfections in crystalline solids and their role in influencing material properties. Mechanical properties: Stress and strain curves for brittle and ductile alloys, elastic, plastic, anelastic, visco-elastic behavior, ductility, resilience, toughness of metals, strengthening mechanisms, grain boundary hardening, solution hardening and work hardening.

Unit 2
Metals and Alloys: Microstrcture, properties and applications of ferrous and non-ferrous materials in aviation and space. Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, recrystallization and grain growth.
Ceramics: Structure, properties and applications of traditional and advanced ceramics for re-entry of space vehicles.

Unit 3
Polymers: Classification of engineering and high performance polymers, additives for engineering and high performance polymers, elastomers. Smart materials and superconductivity, nanomaterials, superalloys. Materials characterization techniques such as, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, differential scanning calorimetry and X-Ray photo electron spectroscopy.

Text Book(s)
Cantor B, Assender H, and Grant P (2001), Aerospace Materials, ISBN 07503 0742 0, IOP Publishing Ltd

Reference(s)

Gauthier M. M. (1995). Engineered Materials Handbook Materials Park, OH: ASM International. [Comprehensive overview on engineering plastics, elastomers, composites, ceramics and ceramic matrix composites.]
Boyer R., Welsch G., and Collings E. W. (1994). Materials Properties Handbook: Titanium alloys. Materials Park, OH: ASM International. [Extensive coverage of Ti alloy data.]
Davis J. R. (1997). ASM Speciality Handbook Heat Resistant Materials. Materials Park, OH: ASM International. [Comprehensive overview on superalloys, ferrous and non-ferrous heat-resistant materials.]

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE202	INTRODUCTION TO THERMODYNAMICS	L-T-P-C: 2-1-0-3

Course Objectives

- To familiarize the students with the application of various law of thermodynamics
- To study the application of heat and work transfer processes in the energy extraction efficiencies using air standard cycles.

Course Outcome

CO1: Understand the law of thermodynamics and various forms of work and energy that can occur.
CO2: Analyze the work and heat interactions associated with a prescribed process path, and to perform a first law analysis of a flow system.
CO3: Apply the understandings of phase change process of pure substances to the flow and non-flow process devices
CO4: Apply second law of thermodynamics and entropy concepts in analyzing the thermal efficiencies of heat engines and determine the reversibility or irreversibility of a process using change in entropy
CO5: Apply ideal cycle analysis to simple heat engine cycles to estimate thermal efficiency and work as a function of pressures and temperatures at various points in the cycle.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	1	-	-	1	-	-	-	-	-	3	2	-

Syllabus

Unit 1
Review of the Laws of Thermodynamics – Introduction to Engineering Applications of Thermodynamic Equilibrium – Quasi-static Process – Cyclic Process – Work and Heat – Application of First Law for Open and Closed Systems: Typical Work Transfer and Heat Transfer Devices – Perfect Gas – Equation of State - Specific Heats – Real Gas Models – Compressibility Chart – Thermodynamic Properties of Fluids – Pure Substance – Phase-change Process of Pure Substance – P-V-T Surface – Steam Tables.

Unit 2
Introduction to the Application of Second Law of Thermodynamics – Heat Engine – Heat Pump –Refrigerator – Irreversible Processes – Reversible Processes – Carnot Cycle – Carnot Engine – Carnot Theorems – Clausius Inequality – Concept of Entropy and Entropy Change – Introduction to Compressibility and Compressible Flow – Propagation of Sound – Mach number.

Unit 3

Thermodynamic Property Relations: Cyclic Rule, Maxwell Relations, T-D-S Equations – Clausius-Clapeyron Equation – Joule-Thomson coefficient and Inversion Line - Fundamentals of Power cycles: Air Standard Otto and Diesel Cycles, Rankine Cycle, Reversed Carnot Cycle, Brayton Cycle and its Application in Propulsion Systems.

Text Book(s)

Cengel, Y.A. and Boles, M.A., "Thermodynamics: An Engineering Approach," Tata McGraw, 2002.
Saad, M.A., 'Thermodynamics: Principles and Practice," Prentice Hall, New Jersey, 1998.

Reference(s)

Borganakke, S. and Wylen V., "Fundamentals of Thermodynamics," Wiley, New York, 2003.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE281 MEASUREMENT AND INSTRUMENTATION LAB. L-T-P-C: 0-0-3-1

Course Objectives

To understand and learn the experimental principles and procedure associated with mechanical measurements such as strain, torque, rpm, temperature, impact force, load, etc.,

Course Outcome

CO1: Perform experiments to find out different types of errors and uncertainty in measurements.
CO2: Understand the principle of operation of various measuring instruments used for determining the pressure, force, frequency, linear variation.
CO3: Measure the performance of the instruments with clear understanding of accuracy, repeatability, and resolution.
CO4: Calibrate the instrumentation required for the measurement of pressure, frequency, force, linear variation.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	2	2	-	-	-	3	-	3
CO2	3	2	1	-	-	-	-	2	2	-	-	-	3	-	3
CO3	2	3	1	1	-	-	-	2	2	-	-	2	3	-	3
CO4	2	2	1	1	-	-	-	2	2	-	-	1	3	-	3

Syllabus

Calibration exercises on general purpose test (GPT) equipments such as Oscilloscope, signal generator, and pressure gauges.
Measurement experiments: Displacement using LVDT, velocity using Pitot tube and anemometer, force using Proving ring and load cell, torque using strain gauges, speed using stroboscope and magnetic pickup, and temperature using thermocouple.
Mini Projects: Interdisciplinary in content based on application of course work completed by the student.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	-	
Periodical 2 (P2)	-	
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

SEMESTER IV

19MAT211	NUMERICAL COMPUTING	L-T-P-C:2-0-2-3

Course Objectives

- To familiarize different numerical methods to solve engineering problems.
- To write computer programs and use toolboxes in the software packages.
- To select a specific numerical method to solve practical problems.

Course Outcomes

CO1: Solve linear and nonlinear algebraic equations and systems of nonlinear equations using numerical. techniques.
CO2: Use regression and interpolation methods for curve fitting.
CO3: Select and apply numerical schemes for differentiating and integrating complicated functions.
CO4: Apply computational schemes for solving systems of ordinary differential equations.
CO5: Solve PDEs by numerical methods

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	2	2									
CO2	3	3	2									
CO3	2	2	3									
CO4	3	2	2									
CO5	2	2	3									

Syllabus

Introduction to programming in MATLAB, examples. Error definitions, Taylor series and error propagation. (**6hrs**)

Roots of equations – Bisection method, fixed point iteration, Newton-Raphson method, secant method, systems of nonlinear equations. Numerical linear algebra – Gauss elimination, LU decomposition, matric inversion, power method for finding eigen values, QR factorisation. (**11 hrs)**

Curve Fitting – Linear regression, polynomial regression, nonlinear regression, Newton's divided difference interpolation, Lagrange interpolation. **(8 hrs**)

Numerical Integration and Differentiation – Trapezoidal rules, Simpson's rules, Newton-Cotes algorithm, Gauss quadrature, high accuracy differentiation formulas, Richardson extrapolation, partial derivatives.
(**8 hrs**)

Differential Equations – Euler's method, improved Euler's methods, Runge-Kutta method, systems of equations, Finite difference method, solution of Laplace equation by FDM, explicit methods for parabolic equations, simple implicit method, Crank-Nicolson method. (**12 hrs**)

Textbooks:

Numerical Methods for Engineers, Steven Chapra and Raymond Canale, 7th Edition, McGraw Hill, 2015.
Applied Numerical Analysis, LaureneFausett, 2nd Edition, Pearson, 2008.
Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley, 2015.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE211	AERODYNAMICS I	L-T-P-C: 3-0-0-3

Course Objectives

This subject provides fundamental understanding of aerodynamics by considering an infinite wing / airfoil. In doing so, the flow domain turns out 2-D and thereby the analysis will be simplified. It also facilitate to apply superposition of potential flows to simulate flow around geometries of practical relevance with good degree of precision.

Course Outcome

CO1: Understand fundamentals and know the non-dimensionalization of aerodynamic forces and moments; familiar with airfoil nomenclature and airfoil characteristics.
CO2: Understand conformal mapping and Jowkowski transformation of airfoil to a circular cylinder.
CO3: Understand plane potential flow and apply to aerodynamic problems of academic and practical interest.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	3	3	3	-
CO2	3	3	-	-	2	-	-	-	-	3	-	3	3	1	-
CO3	3	3	-	-	-	-	-	-	-	3	-	3	3	2	-

Syllabus

Unit 1
Importance of Aerodynamics – Classification and Practical Objectives – Aerodynamic Forces – Moments and their Non-dimensionalization – Airfoil Nomenclature – Airfoil Characteristics.

Unit 2
Complex Functions: Analytic Functions and Cauchy-Riemann Criteria, Conformal Mapping, Joukowski Transformation.

Unit 3
Concept of Circulation – Plane Potential Flow – Laplace Equation – Elementary Flows and its Superposition – Kutta Condition – Kutta-Joukowski Theorem – Kelvin's Circulation Theorem – Starting Vortex.

Text Book(s)
John D Anderson, "Fundamentals of Aerodynamics," 5th edition, McGraw Hill, 2010.

Reference(s)
E.L. Houghton and P.W. Carpenter, "Aerodynamics for Engineering Students," 5th edition, Butterworth-Heinemann, 2003.
Milne-Thomson, "Theoretical Aerodynamics," Dover, 1974.
Krishnamurthy Karamcheti, "Principles of Ideal-Fluid Aerodynamics," 2nd edition, Krieger Pub Co, 1980.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Report

19AEE212	COMPRESSIBLE FLUID FLOW	L-T-P-C: 2-1-0-3

Course Objectives

- Introduce students to the basics of compressibility of flow and the related phenomena.
- Enable them to analyse subsonic and supersonic flows with simplified analytical models.
- Provide an introduction to the applications of compressible flow analysis in aerospace engineering.

Course Outcome

CO1: Study the formation and analysis of shock waves.
CO2: Analyse expansion waves.
CO3: Learn about compressible flow through CD nozzles.
CO4: Study the impact of friction and heat transfer on compressible flow.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	--	-	-	-	-	-	-	-	2	-	2
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	1
CO3	1	1	1	-	-	-	-	-	-	-	-	-	1	-	1
CO4	2	2	-	-	-	-	-	-	-	-	-	-	1	-	3

Syllabus

Unit 1
Review of Thermodynamics: Energy Equation - Compressible Flows: Isentropic Flow, Stagnation Properties. Propagation of Sound, Mach number, Distinction between Subsonic and Supersonic flows, the Acoustic Equation, Finite Waves, Formation of Shock waves.

Unit 2
Flow Through Varying-area Ducts – Normal Shock Wave – Oblique Shock Wave – Shock Polar – Shock Wave Interactions – Prandtl-Meyer Expansion – Effect of Back Pressure on Nozzle Flows – Supersonic Wind Tunnels.

Unit 3
Fanno Flow – Rayleigh Flow – Representation of Shock Waves on the T-S Diagram – Small Perturbation Theory – Similarity Rules – Introduction to the Method of Characteristics .

Text Book(s)
John D Anderson, "Modern Compressible Flow," 3rd edition, Mcgraw-Hill, 2002.

Reference(s)
Shapiro.A.H, "The Dynamics and Thermodynamcis of Compressible Fluid Flow," Vol.1, Ronald Press Company, 1977.
Zucker.R.D and Biblarz.O, "Fundamentals of Gas Dynamics," 2nd edition, John Wiley, 2002.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE213	AEROSPACE STRUCTURES I	L-T-P-C: 3-0-0-3

Course Objectives

To make students to understand and appreciate the importance of theories of failure, buckling, joints and energy methods

Course Outcome

CO1: Understand stress and strain transformation on different plane for combined loading.
CO2: Analysis and simple design of various riveted and welded joints.
CO3: Apply energy methods to obtain structural deformations.
CO4: Obtain critical loads for columns with different end conditions.
CO5: Apply the theories of failure in designing the structures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-

Syllabus

Unit 1
Introduction to theory of elasticity: Stresses and strains at a point, equilibrium equations, boundary conditions, stress and strain transformations, principal stresses and strains, Mohr's circle, bi-axial and tri-axial stresses, constitutive relations, plane stress and plane strain conditions, stress and displacement formulations, strain compatibility relation, governing equations, Airy's stress function, analysis of thin and thick walled pressure vessels.

Unit 2
Analysis of Joints: Types of riveted, bolted, and welded joints, merits and demerits of various joints, study of failure behavior and simple design of joints; Energy Methods: Strain and potential energies, strain energy density, gradually applied loads and suddenly applied loads, Castigliano's theorem I and Castigliano's theorem II, Maxwell- Betti's theorem, unit load method and its applications, principle of virtual work, principle of virtual displacement and principle of virtual force.

