

AUTONOMOUS

# SYLLABUS

VII & VIII Semesters

**B.E in Aeronautical Engineering**

2023

MITE



Invent Solutions

**MANGALORE INSTITUTE OF  
TECHNOLOGY & ENGINEERING**



# MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

## **Institute Vision**

*“To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**”*

## **Institute Mission**

*“To establish world class educational institutions in their respective domains, which shall be **Centers of Excellence** in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic, Sensitive and Demanding, Innovative and Practical, Theoretical and Pragmatic; ALL at the same time**”*

## **Department Vision**

*To be recognized as an innovative leader in Aeronautical engineering through excellence in education by imparting the values of research and developments in the upcoming fields of Aeronautics.*

## **Department Mission**

- *The Department imparts the technical knowledge, practical skills, entrepreneurial skill to students and the channelized guiding in the varied activities with the aim of transforming the graduates into able engineers of tomorrow.*
- *Aeronautical laboratories are specifically designed and laid up in order to develop adaptable students with a strong foundation in skills that are relevant to the challenging world.*
- *To provide students with strong concepts of their core subjects and an application- oriented overview in their stipulated courses.*

## **Program Educational Objectives (PEOs)**

### **After successful completion of the program,**

- *Graduates will have the scientific and technical knowledge to have successful career in Aeronautical industry.*
- *Graduates will have competency to analyze challenges and advancements in the focus areas of Propulsion, Structures, Aerodynamics, Flight Mechanics and Avionics.*
- *Graduates will be motivated and confident to pursue advanced education, research and development and other creative efforts in aeronautical engineering and allied areas.*
- *Graduates will have higher order thinking and leadership skills to become technology leaders of tomorrow.*

## **Program Specific Outcomes (PSOs)**

### **At the end of the program,**

- *Graduates will excel in their professional career in Aeronautical industry and research with highest professional and ethical standards to their activities by acquiring knowledge in basic engineering, mathematics, science and Aeronautical engineering.*
- *Graduates will exhibit professionalism, teamwork in their chosen profession and adapt to current trends, technologies and industrial scenarios by pursuing lifelong learning.*

**LIST OF COURSES**

<b>VII/VIII Semester Courses</b>			
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Sem</b>
<b>PROFESSIONAL CORE COURSES</b>			
1.	23AEPC401	Spacecraft Systems Engineering	VII
2.	23AEPC402	Control Engineering	VII
<b>PROFESSIONAL ELECTIVE COURSES</b>			
3.	23AEPE411	Aircraft Maintenance and Repair	VII
4.	23AEPE412	Fatigue and Damage Tolerant Design of Structures	VII
5.	23AEPE413	Rocket propulsion and Propellants	VII
6.	23AEPE42X	MOOC (NPTEL/SWAYAM) 8/12 weeks	VIII
<b>OPEN ELECTIVE COURSES</b>			
7.	23AEOE411	Fundamentals of Space Vehicle Systems	VII
8.	23AEOE412	Fundamentals of Guided Missiles	VII
9.	23AEOE413	Micro Aerial Vehicles	VII
<b>SKILL ENHANCEMENT COURSE</b>			
10.	23AESE409	Project Phase - II	VII
<b>HUMANITIES &amp; SOCIAL SCIENCE COURSES</b>			
11.	23HMCC406	Constitution of India & Professional Ethics	VII



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## VII Semester (2023 Scheme): Aeronautical Engineering

Sl. No.	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs.	Credits
					L	T	P	CIE	SEE	Total		
1.	23AEPC401	Spacecraft Systems Engineering	Professional Core	AE	3	0	0	50	50	100	3	3
2.	23AEPC402	Control Engineering	Professional Core	AE	3	0	0	50	50	100	3	3
3.	23AEPE4XX	Professional Elective – III*	Discipline Specific Elective	AE	3	0	0	50	50	100	3	3
4.	23AEOE4XX	Open Elective – III**	Open Electives	AE	3	0	0	50	50	100	3	3
5.	23AESE409	Project Phase-II	Project	AE	-	-	12	100	100	200	3	6
6.	23HMCC406	Constitution of India & Professional Ethics	Humanities & Social Sciences	Humanities/Any Engineering Department	1	0	0	50	50	100	2	1
<b>Total Credits</b>											<b>19</b>	

### \*Professional