Unit 3
Buckling of columns: Euler's formula, effective length, load versus deflection plot, load eccentricity, imperfections, South-well plot; Theories of Failure: Maximum principle stress theory, maximum principle strain theory, maximum strain energy theory, maximum shear stress (Tresca) theory, and maximum distortion (von-Mises) theory.

Text Book(s)
James M Gere, Barry J. Goodno "Mechanics of Materials", 8th Edition, Cengage Learning, USA, 2013.
R.C. Hibbeler "Mechanics of Materials", 8th Edition, P P Hall, New Jersey, USA, 2011.

Reference(s)

James M Gere, Stephen P. Timoshenko " Mechanics of Materials", 2nd Edition,CBS Publishers, New Delhi, 1986.

Srivastava, Gope " Strength of Materials", Prentice-Hall of India, 2007

C. T. Sun, "Mechanics of Aircraft Structures", Second Edition, John Wiley & Sons, New York, 2006.

Megson,T.H.G., "Aircraft Structures for Engineering Students", Butterworth-Heinemann, USA, 2007.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE214 INTRODUCTION TO CONTROL THEORY L-T-P-C: 2-1-0-3

Course Objectives

Introduce students to modelling, analysis and design of Linear Time Invariant (LTI) systems

Course Outcome

CO1: Represent LTI electro-mechanical systems, as a transfer function and state space models
CO2: Obtain time response of first and second order systems
CO3: Determine steady state error performance of a given system
CO4: Ability to use methods like Routh, root locus, Nyquist and Bode plots to analyse a system
CO5: Apply root locus and Bode plots in design of systems
CO6: Apply basic state space design methods

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2	1	-	1	1	1	-	2	3	3	3
CO2	3	3	2	1	2	1	-	1	1	1	-	2	3	3	3
CO3	3	3	2	1	2	1	-	1	1	1	-	2	3	3	3
CO4	3	3	2	1	2	1	-	1	1	1	-	2	3	3	3
CO5	3	3	3	1	3	1	-	1	1	1	-	2	3	3	3
CO6	3	3	3	1	3	1	-	1	1	1	-	2	3	3	3

Syllabus

Unit 1
Mathematical Modeling: Linear Systems, Block Diagrams, Feedback, Input Test Signals, Laplace Transforms. Transfer Functions, State Space Representation.

Unit 2
Definition of Stability – Response Vs. Pole Locations – Time Domain Specifications – System Type and Steady-State Errors – Routh's Stability Criterion – Root Locus – Guidelines for Sketching – Bode Plot Techniques – Nyquist Criterion – Stability Margins (Gain and Phase),

Unit 3
Root Locus Design Method: Dynamic Compensation (Lead/Lag), PID Controllers – Frequency Response Design Method – Robust Stability and Robust Performance – Introduction to State Space Design, Controllability and Observability – Introduction to State-Feedback and Estimator Design.

Text Book(s)

Norman S. Nise, "Control Systems Engineering," 6th edition, Wiley India, 2012.

Reference(s)
Ogata, K., "Modern Control Engineering," 5th edition, Prentice Hall, 2010.
R.C. Dorf and R.H. Bishop, "Modern Control Systems," 9th edition, Prentice-Hall, 2001.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE282 MECHANICS OF FLUIDS LAB.	L-T-P-C: 0-0-3-1

Course Objectives

Experimental validation of static and dynamic behaviour of fluids on standard apparatus.

Course Outcome

CO1: Understand the aim of the given experiment along with the underlying theory.
CO2: Setup the experiment and appreciate its limitations.
CO3: Carryout the experiment.
CO4: To draw inferences from the experiments and report the findings

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	2	-	3	-	-	-	-	-	-	-	-	2	3	2	2
CO3	2	-	-	-	2	-	-	-	2	-	-	2	3	2	2
CO4	-	3	-	3	2	-	-	3	2	3	-	2	3	2	2

Syllabus

Flow Experiments: Calibration of Orificemeter and Venturimeter, V and Rectangular Notches, Pipe Friction, Verification of Bernoulli's Theorem, Reynolds Apparatus, Metacentric Height, Jet Impact Studies.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	-	
Periodical 2 (P2)	-	
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE283	MATERIALS TESTING LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To supplement the theoretical knowledge gained in Mechanics of Materials, this course provides students opportunities to become familiar with standard mechanical testing methods and provides fundamental properties of engineering materials under axial, bending, torsional and impact loads.

Course Outcome

CO1: Understand the aim of the experiment (list appended below) along with the underlying theory.
CO2: Setup the experiment and appreciate its limitations.
CO3: Carryout the experiment.
CO4: Record, interpret and report the findings.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	2	-	3	-	-	-	-	-	-	-	-	2	3	2	2
CO3	2	-	-	-	2	-	-	-	2	-	-	2	3	2	2
CO4	-	3	-	3	2	-	-	3	2	3	-	2	3	2	2

Syllabus

Tension test on metals.
Hardness test on metals using the Rockwell and Brinell equipment.
Impact tests on metals using the Charpy and Izod equipment.
Double shear test.
Helical spring tests.
Static bending test on Wood.
Compression tests on Wood.
Deflection test to verify the Maxwell reciprocal theorem.

In addition to the conventional tests, students are assigned to open lab projects that involve experimental studies including fabrication and setting up unconventional testing methods to understand the basic concepts of strength of materials.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	-	
Periodical 2 (P2)	-	
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19SSK211	SOFT SKILLS I	L-T-P-C: 1-0-2-2

Course Outcome

CO 1 - Soft Skills: At the end of the course, the students would have developed self-confidence and positive attitude necessary to compete and challenge themselves. They would also be able to analyse and manage their emotions to face real life situations.

CO 2 - Soft Skills: Soft Skills: At the end of the course, the students would hone their presentation skills by understanding the nuances of content creation, effective delivery, use of appropriate body language and the art of overcoming nervousness to create an impact in the minds of a target audience.

CO 3 - Aptitude: At the end of the course, the student will have acquired the ability to analyze, understand and classify questions under arithmetic, algebra and logical reasoning and solve them employing the most suitable methods. They will be able to analyze, compare and arrive at conclusions for data analysis questions.

CO 4 – Verbal: At the end of the course, the students will have the ability to dissect polysyllabic words, infer the meaning, inspect, classify, contextualise and use them effectively.

CO 5 - Verbal: At the end of the course, the students will have the ability to understand the nuances of English grammar and apply them effectively.

CO 6 – Verbal: At the end of the course, the students will have the ability to identify, analyse and interpret relationship between words and use the process of elimination to arrive at the answer. They will also have the ability to judge, evaluate, summarise, criticise, present and defend their perceptions convincingly.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2	3	3		3
CO2									2	3		3
CO3		3		2								
CO4										3		3
CO5										3		3
CO6									3	3		3

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work - environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, Self motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how

to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words. Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and punctuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving level I: Number system; LCM &HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Cryptogrithms.

TEXTBOOKS

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Quantitative Aptitude by R. S. Aggarwal,S. Chand
Quantitative Aptitude – Abijith Guha, TMH.
Quantitative Aptitude for Cat - Arun Sharma. TMH.

REFERENCES:

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.
More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources
www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

SEMESTER V

19MAT112	LINEAR ALGEBRA	L-T-P-C:2-1-0-3

Course Objectives

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.

Course Outcomes

CO1: Understand the basic concepts of vector space, subspace, basis and dimension.
CO2: Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution.
CO3: Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis, to get the QR decomposition, and to transform the given matrix to diagonal/Jordan canonical form.
CO4: Understand the concept of positive definiteness, matrix norm and condition number for a given square matrix.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	2	1									
CO2	3	3	2									
CO3	3	3	2									
CO4	3	2	1									

Syllabus

Pre-request: Matrices

Review of matrices and linear systems of equations. (2 hrs)
Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis - Dimension - Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis. (12 hrs)
Orthogonal complements - Projection on subspace - Least Square Principle. (6 hrs)

Linear Transformations: Positive definite matrices - Matrix norm and condition number - QR- Decomposition - Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation. (10 hrs)
Change of basis - Nilpotent transformations - Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form. (10 hrs)
SVD.

Text Book
Howard Anton and Chris Rorrs, "Elementary Linear Algebra", Ninth Edition, John Wiley & Sons, 2000.

Reference Book(s)
D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Gilbert Strang, "Linear Algebraand its Applications", Third Edition, Harcourt College Publishers, 1988.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE301	AERODYNAMICS II	L-T-P-C: 2-1-0-3

Course Objectives

This subject deals with basic concepts pertinent to finite wings. In other words, it highlights the deficiency of classical approaches based on airfoil theory by incorporating the real effects of wing-tip vortices that causes the additional induced drag on finite wings.

Course Outcome

CO1: Understand thin airfoil theory and extend it to evaluate effects of thickness and flap deflection.
CO2: Understand and apply finite wing theory to evaluate the aerodynamic coefficients and forces for high aspect ratio finite wings
CO3: Understand flow over delta wings and LEVF technology and an introduction to buffeting.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	-	-	3	-	-	3	3	-
CO2	2	3	-	-	-	-	-	-	-	3	-	-	3	3	-
CO3	3	2	-	1	-	-	-	-	-	3	-	-	3	3	1

Syllabus

Unit 1

Classical Thin Airfoil Theory for Symmetric and Cambered Airfoils: Lift and Moment Coefficients, Center of Pressure, Predicting Zero Lift Angle of Attack, Flapped Airfoils, Effects of Thickness.

Unit 2

Finite Wing Theory: The Concept of Downwash and Induced Drag – Classical Theorems: Curved Vortex Filament, Biot-Savart Law, Helmholtz's Vortex Theorems – Method of Analysis: Prandtl's Classical Lifting Line Theory, Modern Numerical Lifting Line Method, Lifting Surface Theory, Modern Vortex Lattice Numerical Method.

Unit 3

Flow Physics Associated with Delta Wings: Subsonic Flow Pattern, Pressure Envelope, Leading Edge Vortex Flap (LEVF) Technology and Performance Comparison, Buffeting Phenomena and Types of Vortex Breakdown.

Text Book(s)

John D Anderson, "Fundamentals of Aerodynamics," 5th edition, McGraw Hill, 2010.

Reference(s)

E.L. Houghton and P.W. Carpenter, "Aerodynamics for Engineering Students," 5th edition, Butterworth-Heinemann, 2003.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE302	AEROSPACE PROPULSION	L-T-P-C: 2-1-0-3

Course Objectives

Provide introduction to the functioning of aircraft engines and their performance characterization. Explain the components of aircraft engines and enable students to the carry out thermodynamic analysis of the engine cycles. Provide an introduction to rocket propulsion.

Course Outcome

CO1: Apply momentum conservation laws to the process of propulsive thrust production in various system.
CO2: Analyse propulsion cycle using thermodynamics.
CO3: Study combustion and combustor functioning.
CO4: Comprehend the fundamentals of rocket propulsion.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-	1	2	2
CO3	2	-	-	-	-	-	2	-	-	-	-	-	-	2	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Syllabus

Unit 1
Momentum Analysis of Thrust Generation – Types of Propulsion Systems and their Components – Performance Measures – Propellers: Performance Coefficients – Review of Thermodynamic Cycles - Ideal Cycle Analysis: Ramjets, Turbojets and Turbofan Engines.

Unit 2
Component Performance – Analysis of Real Engines – ~~Chemistry~~*Review of Combustion chemistry* – Heat of Combustion – Reaction Rate – Flames – Stability Considerations – Application to Gas Turbine Combustion – Fuels:. Introduction to Aviation Fuels.

Unit 3
Rocket Vehicle Mechanics – Multistaging – Thermodynamics of Rocket Engine – Rocket Engine Performance – Types of Rocket Engines – Fuels for Solid and Liquid Propellant Rockets – Rocket Cooling.

Text Book(s)
Mattingly.Jack.D, "Elements of Propulsion: Gas Turbines and Rockets," AIAA Education Series, 2006.

Reference(s)
Turner.Martin, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.
Mukunda.H.S, "Understanding Combustion," 2nd edition, Macmillan India Limited, 2007.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE303	AEROSPACE STRUCTURES II	L-T-P-C: 3-0-0-3

Course Objectives

To study and analyze the behavior of various thin-walled aerospace structural components under different load conditions.

Course Outcome

CO1: Understand the aircraft structures.
CO2: Analysis of non-circular torsional members
CO3: Evaluate the bending stresses and flexural shear flows in thin walled sections
CO4: Investigate the torsional shear flows in thin walled sections
CO5: Illustrating the concepts of buckling for thin walled sections.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	1	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	2	1	-

Syllabus

Unit 1
Introduction to different aerospace structures, loads on an aircraft, characteristics of aircraft structures, basic structural members in aircraft structures and their functions; Torsion in non-circular bars, Prandtl stress function, St. Venant warping function, membrane analogy, torsion in narrow rectangular section.

Unit 2
Euler – Bernoulli and Timoshenko beam theories, bi-directional bending, bending and transverse shear stresses, bending stresses in narrow rectangular section, general symmetric sections, and thin-walled sections, flexural shear flows (FSF), FSF in thin-walled open sections, shear center in open sections.

Unit 3
Torsional shear flows (TSF) in thin-walled open sections, TSF in thin-walled closed sections (single and multiple cells) and warping in open and closed thin-walled sections, Combined flexural and torsional shear flows in thin-walled closed sections (single and multi-cells) and shear center in closed sections, buckling of non-symmetrical sections and buckling of thin-walled sections

Text Book(s)
C. T. Sun, "Mechanics of Aircraft structures", John Wiley & sons, New York, 2006.

Reference(s)
Megson,T.H.G., "Aircraft Structures for Engineering Students", Butterworth-Heinemann, USA, 2007
Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw–Hill, New York, 1993.
Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, 1985.
Rivello, R. M., " Theory and analysis of flight structures" McGraw-Hill, New York,1969.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE304	AVIONICS	L-T-P-C: 3-0-0-3

Course Objectives

To introduce students to basic avionics systems used in aircrafts and UAVs

Course Outcome

CO1: Explain the importance, subsystems and environmental specifications of Avionics systems
CO2: Derive air data laws and explain its use in air data computer
CO3: Describe working principle of an embedded systems with applications in avionics
CO4: Explain basic elements of electronic communication systems and its applicability to radio navigational aids
CO5: Explain working principle of Inertial sensors like gyros and accelerators and its use in inertial navigation systems
CO6: Explain basic principle of autopilot and UAV systems

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	1	3
CO2	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO3	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO4	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO5	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3
CO6	3	1	1	-	-	-	-	-	-	-	-	1	3	1	3

Syllabus

Unit 1
Introduction: Importance and role of avionics, the avionic environment – Air Data Systems: Air Data Information and its use, Air data laws, sensors and computations.

Unit 2
Embedded systems: Basic hardware building blocks of a typical embedded system – Software concepts relevant to avionics: Interrupts and Real Time Operating Systems – case studies illustrating importance of embedded systems in avionics – Introduction to electronic communication systems – Utility of Radio Navigation Aids.

Unit 3
Inertial sensors and systems: Laser and MEMS Gyros, Accelerometers, Attitude Heading Reference System – Navigation Systems: Basic principles, Inertial Navigation, Strapped-down inertial systems – Introduction to Autopilot and UAV Avionics. Safe disposal of electronic waste

Text Book(s)
R.P.G Collinson, "Introduction to Avionics", Springer, 2002.

Reference(s)

Kayton And Fried, "Avionics Navigation Systems", Wiley, 1997.
Frank Vahid ,Tony Givargis, "Embedded System Design",Wiley, 2006.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE381	AERO-STRUCTURES LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To provide the basic knowledge of the testing equipment for various thin walled structural components and to impart the practical exposure with the measuring equipment and sensors.

Course Outcome

CO1: Understand the aim of the experiments and correlate the results with real time structures
CO2: Execute the experimental setup and observe the readings for analysis.
CO3: Analyse the experimental results and interpret with theoretical calculations.
CO4: Apply the concepts by doing an open lab experiments and presentation.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	2	1	3	-	3	-	-	-	-	-	-	2	2	3	2
CO3	2	1	-	-	3	-	-	-	2	-	-	2	3	3	2
CO4	1	1	-	3	3	-	-	1	2	2	-	2	3	2	2

Syllabus

Determination of principal axis in unsymmetrical bending of beams.
Experiment on constant strength beam.
Determination of shear centre location for open and closed thin-walled sections.
Testing of beam with combined loading.
Measurement on vibrations of beams.
Wagner beam – Tension field beam experiments.
Determination of stresses in thin walled cylinder.
Finding the buckling strength of column using the South well plot test.

In addition to the conventional tests, students are assigned to open lab projects that involve experimental studies including fabrication and setting up unconventional testing methods to understand the basic concepts of thin walled member behaviour.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	-	
Periodical 2 (P2)	-	
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE382	AVIONICS LAB	L-T-P-C: 0-0-3-1

Course Objectives

To expose students to carry out experiments related to avionics and control systems using Matlab.

Course Outcome

CO1: Understanding of given open/closed loop control system experiment.
CO2: Ability to setup the experiment in Matlab environment.
CO3: Ability to code in Matlab and carryout the experiment.
CO4: To draw inferences from the Matlab simulations.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	2	1	3	-	3	-	-	-	-	-	-	2	2	3	2
CO3	2	1	-	-	3	-	-	-	2	-	-	2	3	3	2
CO4	1	1	-	3	3	-	-	1	2	2	-	2	3	2	2

Syllabus

Topics : Control System Exercices using MATLAB : Analysis and design of closedloopaircraftsystemsusing techniques likeRootIocus, Nyquist and Bode Plot.
Mini Project : Related to Control, Electronics and Navigation

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	-	
Periodical 2 (P2)	-	
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19SSK301	SOFT SKILLS IIL-T-P-C: 1-0-2-2

Course Outcomes

CO # 1 - Soft Skills: At the end of the course, the students will have the ability to communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their inter-personal and leadership skills.

CO # 2 - Soft Skills: At the end of the course, the students shall learn to examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus.

CO # 3 - Aptitude: At the end of the course, students will be able to identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics.

CO # 4 – Verbal: At the end of the course, the students will have the ability to relate, choose, conclude and determine the usage of right vocabulary.

CO # 5 - Verbal: At the end of the course, the students will have the ability to utilise prior knowledge of grammar to recognise structural instabilities and modify them.

CO # 6 – Verbal At the end of the course, the students will have the ability to comprehend, interpret, deduce and logically categorise words, phrases and sentences. They will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas.

Syllabus

Professional grooming and practices: Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behaviour, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation, conclude the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.

Group discussions: Advantages of group discussions, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.

Listening comprehension advanced: Exercise on improving listening skills, grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving level III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

Non-verbal reasoning and simple engineering aptitude: Mirror image; Water image; Paper folding; Paper cutting; Grouping of figures; Figure formation and analysis; Completion of incomplete pattern; Figure matrix; Miscellaneous.

Spacial aptitude: Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems etc., related problems.

TEXTBOOK(S)

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Quick Maths – Tyra.
Quicker Arithmetic – Ashish Aggarwal

Test of reasoning for competitive examinations by Thorpe.E. TMH
Non-verbal reasoning by R. S. Aggarwal, S. Chand

REFERENCE(S)

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova
More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources
www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

19LIV390	LIVE-IN-LAB I	L-T-P-C: 0-0-0-3

Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- User Need Assessment through Quantitative and Qualitative Measurements
- Designing a solution by integrating Human Centered Design concepts
- Devising proposed intervention strategies for Sustainable Social Change Management

Course Outcome

CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement.
CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal.
CO3: Identify and formulate the research challenges in rural communities.
CO4: Design solutions using human centered approach.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3		3		1	1		3	3		3
CO2		3						3	3	3		
CO3		3					1		3	3		3
CO4	3		3				3	3	3	3		3

Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [75 marks]	
Workshop (Group Participation)	15
Village Visit Assignments & Reports	15
Problem Identification and Assessment	15
Ideation: Defining the Needs, Proposed Designs & Review	20
Poster Presentation	10
External [25 marks]	
Research Paper Submission	25
Total	**100**
Attendance (To be added separately)	5
Grand Total	**105**

SEMESTER VI

19AEE311	FINITE ELEMENT METHODS FOR AEROSPACE	L-T-P-C: 2-1-0-3

Course Objectives

Understand the concepts of mathematical modeling of engineering problems by introducing the Finite Element Methods and to help the students use this method and commercial software package to solve simple aerospace structures.

Course Outcome

CO1: Understand the concepts behind variational methods and weighted residual methods in FEM.
CO2: Identify the application and characteristics of FEA elements such as bars, beams, plane and Isoparametric elements, and 3-D element.
CO3: Develop element characteristic equation procedure and generation of global stiffness equation will be applied.
CO4: Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
CO5: Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	2	1	2	-	-	-	-	-	-	-	1	3	-
CO3	2	1	3	2	-	-	-	-	1	1	-	-	1	2	1
CO4	1	1	2	1	2	-	-	-	-	-	-	-	1	1	-
CO5	1	2	1	1	3	-	-	-	2	2	-	2	-	1	3

Syllabus

Unit 1
Introduction to FEM - equilibrium condition, strain-displacement relation, linear constitutive relations - domain discretization, types of elements, assembly procedures, boundary conditions- Formulations: Potential energy method, Variational formulation, Weighted residual, Galerkin and Rayleigh-Ritz methods.

Unit 2
Coordinate systems, convergence criteria, 1D Elements: Axial elements basic formulations, formations of shape functions, problems using 1D elements, Beam (bending) element: formulations and formation of shape function

and problems – 2D elements: Plane stress and Plane strain element formulation, shape function development, problems using 2D elements - axi-symmetric elements- iso-parametric formulation of elements.

Unit 3

3D element formulations - Introduction to FE formulation of Plate bending and shell elements - Numerical integration - Solution techniques of the numerical equations- Introduction to FE software- FE modeling of aircraft and spacecraft components- Application of boundary conditions and loadings on FE models- Analysis of subcomponents like wings, fuselage, motor casing, etc.

Text Book(s)

Daryl L. Logan, "A First Course in the Finite Element Method", CL, New Delhi,2007.

Reference(s)

C. S. Krishnamoorthy, "Finite Element Analysis" , Tata McGraw-Hill Publishing Company Limited, New Delhi, 1999.

David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi.

Megson, T. H. G., " An introduction to aircraft structural analysis", Butterworth-Heinemann, USA, 2010.

Tirupathi R. Chandrapatla and Ashok D. Belegundu, "Introduction to Finite Element in Engineering", Prentice Hall of India, New Delhi.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports.

19AEE312	FLIGHT MECHANICS	L-T-P-C: 2-1-0-3

Course Objectives

· To understand the performance parameters and performance evaluation of aircrafts fitted with turbojet engines
· To understand the performance parameters and performance evaluation of aircrafts fitted with piston propeller engines
· To evaluate the longitudinal static stability of a fixed wing aircraft in low subsonic flow and introduce the concepts of static lateral and directional stability.
· To introduce the concept of dynamic stability.

Course Outcome

CO1: Understand and apply equations of motion for an aircraft. Evaluate performance of turbojet aircrafts for climb, steady flight and turn.
CO2: Glide and take-off and landing performance evaluation. Evaluate the climb, steady flight and turn performance of piston-engine aircrafts
CO3: Able to evaluate longitudinal static stability and understand the principle of dynamic stability.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	-	-	-	-	-	3	-	-	3	2	3
CO2	3	3	-	3	-	-	-	-	-	3	-	3	3	2	3
CO3	3	3	-	3	-	-	-	-	-	3	-	3	3	2	3

Syllabus

Unit 1
Equations of Motion – Forces Acting on the Aircraft – Review of Aerodynamic Characteristics of the Wing and Compressibility Effects – Review of Propulsion Systems and their Performance Characteristics – Drag Contribution from Aircraft Components – Airplane Performance of Turbojets: Steady Flight, Range, Endurance, Conditions for Maximum Range and Endurance, Climb Performance, Turn Performance, Maximum Load Factor During Turn.

Unit 2
Glide Performance - Take-Off and Landing Performance – Performance of Piston-Props: Steady Flight Climb and Turn Performance, Climb Performance, Turn Performance, Comparison with Turbojets - Turbofan and Turboprop Performance Evaluation Guidelines.

Unit 3
Concept of Static and Dynamic Stability – Longitudinal Stability: Neutral Point, Stick-Fixed and Stick Free Stability – Longitudinal Control – Hinge Moments – Control Power – Directional Stability and Control – Lateral Stability and Control – Introduction to Dynamic Stability – Stability Derivatives.

Text Book(s)

Hale, Francis J, "Introduction to Aircraft Performance, Selection, and Design". Wiley, 1984.
Nelson.R.C, "Flight Stability and Automatic Control", 2nd edition, McGraw-Hill, 1998.

Reference(s)

Perkins.C.D and Hage.R.E, "Aircraft Performance, Stability and Control", 11th edition, Wiley, 1967.
Anderson.J.D,, "Aircraft Performance and Design", McGraw-Hill, 2010.
Russel.J.B,, "Performance and stability of aircraft", Butterworth-Heinemann, 1996.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE383	PROPULSION LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To learn the thermal and fluid flow measurement techniques pertaining to the aircraft and rocket propulsion systems using experimental simulation of thermal fluid flow behavior.

Course Outcome

CO1: Conduct the fluid and thermal flow experiments and identify the errors and uncertainties.
CO2: Acquire the understanding of the engineering principles from the different experimental fluid-thermal flow measurements.
CO3: Examine and interpret the experimental results available in the form of tables, graphs, and figures.
CO4: Develop the report from the experimental procedure and outcome of the experiments.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	2	2	-	-	-	3	1	2
CO2	3	2	2	2	-	-	-	2	2	-	-	-	3		2
CO3	2	3	3	3	2	-	-	2	2	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	2	2	2	2	-	3	-	2

Syllabus

Propeller Testing: Estimation of Static Performance, Estimation of Figure of Merit – Nozzle Testing: Mach number Distribution along a Convergent-divergent Nozzle – Flame Speed Measurement: Variation of Flame Speed with Equivalence Ratio – Study of Free Incompressible Jet: Study of Velocity Profiles and the Entrainment Process – Cascade Testing: Measurements of Velocity and Pressure in a Cascade Flow Field: Effect of the Variation in Angle of Attack.

Text Book(s)

Phillip Hill and Carl Peterson, "Mechanics and Thermodynamics of Propulsion," 2nd edition, Pearson (India), 2009.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE384	LOW-SPEED AERODYNAMICS LAB.	L-T-P-C: 0-0-3-1

Course Objectives

To effectively implement aerodynamic optimization of moving / flying machines.

Course Outcome

CO1: Wind Tunnel Calibration that characterizes the quality of flow in the test section.
CO2: Developing valid test models based on dimensional analysis, and model design criteria.
CO3: Qualitative and Quantitative measurements that include flow visualization and image processing, and static pressure distribution with respect to Reynolds number.
CO4: Extracting flow structures, and the form-drag for aircraft configurations, UAV, locomotives and automobiles.
CO5: To execute effectively the aerodynamic optimization for flying or moving machines.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	-	-	-	-	1	1	-	1	3	1	1
CO2	3	3	1	3	3	-	-	-	1	1	-	1	3	3	3
CO3	3	3	-	3	3	-	-	-	1	1	-	1	2	3	3
CO4	3	3	-	3	-	-	-	-	1	1	-	1	3	1	3
CO5	3	3	2	3	2	-	1	-	1	3	-	1	3	3	3

Syllabus

Wind Tunnel Calibration: Velocity Measurements, Boundary Layer Thickness Characterization - Quantification of Level of Turbulence in the Wind Tunnel: Sphere Test – Pressure or Form Drag Measurements: Finite and Infinite Wings, Fuselage, UAV, Locomotives – Flow Visualization: Smoke, Tuft, Surface Coating – Image Processing: Essential Aspects of Image Enhancement Utilizing Commercial Software MATLAB to extract Flow Structures – Open Projects relevant to Aerodynamics.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE385	INNOVATIONS LAB.	L-T-P-C: 0-0-3-1

Course Objective

To enable students to convert their innovative ideas to products

Course Outcome

CO1: Market survey to identify under-served needs of common people, existing solutions and predict demand.
CO2: Propose solution (engineering/social) to meet the under-served need.
CO3: Analyse the impact of the proposed solution on environment and society.
CO4: Fabricate prototype with emphasis on industrial design.
CO5: Formulate a business model.
CO6: Ability to convince funding agencies (pitching)

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	2	3	-	-	2	3	-	2	1	-	1
CO2	2	2	2	-	2	3	-	-	2	2	-	-	2	-	1
CO3	1	1	-	1	1	3	3	3	2	2	-	2	2	-	1
CO4	3	3	3	3	3	2	2	3	3	2	-	2	2	-	1
CO5	-	2	-	-	2	-	-	-	-	-	3	2	-	-	1
CO6	-	-	-	-	-	-	-	-	3	3	3	2	-	-	1

Syllabus

Activities: Identification of Problem – Identification of Criteria and Constraints – Market Study – Brainstorming for Possible Solutions – Generation of Ideas – Exchange of Ideas and Obtaining Feedback From Mentors and Batch-mates – Exploration of Possibilities – Study of Environmental and Social Impact of Innovative Ideas – Convergence on Methodology and Solution to the Problem – Viability for Scaling Up – Build a Model or Prototype – Paper Submissions / Patent Proposals.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

•CA –Presentations and Reports

19SSK311	SOFT SKILLS III	L-T-P-C: 1-0-3-2

Course Outcomes:

CO # 1 - Soft Skills: At the end of the course, the students will have the ability to prepare a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and knowledge to present themselves confidently. They would be sure-footed in introducing themselves and facing interviews.

CO # 2 - Soft Skills: At the end of the course, the students will have the ability to analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO # 3 - Aptitude: At the end of the course, students will be able to interpret, critically analyze and solve logical reasoning questions. They will have acquired the skills to manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions.

CO # 4 – Verbal: At the end of the course, the students will have the ability to understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same.

CO # 5 - Verbal: At the end of the course, the students will have the ability to decide, conclude, identify and choose the right grammatical construction.

CO # 6 – Verbal: At the end of the course, the students will have the ability to examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also have the ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English.

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation / knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Co-ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOK(S)

A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
The Hard Truth about Soft Skills, by Amazone Publication.
Data Interpretation by R. S. Aggarwal, S. Chand
Logical Reasoning and Data Interpretation – Niskit K Sinkha
Puzzles – Shakuntala Devi
Puzzles – George J. Summers.

REFERENCE(S)

Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.
More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
The BBC and British Council online resources
Owl Purdue University online teaching resources

www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

19LIV490	LIVE-IN-LAB II	L-T-P-C: 0-0-0-3

Course Objectives

- Proposal writing in order to bring in a detailed project planning, enlist the materials required and propose budget requirement.
- Use the concept of CoDesign to ensure User Participation in the Design Process in order to rightly capture user needs/requirements.
- Building and testing a prototype to ensure that the final design implementation is satisfies the user needs, feasible, affordable, sustainable and efficient.
- Real time project implementation in the village followed by awareness generation and skill training of the users (villagers)

Course Outcome

CO1: Learn co-design methodologies and engage participatorily to finalise a solution
CO2: Understand sustainable social change models and identify change agents in a community.
CO3: Learn Project Management to effectively manage the resources
CO4: Lab scale implementation and validation
CO5. Prototype implementation of the solution

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	3			1	3	3	3		3
CO2									3	3		
CO3									3	3	3	
CO4	3		3			3	1	3	3	3		3
CO5			1						3	3		

Syllabus

The students shall visit villages or rural sites during the vacations (after 6th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.
Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [63 marks]	
1. Proposed Implementation Presentation Round 1	**2**
2. Proposal Submission + Review	**6**
3. Co-design	**6**
i. Village Visit I (Co-Design Field Work Assignments)	4
ii. Presentation of Co-design Assessment	2
4. Prototype Design	**14**
i. Prototype Design	4
ii. Prototype Submission	8
iii. Sustenance Plan	2
5. Implementation	**35**
i. Implementation Plan Review	3
ii. Implementation	24
iii. Testing & Evaluation	4
iv. Sustenance Model Implementation	4
External [37 marks]	
6. Research Paper	**18**
7. Final Report	**15**
8. Poster Presentation	**4**
Total	**100**
Attendance	5
Grand Total	**10**

SEMESTER VII

19AEE401	COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE	L-T-P-C: 2-1-0-3

Course Objectives

The objective of the course is to introduce students to the finite difference method and related numerical techniques involved in the study of fluid flow problems.

Course Outcome

CO1: Recall the governing equation of fluid dynamics in conservation and non-conservation form.
CO2: Utilize finite difference method for the discretization of the fluid flow problems.
CO3: Make use of suitable numerical methods for solving the governing equations in the discretizieddomain by understanding stability sand convergence.
CO4: Choose proper structured / unstructured 2D grids specific to particular fluid flow problems.
CO5: Apply the FDM to develop CFD techniques: Lax-Wendroff ,MacCormack techniques.
CO6: Experiment numerically the theoretical understanding of Computational Fluid Dynamics using software packages.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	-	-	-	-	-	-	-	1	3	1	2
CO2	3	3	1	2	2	-	-	-	-	-	-	1	3	2	2
CO3	3	3	1	2	3	-	-	-	2	-	-	1	3	3	2
CO4	2	3	1	1	3	-	-	-	-	-	-	2	3	3	2
CO5	3	3	3	1	3	-	-	-	-	-	-	2	3	3	2
CO6	2	3	3	3	3	-	-	-	3	3	-	3	3	3	3

Syllabus

Unit 1
Introduction to Numerical Methods – Properties of Numerical Solutions: Errors, Consistency, Accuracy, Stability, Convergence, Conservation – Review of Governing Equations of Fluid Dynamics – Review of Classification of PDE's and their Physical Implications for Compressible Flows.

Unit 2
Introduction to the Finite Difference Methods: Discretization of Temporal and Spatial Derivatives, Explicit and Implicit Formulations – Mccormack's Scheme, Extensions to Viscous Flows – Shock Capturing – Lax-Wendroff Method.

Unit 3
Stability Analysis: Von Neumann Stability Criteria, CFL Criterion for Stability – Introduction to Grid Generation: Body Conforming Grids, Algebraic and Elliptic Grids, 2D Unstructured Grids, C-Grids, O- Grids and H-Grids for Flow Past Airfoils and Wings – Simulation of External and Internal Flows as Applied to Aerospace Components.

Text Book(s)

John D Anderson, "Computational Fluid Dynamics – The Basics With Application", Mcgraw-Hill, 1995.

Reference(s)

T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press,2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE402	AERO DESIGN	L-T-P-C: 2-2-3-5

Course Objectives

· To understand and apply aero design principles and methodologies for the conceptual design of an aircraft.
· To apply concepts learnt in previous semesters to conceptual design.

Course Outcome

CO1: Able to apply basic aerodynamic, propulsion, structural and flight mechanics concepts to practical Design problems and to analyze the effects of design parameters theoretically.
CO2: Appreciate and understand constraints and compromises needed in practical cases.
CO3: Understand issues in various types of flying vehicle design and able to apply basic aerospace concepts for the design of these vehicles
CO4: Able to select and conceptually design Propulsion systems and estimate the weight, volume, shape and size of aero-vehicles.
CO5: Able to analyze and evaluate weights and stability issues and able to design control surfaces
CO6: Able to appreciate and evaluate a design and conduct trade-off studies and market and technological trend studies.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	1	2	3	3	1	3	2	3	3
CO2	2	3	3	3	-	3	3	3	3	3	2	3	1	3	3
CO3	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	-	-	2	3	3	3	3	3	3	3
CO6	3	3	3	3	2	3	2	3	3	3	3	3	1	3	3

Syllabus

Unit 1
Review of Aircrafts and Spacecrafts – Introduction to Design Process: Design Requirements, Data Collection & Statistical Study, Conceptual, Preliminary and Detailed Designs, Regulatory Requirements.

Unit 2
Weight, Volume and Size Estimates: Fixed Wing, Flapping Wing and Rotary Wing Vehicles, Launch Vehicles, Satellites, Lunar and Interplanetary Vehicles, Atmospheric Re-Entry Vehicles, Missiles, Airships, Aerostats and Parachutes – Aerodynamic and Control Surface Design for Atmospheric Vehicles and Space Vehicles – Selection and Design of Propulsion System.

Unit 3
Weight Distribution and Stability Estimates – Estimation of Control Characteristics – Performance Evaluation and Trade-Off Studies – Current Technological and Regulatory Trend Studies – Market Study.

Text Book(s)

Daniel P. Raymer, "Aircraft Design - A Conceptual Approach," 5th edition, AIAA Education Series, 2012.

Reference(s)

Ajoy Kumar Kundu, "Aircraft Design," Cambridge University Press, 1st Edition, 2010.
Leeland M Nicolai and Grant E.Carichner, "Fundamentals of Aircraft and Airship Design-Volume I," AIAA, 1st Edition, 2010.
Leeland M Nicolai, and Grant E.Carichner, "Fundamentals of Aircraft and Airship Design-Airship Design & Case Studies -Volume II," AIAA, 1st Edition , 2013.
Anderson.J.D,, "Aircraft Performance and Design", McGraw-Hill, 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE403	FLIGHT DYNAMICS AND CONTROL	L-T-P-C: 3-0-0-3

Course Objectives

To introduce students to flight dynamics and control of aircrafts in order to achieve satisfactory flying and handling qualities.

Course Outcome

CO1: Explain static and dynamic stability of an aircraft
CO2: Apply 'Small perturbation theory' to derive Linear equations of motion of an aircraft
CO3: Derive stability derivatives using first principles
CO4: Understand concept and physics of Longitudinal and lateral Modes
CO5: Derive transfer function of aircraft motion for different control surface inputs
CO6: Recognise the importance of Flying and Handling qualities
CO7: Discuss advanced concepts like stability augmentation system, autopilot and control configured vehicles

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	-	-	-	-	1	3	2	2
CO2	2	2	1	1	2	-	-	-	-	-	-	1	3	1	2
CO3	1	2	3	1	2	-	-	-	-	-	-	1	3	3	3
CO4	1	2	3	1	2	-	-	-	-	-	-	1	3	3	1
CO5	2	2	2	1	-	-	-	-	-	-	-	1	3	2	3
CO6	2	2	3	1	2	2	-	-	-	-	-	1	3	3	3
CO7	2	1	3	-	1	1	1	-	-	-	-	1	3	3	3

Syllabus

Unit 1
Review of Static Stability – Concepts and Introduction to Dynamic Stability – Review: Body Axis, Stability Axis, Earth Axis – Euler Angles – Transformation between axis – Advantages of different axis – Aircraft Equations of Motion.

Unit 2
Small Perturbation Theory: Linear Equations of Motion, Stability Derivatives, Longitudinal and Lateral Modes – Concept and Physics – Characteristic Equation – Transfer Function Approach – State Space Modelling and its application to Modes.
.

Unit 3
Flying and Handling Qualities – Autopilots – Stability Augmentation System (SAS). Active Control Technology(ACT): Relaxed static stability, gust load alleviation, direct lift control, direct side force generator**.**

Text Book(s)

M.V. Cook, Flight Dynamics Principles, "A Linear Systems Approach To Aircraft Stability And Control," 3rd Edition, Elsevier, 2013.

Reference(s)

Robert C Nelson,"Introduction To Flight Stability And Automatic Control," 2nd Edition, Mcgraw-Hill, 1998.
Warren F Philips, "Mechanics Of Flight", Wiley, 2004.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE481	FLIGHT TESTING LAB	L-T-P-C: 0-0-3-1

Course Objectives

Performance evaluation of various aircraft using the flight simulator setup

Course Outcome

CO1: Understand the aim of the given experiment along with the underlying theory.
CO2: Ability to setup the experiment in the flight simulator.
CO3: Carryout the experiment in the Flight Simulator.
CO4: To draw inferences from the experiments and report the findings.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	2	-	3	-	-	-	-	-	-	-	-	2	3	2	2
CO3	2	-	-	-	2	-	-	-	2	-	-	2	3	2	2
CO4	-	3	-	3	2	-	-	3	2	3	-	2	3	2	2

Syllabus

- Flight testing using a simulator, to determine following:
- Glide performance
- Climb rate
- Range and endurance
- Turn rate
- Short period and Phugoid mode
- Roll subsidence

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	80	
End Semester		20

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE495	PROJECT PHASE I	L-T-P-C: 0-0-6-2

Course Objectives

To introduce a group task to work on theoretical, computational or experimental projects and ask students to finish the projects in time and present their results both orally and as written reports

Course Outcome

CO1: Ability to identify a problem, formulate a methodology, analyze, investigate the results, using acquired theoretical knowledge.
CO2: Work as an effective team member.
CO3: Manage the cost and time of the project.
CO4: Ethically communicate the results both orally and as written reports.
CO5: Assess the societal and environment effects of the project.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-		3	3	2	2
CO2	-	-	-	-	-	-	-	-	3	2	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	2
CO4	-	-	-	-	-	-	-	3	-	3	-	-	-	-	2
CO5	-	-	-	-	-	3	3	-	-	-	-	-	-	-	2

Syllabus

Various project titles based on areas covered up to 7th semester are allotted to batches of 3 to 4 students. Preliminary studies and investigations on the allotted topic.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	60	
End Semester		40

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE499	PROJECT PHASE II	L-T-P-C: 0-0-30-10

Course Objectives

To introduce a group task to work on theoretical, computational or experimental projects and ask students to finish the projects in time and present their results both orally and as written reports

Course Outcome

CO1: Ability to identify a problem, formulate a methodology, analyse, investigate the results, using acquired theoretical knowledge.
CO2: Work as an effective team member.
CO3: Manage the cost and time of the project.
CO4: Ethically communicate the results both orally and as written reports.
CO5: Assess the societal and environment effects of the project.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-		3	3	2	2
CO2	-	-	-	-	-	-	-	-	3	2	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	2
CO4	-	-	-	-	-	-	-	3	-	3	-	-	-	-	2
CO5	-	-	-	-	-	3	3	-	-	-	-	-	-	-	2

Syllabus

To achieve objectives and to carry out detailed investigation towards the outcome of each allotted project.

Evaluation Pattern

Assessment	Internal	End Semester
*Continuous Assessment (CA)	60	
End Semester		40

•CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVES II

19AEE331	FUNDAMENTALS OF HEAT TRANSFER	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE201- MECHANICS OF FLUIDS

Course Objectives

The objective of this course is to provide the students with a basic understanding of phenomena of heat transfer: Conduction, convection and radiation, and the methods to solve engineering problems that involve heat transfer

Course Outcome

CO1: Understanding the basics of three modes of heat transfer and their fundamentals, namely conduction, convection and radiation.

CO2: Apply the conduction fundamentals to obtain solutions for steady/unsteady state heat conduction problems like heat transfer through solids slabs, extended surfaces, semi-infinite and infinite solids.

CO3: Know the parameters influencing convection, their empirical formulation and application to basic free and forced convections problems

CO4: Understand the properties of radiation, physical mechanism, shape factors and radiation shields and apply the concepts to basic problems in radiative heat transfer.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	2	-	-	-	-	-	-	-	3	1	2
CO2	2	3	1	1	2	-	-	-	-	-	-	-	3	1	2
CO3	2	3	1	1	2	-	-	-	-	-	-	-	3	1	2
CO4	2	3	1	1	-	1	-	-	-	-	-	-	3	1	2

Syllabus

Unit 1

Basic Modes of Heat Transfer: Steady State Calculations with Multiple Modes of Heat Transfer – One-Dimensional Steady State Heat Conduction: Composite Medium, Critical Thickness, Effect of Variation of Thermal Conductivity in Solids, Extended Surfaces – Unsteady State Heat Conduction: Lumped System Analysis – Heat Transfer in Semi-infinite and Infinite Solids - Application of Numerical Techniques.

Unit 2

Fundamentals of Convection: Physical Mechanism, Reynolds Analogy - Free Convection In Vertical Flat Plate – Empirical Relation in Free Convection – Forced Convection – Laminar and Turbulent Convective Heat Transfer Analysis in Flows between Parallel Plates, over Flat Plate and in Circular Pipe – Applications of Numerical Techniques in Problem Solving.

Unit 3

Boiling and Condensation – Radiative Heat Transfer: Introduction To Physical Mechanism, Radiation Properties, Radiation Shape Factors, Heat Exchange between Non-Black Bodies, Radiation Shields. Classification of Heat Exchangers – Temperature Distribution – Overall Heat Transfer Coefficient – Heat Transfer in Gas Turbine Combustion Chambers, Rocket Thrust Chambers and Cryogenic Systems

Text Book(s)

Incropera.F.P. and Dewitt.D.P., "Fundamentals of Heat and Mass Transfer," 5th edition, John Wiley and Sons, New York, 2002.

Reference(s)

Yunus A. Cengel., "Heat Transfer – A practical approach," 2nd edition, Tata McGraw-Hill, 2002

Holman. J.P., "Heat Transfer," 6th edition, McGraw-Hill, New York, 1991.

Sutton. G.P., "Rocket Propulsion Elements," 5th edition, John Wiley and Sons, New York, 1986.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE332	MANUFACTURING PROCESS	L-T-P-C: 3-0-0-3

Course Objectives

The objective of this course is to provide the students with the basic concepts of Conventional/ unconventional manufacturing process involved in the production of aerospace components.

Course Outcome

CO1: Recalling the material triad and to know about materials used in aerospace industries.

CO2: Understanding the fundamentals of casting and rolling, traditional processes and process used in aerospace Industries.

CO3: Understanding fundamentals of welding and riveting, traditional processes and process used in aerospace Industries.

CO4: Understanding the concept of powder metallurgy and its process.

CO5: Understanding unconventional machining process, rapid prototyping and surface modification process.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	-	-	-	3	3	-	2
CO2	3	-	2	-	-	-	-	-	-	-	-	3	3	-	2
CO3	3	-	2	-	-	-	-	-	-	-	-	3	3	-	2
CO4	3	-	2	-	-	-	-	-	-	-	-	3	3	-	2
CO5	3	-	2	-	-	-	-	-	-	-	-	3	3	-	2

Syllabus

Unit 1

Introduction to casting, rolling, forging, extrusion, drawing and sheet metal working- types of defects and remedies.

Unit 2

Introduction to welding and their types, Welding defects: causes and remedies. Rivet and its types. Definition and concept – production of metal powders-characteristics of metal powders- compaction -sintering – design consideration- process capability- applications.

Unit 3

Abrasive jet machining, ultrasonic machining, Electro-discharge machining, electrochemical machining and laser beam machining. Surface modification processes-diffusion coating-electroplating-anodizing-conversion coating-hot dipping- ceramic and diamond coating. Rapid Prototyping & Its types, CNC and Types of CNC's.

Text Book(s)

F.C.Campbell, "Manufacturing Technology for Aerospace Structural materials", Elsevier Science Ltd; 1 edition (15 August 2006)

Reference(s)

SeropeKalpakjian and Steven R.Schmid, 'Manufacturing Engineering and Technology', Pearson Education Asia, 2000 (fourth edition) (Indian Reprint 2000).

P.K. Mishra, 'Nonconventional Machining process', Narosa Publishing House, 2006.

A.Azad, 'Fundamentals of Computer Aided Manufacturing', Jaico Publishing House, 2006.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE333	VIBRATION ANALYSIS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE- MECHANICS OF MATERIALS

Course Objectives

To make students to understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions by deriving equations of motion and solution methods for free and forced vibratory systems

Course Outcome

CO1: Derive equation of motion for systems under translational and rotational motions.
CO2: Know how to obtain response to Initial conditions or forced excitations.
CO3: Derive equations of motion for MDOF systems and obtain normal modes.
CO4: Know how to obtain response of MDOF systems for any excitations.
CO5: Derive equation of motion for continuous (1D) systems and obtain natural frequencies and normal modes.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO3	3	3	1	1	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	3	3	2	-

Syllabus

Unit 1
Introduction to vibration, undamped vibration, natural frequency, damped vibration, viscous damped system, under, over and critically damped system, logarithmic decrement, Coulomb damping, response to initial condition, response to simple harmonic motion, rotating unbalance, base excitation, whirling of shafts, vibration measuring instruments, response to periodic motion

Unit 2
Response to non-periodic motions, impulse response, step response, convolution and Du Hamel integrals, Numerical methods: Runge-Kutta method, Normal mode analysis, response to initial conditions, beat phenomenon, response to simple harmonic motion, damped vibration, static and dynamic coupling, principle coordinate, decoupling, Rayleigh's proportionality damping, vibration absorber.

Unit 3
Modeling of multi-degree freedom system, stiffness and flexibility influence coefficients, modeling of beam and portal members, response to periodic and non-periodic motions, modal analysis (mode – synthesis method), Vibration of continuous: Free vibration of string, bar, shaft and beam.

Text Book(s)

W. T. Thomson, "Theory of vibrations with applications," Pearson, 1997.

Reference(s)

Leonard Meirovitch, "Elements of vibration Analysis," Tata McGraw Hill, 1986.
Leonard Meirovitch, "Fundamentals of vibration," McGraw Hill, 2001.
S. S. Rao, "Mechanical vibrations," Pearson, 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE334	COMPUTATIONAL METHODS FOR ENGINEERSL-T-P-C: 3-0-0-3

Course Objectives

The objective of the course is to introduce students to the numerical techniques commonly used in solving engineering problems

Course Outcome

CO1: Given an engineering problem, understand the mathematical model required to describe the problem.
CO2: Comprehend the physics represented by the mathematical model to select an appropriate method/algorithm.
CO3: Apply the numerical solution method via a well-designed computer program.
CO4: Analyse the numerical solutions that were obtained in regards to their accuracy and suitability for applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	1	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	3	1	-
CO3	1	2	2	3	3	-	-	-	-	-	-		2	2	-
CO4	1	1	2	2	3	3	-	-	-	-	-	3	3	3	2

Syllabus

Unit 1
Introduction to Numerical Techniques: Numerical Methods – Round off and truncation errors – Approximations – Order of Convergence – Numerical interpolation. Application of concepts: Modelling friction in flows within constrained geometries – Generation of aerofoil geometries – Computation of a projectile trajectory

Unit 2
Solution techniques of a linear system of equations: Gauss elimination – Gauss-Jordan method– LU Decomposition – Iterative methods for linear systems. Solution of non-linear equations: Optimisation & Newton-Raphson methods. Application of concepts: Response of multi degree of freedom systems – Panel Method for Aerofoils – Optimisation of a parachute production cost.

Unit 3
Computational methods for ODEs: Eigen values – Single step methods – multi-step methods. Stability, consistency, accuracy and efficacy of these methods. Application of concepts: Dynamics of the linear simple pendulum – Dynamics of the non-linear simple pendulum – Modelling heat dissipation in turbine blades – Modelling the flow over flat plate geometry.

Text Book
S. C. Chapra, and R. P. Canale. Numerical methods for engineers. Boston: McGraw-Hill Higher Education, 2010.

Reference(s)

S. P. Venkateshan, and P. Swaminathan. Computational methods in engineering. Elsevier, 2013.
R.H. Landau, M.J.Paez and C.C.Bordeianu, Computational Physics -Problem Solving with Computers, Wiley-VCH, 2001.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVE IV

19AEE341	EXPERIMENTAL AERODYNAMICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE- MECHANICS OF FLUIDS, 19AEE- AERODYNAMICS I, 19AEE- AERODYNAMICS II and 19AEE - COMPRESSIBLE FLUID FLOW

Course Objectives

In order to get a flavor and hands on experience in measurement techniques and data analysis pertinent to fluid mechanics.

Course Outcome

CO1: Understand and appreciate the fundamentals of measurements and turbulence in experimental aerodynamics.
CO2: Know the various flow visualization techniques and their applications for different scenarios
CO3: Understand various velocimetry techniques and instrumentation.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	-	-	-	-	-	3	-	3	3	3	1
CO2	2	2	2	3	3	-	-	-	-	3	-	3	3	2	1
CO3	2	2	2	3	-	-	-	-	-	3	-	3	3	2	3

Syllabus

Unit 1
Examples of Fluid Mechanics Measurements: Wind-Tunnel Studies, Turbulent Mixing Layer, Spatial and Temporal Resolution in Measurements, Classification of Deterministic Data, Random Data, Signal Analysis and Uncertainty Analysis.

Unit 2
Qualitative Characterization: Flow Visualization in Liquid and Gaseous Medium, Colored Filament, Smoke, Vapor and Tufts Visualization, Image Processing Techniques, Identifying Structures - Optical Systems for Flow Measurement: Shadowgraph, Schlieren and Interferometric Techniques

Unit 3
Quantitative Characterization: Drag Measurements, Static Probes, Pressure Sensitive Paints (PSP), Velocity Measurements, Pitot-Static Probe, Theromocouple, Thermal Anemometers (Hot Wire and Film Sensors), Laser Velocimetry (LDA), Particle Image Velocimetry (PIV).

Text Book(s)
Cameron Tropea, Alexander L Yarin, John F Foss, "Springer Handbook of Experimental Fluid Mechanics," Springer, 2007.

Reference(s)

Richard J Goldstein, "Fluid Mechanics Measurements," 2nd edition, Taylor & Francis, 1996.
Wolfgang Merzkirch, "Flow Visualization," Academic Press, 1974.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE342	COMPOSITE MATERIALS AND MECHANICS	L-T-P-C: 3-0-0-3

Course Objectives

- Introduction to composite
- Advantages of composite
- Processing of composite
- Reinforcement of composite
- Testing of composite

Course Outcome

CO1: Understandbasics of polymers: thermosetting and thermoplastics and their various properties.
CO2: Introduction to various fibers and composites

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	1	3	2	2	2	1	1	2	2	1	2
CO2	3	2	2	2	2	3	2	2	3	1	2	2	2	1	2

Syllabus

Unit 1
Introduction to Composites:Concept of Composite materials, Classification of Composites, Various types of composites, Classification based on Matrix Material: Organic Matrix Composites (Polymer matrix composites (PMC)/Carbon Matrix Composites or Carbon-Carbon Composites, Advantages of Composites materials. Reinforcements and Matrices for various types of composites Fibers/Reinforcement Materials, Role and Selection of reinforcement materials, Types of fibers, Mechanical properties of fibers,

Unit 2
Functions of Matrix, Desired Properties of Thermosets and Thermoplastics, Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Laminated composites, Lamina and Laminate Lay-up, Ply-orientation definition, Manufacturing processes. Testing of Composites:Mechanical testing of composites, Tensile testing, Compressive testing.

Unit 3
Determination of longitudinal and transverse strengths of lamina, mechanics of short fiber composites, stress-strain relationships of anisotropic lamina with arbitrary orientations, analysis of laminated composites, types of laminates, stress-strain variation in laminates using classical lamination theory, thermal stresses in laminates, different types of failure criteria, introduction to inter-laminar stresses in composites.

Text Book(s)
Jones R. M., " Mechanics of Composite Materials", Hemisphere Publishing Corporation, New York

Reference(s)
Agarwal B. D. and Broutmen L. J. "Analysis and performance of Fiber Composites", John Wiley and Sons, New York 1990.
***Chawla,** Krishan K (2012), Composite Materials, Science and Engineering, ISBN: 978-0-387-74365, Springer.*
Sam Zhang, Dongliang Zhao (2013), Aerospace Materials Handbook, ISBN: 978-1-4398-7329-8, Taylor and Francis.

*LeonardHollaway (1994), Handbook of Polymer Composite for Engineers**, ISBN: 1-85573-1290,Woodhead Publishing Ltd.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE343	ADVANCED AVIONICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE – AVIONICS

Course Objectives

To introduce students to advanced avionics systems used in both aircrafts and UAVs

Course Outcome

CO1: Basic understanding of electronic communication system
CO2: Explain digital communication blocks and its application in telemetry
CO3: Understand the operating principles of electronic navigation aids
CO4: Understand working principles of Autopilots and Flight management systems
CO5: Explain data bus used in aircraft and its utility in realising modular avionics
CO6: Understand working principle of basic blocks in a typical UAV

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO2	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO3	2	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO4	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO5	2	1	1	1	-	-	-	-	1	-	-	1	3	1	2
CO6	3	1	1	1	-	-	-	-	1	-	-	1	3	1	2

Syllabus

Unit 1

Electromagnetic wave propagation and its relevance to aviation – Electronic communication systems: Functional Description of basic building blocks: Antenna, Amplifier, Filter, Modulator and Demodulator – Introduction to Digital communication and telemetry.

Unit 2

System level description of Radio Navigation Aids: Instrument Landing System, Very High Frequency Omni Range, Automatic Direction Finder, Distance Measuring Equipment, GPS, Radar, Traffic Alert and Collision Avoidance.

Unit 3

Autopilots and Flight Management System: Autopilots, Flight Management Systems – Avionic system integration: Background, Data bus systems, Integrated modular avionics.

Text Book(s)

R.P.G Collinson, "Introduction to Avionics", Springer, 2002.
Frenzel Louis, "Principles of Electronic Communication Systems", 4th Edition, McGraw-Hill, 2015.

Reference(s)

Kayton and Fried, "Avionics Navigation Systems", 2nd edition, Wiley, 1997.
Dale R. Cundy,Rick S. Brown, "Introduction to Avionics", Prentice Hall, 1997.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE344	HYPERSONIC FLOW THEORYL-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - COMPRESSIBLE FLUID FLOW

Course Objectives

· To appreciate the difference and commonalities between supersonic and hypersonic flows.
· To understand the basic physics of hypersonic flow and their applications in space shuttles, atmospheric re-entry, scramjet engines and other practical situations.
· To understand and apply approximate and exact methods in hypersonic flow theory.

Course Outcome

CO1: Identify the critical flow physics phenomenon influencing hypersonic and planetary re-entry flows.
CO2: Explain the recent developments in hypersonic flow theory with application to Aerospace Systems.
CO3: Utilize Shock-Expansion theory, Surface inclination method, and Newtonian theory for the estimation of pressure distribution of simple shapes.
CO4: Formulate and solve the problems involving invicid hypersonic flow over blunt bodies.
CO5: Interpret the influence of viscous effects in the hypersonic flow over simple shapes.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	-	-	-	-	-	-	3	-	-
CO2	2	2	3	3	-	1	-	-	-	-	-	-	3	-	1
CO3	2	3	3	3	-	-	-	-	-	-	-	-	3	2	1
CO4	2	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO5	1	2	3	3	1	2	-	-	-	-	-	-	3	-	2

Syllabus

Unit 1
Introduction – Basic Considerations and Definitions – Videos of Atmospheric Re-Entry – Thin Shock Layer – Entropy Layer – Viscous Interaction – Low Density Flows – High Temperature Effects – Visual Presentation of Damages Due to High Temperature Effects – Hypersonic Flight Paths.

Unit 2
Inviscid Hypersonic Flow Theory: Shock Expansion Method, Surface Inclination Methods – Small Disturbance Equations and Approximate Methods – Similarity Laws.

Unit 3
Exact Methods – Method of Characteristics Review – Unit Processes for Method of Characteristics: Planar, Axisymmetric and 3-D Flows – Blunt Body Problem and Shock Interaction Types – Modern Computational Methods – Introduction to Viscous Hypersonic Flows.

Text Book(s)
John D. Anderson, "Hypersonic and High Temperature Gas Dynamics," McGraw Hill, 2002.

Reference(s)

Wallace D. Hayes and Ronald F. Probstein, "Hypersonic Flow Theory," 2nd edition, Academic Press, 1959.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE345	AERO-ELASTICITYL-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - MECHANICS OF MATERIALS

Course Objectives

To make students to understand and appreciate the importance of Aeroelasticity in design of aircrafts those operate in steady and unsteady aerodynamic environment by deriving the governing equations and obtain the solution for static and dynamic aero elastic problems.

Course Outcome

CO1: Know how to obtain equations of motion for MDOF systems using influence coefficients.
CO2: Obtain response to a force for continuous systems.
CO3: Understand divergence and aileron effeteness of a wing.
CO4: Understand flutter phenomena of a wing.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	2	-
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	2	-
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	2	-

Syllabus

Unit 1
Free vibration analysis of basic structural members with different boundary conditions, analytical and approximate solutions, response of basic structural members to periodic and non-periodic forces, mode synthesis, approximate solutions.

Unit 2
Static aeroelasticity, divergence of a typical airfoil section, aileron reversal, divergence of one dimensional strucrures: straight and swept wings, aileron reversal of one dimensional straight wing.

Unit 3
Aeroelastic flutter, stability characteristics, aeroelastic analysis of a typical airfoil section: single degree and two degree freedom, classical flutter analysis, classical unsteady aerodynamic theory, engineering solution for flutter, U-g and p-k methods, response to gust loads.

Text Book(s)
Dewey H. Hodges, and G. Alvin Pierce, "Introduction to structural dynamics and aeroelasticity," Cambridge U niversity Press, 2002

Reference(s)

Raymond L. Bisplingoff, Holt Ashley, Robert L. Haffman., "Aeroelasticity", Dover Publications, 1996.

Raymond L. Bisplingoff, Holt Ashley, "Principles of Aeroelasticity", Dover Publications, 2002.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVE V

19AEE431	AIR BREATHING ENGINES	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - AEROSPACE PROPULSION

Course Objectives

Introduce the design parameters and momentum analysis of turbo machines. Enable the students to do velocity triangle analysis. Introduce the details of design of combustors, intakes and nozzles of air breathing engines

Course Outcome

CO1: Review concepts of Propulsion engine cycle.
CO2: Study momentum transfer through turbo machines.
CO3: Analyse design and performance of axial flow turbo machines.
CO4: Analyse flow through centrifugal compressors.
CO5: Learn parameters that govern combustor design.
CO6: Analyse flows through intakes and nozzles.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	1	2
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	2
CO5	1	-	-	-	-	-	2	-	-	-	-	-	-	-	2
CO6	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-

Syllabus

Unit 1

Review of Cycle Analysis of Air-Breathing Engines – Application of Euler's Turbo Machinery Equation to Axial and Centrifugal Machines: Velocity Diagrams, Stage Parameters, Three Dimensional Flows In Turbo-Machinery – Components of Axial and Centrifugal Turbines – Performance Maps – Compressor Turbine Matching – Compressor Surge

Unit 2

Thermal Limits of Blades and Vanes – Blade Cooling, Film Cooling and Regenerative Cooling –Subsonic, Supersonic and Hypersonic Inlets – Inlet Sizing – Inlet Performance – The Combustion Process: Stability, Length, Scaling

Unit 3

Types of Combustors – Combustor Performance – Afterburners – Flame Stabilization – Nozzles, Thrust Vectoring – Nozzle Performance.

Text Book(s)

Mattingly. Jack.D, "Elements of Propulsion: Gas Turbines and Rockets," AIAA Education Series, 2006.

Reference(s)

Flack.R.L, "Fundamentals of Jet Propulsion with Applications," Cambridge University Press, 2005.
Hill and Peterson, "Mechanics and Thermodynamics of Propulsion," Dorling Kindersely (India), 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE432	ENGINEERING FRACTURE MECHANICSL-T-P-C: 3-0-0-3	Pre

Requisite(s): 19AEE - MECHANICS OF MATERIALS

Course Objectives

Introduce the physical and mathematical principles of linear and nonlinear fracture mechanics and their applications in wide range of engineering design using energy release rate and stress intensity approaches. This course will expand the student knowledge on use of finite element software to design fracture problems.

Course Outcomes

CO1: Illustrate the types of fractures with characteristic features and different growth mechanisms.
CO2: Understanding the principles of energy release rate and determining the energy release rate on different failure modes.
CO3: Determination of stress intensity factor (SIF) for plane, surface and embedded cracks under various types of loads.
CO4: Study of J-Integral approach to determine fracture energy and introduction to CTOD method.
CO5: Identifying the various testing procedures to determine fracture toughness.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	1	-	-	-	-	-	-	-	1	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-	2	1	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-	2	1	-
CO4	2	2	2	1	2	-	-	-	-	-	-	-	2	1	1
CO5	-	1	1	-	2	-	-	-	-	-	-	-	-	2	1

Syllabus

Unit 1

Introduction to Linear and Elasto-plastic fracture mechanics (FM), historical development of FM, modes of fracture, crack growth mechanisms, brittle and ductile fracture behaviour. study on energy release rate (G), derivation of 'G' on Double cantilever beam, Energy release rate derivation on different modes of failure, Necessary and sufficient conditions of FM and stable and unstable fracture mechanisms.

Unit 2

Introduction to stress to intensity factor, K, (SIF)– Cauchy- Riemann conditions, Westergaard's stress function, stress intensity factors derivations for different failure modes. Determination of crack-tip stresses and displacement field, principal of superposition – study on K and G relation. SIF of surface and embedded cracks.

Unit 3

Determination of Crack Opening Displacement (CTOD/COD). Energy release rate by J-integral approach, Evaluation of failure energy by numerical approach. Study on different fracture toughness tests: plane strain test, Compact tension test, three-point bending test, C-specimen test, Chevron notch test.

Text Book(s)

Anderson, T.L., "Fracture Mechanics", 2nd Edition, CRC Press, 1995.

Reference(s)

Ramesh, K., "e-book on Engineering Fracture Mechanics", IIT-Madras publisher.
Prashant Kumar, "Elements of Fracture Mechanics" Tata McGraw-Hill Education, 2009.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE433	HELICOPTER THEORY	L-T-P-C: 3-0-0-3

Course Objectives

To make students to understand the fundamentals of helicopter (momentum and blade element) theory and apply these theories to hover and forward flight conditions.

Course Outcome

CO1: Estimate the performance of a helicopter using momentum theory.
CO2: Understand the blade element theory for hover and vertical flight.
CO3: Understand the blade element momentum theory for forward flight.
CO4: Analyse the blade response and trim condition of a helicopter rotor system.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	1	-	-	3	3	2	-
CO2	3	3	3	-	-	-	-	-	1	-	-	3	3	2	-
CO3	3	3	3	-	-	-	-	-	1	-	-	3	3	2	-
CO4	3	3	3	3	2	-	-	-	1	-	-	3	3	2	-

Syllabus

Unit 1
Historical development, configurations of helicopters, rotor system, flight control and mechanism, hovering theory, momentum theory for hover and vertical flight, blade element theory for hover and vertical flight, combined blade element momentum (BEM) theory.

Unit 2
Momentum theory for forward flight, various non-uniform inflow models, blade element theory for forward flight, non-dimensional hub forces and moments, estimation of power for forward flight.

Unit 3
Idealization of rotor blades, flap-lag and torsional dynamics of the blade, rotor blade flapping motion: A simple model, helicopter trim analysis.

Text Book(s)
C. Venkatesan, "Fundamentals of helicopter dynamics," CRC Press, 2015

Reference(s)
W. Johnson, "Helicopter theory", Princeton University, 1980.
R. S. Bramwell, "Helicopter dynamics", Edward Arnold Publications, 1976

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVE VI

19AEE441	ROCKET AND SPACECRAFT PROPULSION	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - COMPRESSIBLE FLUID FLOW

Course Objectives

- To build up necessary background for understanding the Rocket and Spacecraft Propulsion systems.
- To learn the propulsion system performance parameters and its influence on the various atmospheric conditions.
- To understand the various properties of the rocket propellants and its selection pertaining to the needs of propulsive system performance.

Course Outcome

CO1: Understand the operating principle of the rocket and spacecraft propulsion systems.
CO2: Develop the expressions for the performance parameters such as thrust, specific impulse, thrust coefficient, characteristic velocity, etc.,
CO3: Interpret the influence of atmospheric conditions on the performance parameters of the rocket and spacecraft propulsion systems.
CO4: Distinguish solid rocket motor, liquid propellant rocket, and hybrid rocket motor in terms of general characteristics, propellant properties with its relative advantages and disadvantages.
CO5: Demonstrate the working principle with relative advantages and disadvantages of advanced propulsion systems such as electric propulsion and nuclear propulsion

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	1	-
CO3	2	3	3	3	-	1	-	-	-	-	-	-	3	2	2
CO4	1	1	2	2	-	-	-	2	-	-	-	-	3	1	1
CO5	2	2	1	1	-	1	-	2	-	-	-	-	3	1	1

Syllabus

Unit 1
Principle of Rocket Propulsion – Rocket Equation – Development of Thrust – Nozzle Design – Effect of Atmosphere – Thermodynamic Thrust Equation – Characteristic Velocity – Performance Parameters.

Unit 2
Liquid Propellant Rocket Engine – Cryogenic and Semi-cryogenic Engines – Basic Configuration – Types of Propellants – Propellant Feed Systems – Combustion of Liquid Propellants – Injectors and Thrust Chambers – Combustion Instability – Solid Propellant Fundamentals – Types of Solid Propellants – Propellant Processing and Manufacture – Grain Configuration – Igniter Hardware – Combustion of Solid Propellants – Hybrid Rocket Engines.

Unit 3

Electric Propulsion: Electrothermal and Electromagnetic Thrusters, Applications of Electric Propulsion, Electric Power Generation – Nuclear Propulsion – Operational Issues – Practical Approaches for Single Stage to Orbit Vehicles.

Text Book(s)

Truner.Martin, "Rocket and Spacecraft Propulsion," 3rd edition, Springer, 2009.
Sutton.G.P, Biblarz.O, "Elements of rocket propulsion," 7th edition, John Wiley & Sons Inc, 2010.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE442	ADVANCED COMPOSITE STRUCTURES	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - COMPOSITE MATERIALS AND MECHANICS

Course Objectives

- Introduction to High performance composite
- Introduction to space environments
- Durability of thermosetting and thermoplastic polymers
- Repair of composite
- Simulation and Testing of composite

Course Outcome

CO1: Demonstrate understanding of fundamentals in materials, manufacturing, mechanics, design, and repair of polymeric matrix composites.
CO2: Identify advantages and disadvantages of polymeric matrix composites with respect to metals.
CO3: Apply the knowledge acquired to the design and manufacturing of high-performance composite Structures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	2	2	2	2	1	1	1	1	1	2
CO2	1	1	2	1	1	2	2	1	1	1	2	1	2	1	2
CO3	3	3	2	2	2	3	2	2	3	2	2	3	2	2	3

Syllabus

Unit 1
Concept of aviation and space environments. Ionizing and non-ionizing radiation at Low Earth Orbit (LEO) and Geo Synchronous Earth Orbit (GEO). Charged plasma and atomic oxygen in space. Different thermosetting and thermoplastic polymers and their applications as structural and semi structural components for aviation and spacecraft.

Unit 2
Durability of thermosetting and thermoplastic polymers under aviation and space environments. Scope of high performance polymers. Scope of high performance and ultra high performance polymers. Defects of composites under mechanical fatigue, thermal fatigue, humidity, lightning strike, ultra violet radiation, ultra high vacuum and high energy radiations.

Unit 3
Simulation of test facilities in laboratory. State of the art technologies to repair composite defects. Importance of nano composite and nano adhesive bonding. Importance of fire resistant polymeric composites and electrically conductive composites.

Text Book(s)

Omari V. Mukbaniani, Marc J. M. Abadie, Tamara Tatrishvili (2015), High-Performance Polymers for Engineering-Based Composites, ISBN 9781771881197 - CAT# N11265, CRC Press.

Reference(s)

Yu Bai, Thomas Keller (2014), High Temperature Performance of Polymer Composites, ISBN: 978-3-527-32793-5, Wiley-VCH.
Eric Baer (1991), High Performance Polymers: Structures, Properties, Composites, Fibers, ISBN-13: 978-1569900024, Amazon Prime

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE443	STATE SPACE TECHNIQUES	L-T-P-C: 3-0-0-3

Course Objectives

- To revisit vector spaces and matrix algebra and to explain basis vectors and span of vector spaces.
- Define terms : degeneracy, orthonormal sets, linear transformations and solution of simultaneous linear algebraic equations.
- Derive state space equations and associated canonical forms, explain eigen values and eigen vectors, establish relation between transfer functions and state space forms.
- Apply Controllability and Observability criteria to state feedback and output feedback systems. Execute arbitrary pole placement techniques and design State Observers.

Course Outcome

CO1: Recall Matrix Algebra and Vector Spaces, Understand basis vectors, dimension & span of vector spaces.
CO2: Define degeneracy, orthonormal set, linear transformation, Change of basis and solve simultaneous linear algebraic equations.
CO3: Derive and understand State space equations, Canonical realizations, Relate Transfer function and State space form to obtain any one from the other.
CO4: Evaluate Eigen values and Eigen vectors, Analyse Functions of square matrices and Cayley-Hamilton theorem.
CO5: Apply Controllability & Observability criteria to State feedback and Output feedback systems.
CO6: Execute arbitrary Pole placement and design State Observers to reconstruct state variables.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	-	-	1	-	1	-	-	-	-	3
CO2	3	2	-	2	2	-	-	1	-	1	-	-	-	-	2
CO3	3	2	-	2	2	-	-	-	-	-	-	-	1	-	-
CO4	2	3	-	3	3	-	-	-	-	-	-	1	-	-	2
CO5	2	2	2	2	2	-	-	-	-	1	1	3	3	3	1
CO6	2	3	3	3	2	1	1	-	1	-	1	3	1	3	-

Syllabus

Unit 1
Concepts of Matrix Algebra and Vector Spaces (revision) – Solution of Simultaneous Equation for Squares – Under-Determined and Over-Determined Systems – Concepts of Basis Vector Transformations; Similarity and Adjoint Transformation – Eigen Values and Eigen Vectors: Canonical Forms, Jordon Forms, Characteristic Equations, Analytical Functions of Square Matrices, Cayley-Hamilton Theorem.

Unit 2
Concepts of State, State-Space and State-Vector – Mathematical Modes in the State Space Form – State Equation and High-Order Differential Equations – State Space Form for Aerospace Systems, for e.g., Dynamic Behavior of Aircraft, Missile, Satellites, INS., etc. – Solution of Homogenous State Equations.

Unit 3

Solution of Non-Homogenous State Equations – Controllability and Observability of Systems – Concepts of Output Feedback and Full State Feedback, Pole-Placement Design – Concept of an Observer – Basics of Optimal Control.

Text Book(s)

Friedland, B. "Control System Design", Dover, 2005.

Nise, Norman S. "Control Systems Engineering," 4th Edition, Wiley, 2004.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVE VII

19AEE451	TURBULENT FLOWS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - MECHANICS OF FLUIDS

Course Objectives

The purpose of this subject is to familiarize instability analysis and its application in the theoretical characterization of laminar-turbulent transition. In addition, it will also help students to appreciate and understand the relevance of credible hypothesis crucial for turbulence models. Thereby, students will acquire and be capable to utilize this fundamental understanding for many practically relevant turbulent flows

Course Outcome

CO1: Develop theoretical characterization for laminar-turbulent flow transition.
CO2: Examine the nature of turbulence based on classical theory and empirical results.
CO3: Comprehend closure problem pertinent to turbulence and make use of turbulence models to study the nature of turbulence.
CO4: Apply standard hypothesis to quantify eddy structures and implement the basic concepts to refine existing turbulence models.
CO5: Distinguish the delicate aspects of turbulent boundary layer flows from free turbulent flows

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	-	-	-	-	-	-	2	3	-	-
CO2	3	3	-	3	3	-	-	-	-	-	-	1	3	-	-
CO3	3	3	-	3	3	-	-	-	-	-	-	2	3	-	-
CO4	3	3	-	3	3	-	-	-	-	-	-	2	3	-	-
CO5	3	3	-	3	3	-	-	-	-	-	-	2	3	1	-

Syllabus

Unit 1
Onset of Turbulence: Laminar Flow, Transition, Turbulent Flow – Laminar-Turbulent Transition: Taylor's Rotating Cylinder Experiment, Benard's Natural Convection Experiment, Reynolds Experiment, Reynolds Number Concept Based on Volume Flux and Pressure Gradient – Stability Theory of Laminar Flows: Method of Small Disturbances, Orr-Sommerfeld Equation, Modes of Stability, Curve of Neutral Stability, Indifference Reynolds Number, Absolute and Convective Instabilities. .

Unit 2
Inviscid Instability: Rayleigh Equation, Point of Inflection Criteria, Critical Layer – Fundamentals of Turbulent Flow: Mean Motion, Fluctuations, Quasi-steady Approach, Apparent Viscosity, Reynolds Stresses (Momentum Theorem &Navier-Stokes Equations), Classical Empirical Results on Turbulence, Wind-tunnel Turbulence.

Unit 3
Semi-empirical Hypothesis: Eddy Viscosity, Prandtl Mixing Length – Isotropic Turbulence: Kolmogorov Hypothesis, Kolmogorov Length and Time Scales - Free Turbulent Flows: Jet Boundary, Free Jet, Wake.

Text Book(s)

Herrmann Schlichting, Klaus Gersten, "Boundary Layer Theory," 8th edition, Springer-Verlag, 2000.

Reference(s)

Pijush K. Kundu, Ira M. Cohen, David R. Dowling, "Fluid Mechanics," 5th edition, Academic Press, 2012.
Davidson, P.A., "Turbulence: An Introduction for Scientists and Engineers," Oxford University Press, 2004.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE452	SPACE FLIGHT MECHANICS	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the basic conservation laws of specfic energy and specific angular momentum and apply them to orbital maneuvers.
- To understand orbital elements and solve two body problems in orbital mechanics.
- Study various applications of orbital mechanics such as intercept, rendezvous, planetary motions and interplanetary trajectories.

Course Outcome

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

CO2: Orbit element determination from position and velocity vectors. Know effects of perturbations to orbits, know ground trace and basic orbital maneuvers

CO3: Know Kepler and Gauss problem, ballistic missile trajectories, interplanetary and lunar trajectories and basics of satellite attitude dynamics

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	2	-	-	3	3	2
CO2	3	3	2	2	-	-	-	-	-	2	-	2	3	3	2
CO3	3	3	2	2	-	-	-	-	-	2	-	3	3	3	2

Syllabus

Unit 1

Elements of Conics – The n-Body Problem and Reduction to Two-Body Problem – Types of Orbits – Conservation of Energy and Angular Momentum in Orbits – Spherical Trigonometry – Geocentric-Equatorial, Heliocentric-Ecliptic, Right Ascension Declination, Topocentric-Horizon and Perifocal Co-Ordinate Systems and Transformations between them – Classical Orbital Elements.

Unit 2

Orbital Elements Determination from Position and Velocity at a Point – Determining Position and Velocity from Orbital Elements – Orbit Determinations from a Single Radar Observation, Three Position Vectors and Optical Sightings – Ellipsoidal Earth Model: Geodetic and Geocentric Latitudes – Ground Trace of Satellites – Solar and Sidereal Times – Precession of The Equinoxes – Low and High Earth Orbits: Orbital Perturbations due to Oblateness of Earth – Orbital Maneuvers: General Coplanar Orbit Transfer, Hohmann Transfer, Simple Plane Changes to an Orbit.

Unit 3

Time-Of Flight and Eccentric Anomalies for Elliptic, Parabolic And Hyperbolic Orbits – Kepler's Problem and Solution Algorithm – Gauss Problem: General Methods of Solution – Intercept and Rendezvous with Examples – Ballistic Missile Trajectories: Effect of Earth Rotation – Interplanetary Trajectories: Spheres of Influence and the Patched Conic Approximation, Synodic Periods – Satellite Attitude Dynamics: Torque Free Motion, Stability of Torque Free Motion, Spin Stabilization, Gyroscopic Attitude Control, Gravity Gradient Attitude Control.

Text Book(s)

Roger R Bate, Donald D Mueller, Jerry E White And William W Saylor, "Fundamentals of Astrodynamics," 2nd edition, Dover, 2015.

Marshall H Kaplan, "Modern Spacecraft Dynamics and Control," Wiley, 1976.

Reference(s)

Howard Curtis, "Orbital Mechanics for Engineers and Scientists," 3rd edition, Elsevier, 2010.

Marcel J. Sidi, "Spacecraft Dynamics And Control: A Practical Engineering Approach," Cambridge University Press, 1997.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE453	MULTI DISILIPINARY DESIGN OPTIMIZATION	L-T-P-C: 3-0-0-3

Course Objectives

The objective of this course is to provide the students with the basic concepts of optimization, the modeling skills necessary to formulate and solve the optimization problems.

Course Outcome

CO1: Understand the terms optimization, design variables, objective functions, constraints and the types of optimization.
CO2: Understand the single variable, multi-variable optimization with and without constraints.
CO3: Apply the suitable optimization algorithm for the given problem.
CO4: Analyse the accuracy of the optimization algorithms.
CO5: Understanding and apply the non-conventional optimization methods for multi-objective functions. and to know about types of non-conventional optimization methods.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	1	2
CO2	3	2	1	-	-	-	-	-	-	-	-	1	3	1	2
CO3	3	3	2	1	1	-	-	-	-	-	-	3	3	2	3
CO4	3	3	1	-	-	-	-	-	-	-	-	1	3	2	2
CO5	3	3	2	1	1	-	-	-	-	-	-	3	3	2	3

Syllabus

Unit 1
Single Variable Optimization: Introduction to Optimization, Optimality Criteria – Bracketing Methods: Exhaustive Search Method, Bounding Phase Method, Region Elimination Methods, Golden Section Search Method, Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method.

Unit 2
Multivariable Optimization: Optimality Criteria – Gradient Based Methods: Steepest Descent Method, Conjugate Direction Method, Conjugate Gradient Method and Newton's Method – Constrained Optimization: Karush-Kuhn-Tucker Optimality Criteria, Direct Methods, Indirect Methods, Penalty Function Methods.

Unit 3
Global Optimization: Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization, Multi-Objective Optimization – Pareto Optimality – Global Function /Weighted Sum.

Text Book(s)
Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", 2nd edition, Prentice Hall of India, New Delhi, 2012.

Reference(s)

Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", Wiley, 2010.
J. Arora, "Introduction to Optimum Design," 3rd Edition, Elsevier, 2012.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

PROFESSIONAL ELECTIVE VIII

19AEE461	ADVANCED COMPUTATIONAL FLUID DYNAMICS	L-T-P-C: 3-0-0-3

Pre Requisite(s): 19AEE - MECHANICS OF FLUIDS, 19AEE- COMPUTATIONAL FLUID DYNAMICS FOR AEROSPACE

Course Objectives

The objective of the course is to introduce students to the finite volume method and related advanced numerical techniques and algorithms.

Course Outcome

CO1: Understanding strong and weak form of governing equation and the basics of Finite Volume Method (FVM) to discretize partial differential equations.

CO2: Applying FVM schemes like upwind, Center Difference, power-law, quick, TVD for convection-diffusion type problems and assess the schemes.

CO3: Applying solution methodologies like SIMPLE, SIMPLER, SIMPLEC, PISO for staggered and collocated grids.

CO4: Understanding Turbulence Models and Associated parameters.

CO5: Understanding of advanced concepts: multigrids, flux-vector splitting, spectral methods, aerodynamic shape optimization.

CO6: Numerically model the theoretical understanding of Computational Fluid Dynamics using open-source packages such as LAMMPS, Open Foam.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	2	2	2	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	-	-	-	-	-	-	-	-	-	-	2	3	2	-
CO5	2	2	-	-	-	-	-	-	-	-	-	2	2	2	-
CO6	2	2	-	2	3	-	-	-	-	-	-	2	2	3	2

Syllabus

Unit 1

Strong and Weak Form of Conservation of Equations – Introduction to Finite Volume Method: Discretization Schemes and their Properties for Finite Volume Method.

Unit 2

Finite Volume Method for Convection-Diffusion Problems: Central Differencing, Upwind Differencing, Power-Law Differencing, Quick and TVD Schemes with their Assessments – Staggered and Collocated Grids – Introduction to Multigrids – Flux-Vector Splitting.

Unit 3

Introduction to Solution Algorithms: SIMPLE, SIMPLER, SIMPLEC and PISO Algorithms – Introduction to Turbulence Models and Associated Parameters – Introduction to Aerodynamic Shape Optimization – Introduction to Spectral Methods.

Text Book(s)

Hirsch, "Numerical Computation of Internal and External Flows- Vol 1-2", 2nd edition, Elsevier, 2007.
Veertseeg.H, Malalasekara.W, "An Introduction to Computational Fluid Dynamics- The Finite Volume Approach", 2nd edition, Pearson Education Limited, 2008.

Reference(s)

T.J. Chung, "Computational Fluid Dynamics," 2nd edition, Cambridge University Press, 2010.
John Tannehill, Dale Anderson, Richard Pletcher, "Computational Fluid Mechanics and Heat Transfer," 3rd Edition, CRC Press, 2013.
Canuto C., Hussaini M. Y., Quarteroni A., and Zang T.A., "Spectral Methods. Fundamentals in Single Domains." Springer-Verlag, 2006.

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE462 SURFACE ENGINEERING, COATING AND JOINING TECHNOLOGIES L-T-P-C: 3-0-0-3

Course Objectives

- Fundamentals of Science Engineering
- Fundamentals of Coating Technology
- Necessity of surface modification of materials
- Basics of adhesive bonding and its advantages
- Basics of welding and its advantages

Course Outcome

CO1: Understanding of surface Engineering
CO2: Application of surface Engineering.
CO3: Understanding of plasma processing of material
CO4: Understanding of adhesive bonding.
CO5: Application of adhesive bonding

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	2	2	2	2	1	1	2	2	2	2
CO2	1	2	2	2	1	2	1	2	2	2	1	2	2	1	2
CO3	2	1	2	2	1	1	2	2	2	1	2	2	1	2	2
CO4	2	2	2	2	2	2	2	2	2	1	1	2	2	1	2
CO5	2	2	2	2	2	2	3	2	2	2	2	2	1	2	2

Syllabus

Unit 1
Introduction: Engineering components, surface dependent properties and failures, importance and scope of surface engineering. Surface and surface energy: Structure and types of interfaces, surface energy and related equations. Surface modification of steel and ferrous components, Surface modification using gaseous medium: Nitriding carbonitriding (diffusion from gaseous state) (principle and scope of application).

Unit 2
Surface engineering by energy beams: General classification, scope and principles, types and intensity/energy deposition profile. Surface engineering by energy beams: Laser assisted microstructure modification – surface melting, hardening, shocking and similar processes. Surface engineering by spray techniques: Plasma coating (principle and scope of application). Characterization of surface microstructure and properties.

Unit 3
Fundamentals of Adhesive Bonding, Stress Distribution in Adhesive Bonding, Adhesive Bonding geometry and fracture analysis, Adhesive bonding of similar and dissimilar materials, Fundamentals of welding, Stress Distribution in welding.

Text Book(s)

Peter M. Martin (2011), Introduction to Surface Engineering and Functionally Engineered Materials, ISBN 978-0-470-63927-6, Scrivener Publishing LLC.

Reference(s)

Arthur A. Tracton (2006), Coatings Technology Handbook, ISBN 978-1-57444-649-4, Taylor & Francis Group LLC.

*Samuel Benavides (2009), Corrosion Control in the Aerospace Industry, **ISBN 13:** 9781845693459, Woodhead Publishing Ltd.*

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Reports

19AEE463PRINCIPLES OF AIRPORT MANAGEMENT **L-T-P-C: 3-0-0-3**

Course Objective

To introduce students to basic principles of Airport Management

Course Outcome

CO1: Understand various functions of airport management.
CO2: Exposure to environmental regulation for airport.
CO3: Understand airline operations.
CO4: Appreciate role of logistics in airport management.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	2	-	2	-	2	-	-	1	1	-	-	2
CO2	-	-	-	-	-	-	3	2	-	-	1	1	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2
CO4	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2

Syllabus

Unit 1
History of Aviation- Development of Air transportation in India-Major players in Airline Industry-Swot analysis in Airline Industry-Market potential of Indian Airline Industry—Current challenges in Airline Industry-Completion in Airline Industry-IATA & ICAO

Airport management:
Airport planning-Operational area and Terminal planning, design, and operation-Airport operations-Airport functions-Organization structure of Airline and Airports sectors-Airport authorities-Global and Indian scenario of Airport management – DGCA –AAI.

Unit 2

Air transport services:
International trends-Emerging Indian scenario-PPP- Public Private Participation in Indian Airports-Environmental regulations-Private participation in International developments-Environment regulations-Regulatory issues-Meteorological services for Aviation-Airport fees, rates, and charges

Airline operations:
Airline Terminal Management-Flight Information Counter/Reservation and Ticketing-Check In/Issue of Boarding pass-Customs and Immigration formalities-Co-ordination-Security Clearance-Baggage and -Handling of Unaccompanied minors and Disabled Passengers-Handling of Stretcher Passengers and Human Remains-Handling of CIP,VIP & VVIP-Co-ordination of Supporting Agencies /Departments.

Unit 3

Logistics and air cargo management:
Concept of Logistics- Role of Ware Housing-trend in material handling-Global Supply Chain-Quality concept and Total Quality Management-improving Logistic performance-Air Cargo Concept- Cargo Handling-Booking of Perishable Cargo and Live Animals- Industry Relation-Type of Air Cargo-Air Cargo Tariff, ratios and Charges-Airway Bill, Function, Purpose.

Text Book(s)
Wells.A, "Airport Planning and Management," 4th edition, McGraw-hill, London, 2000.
Alexander T.Well, Seth Young, "Principles of Airport Management," McGraw Hill 2003

Evaluation Pattern

Assessment	Internal	End Semester
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

•CA – Can be Quizzes, Assignment, Projects, and Report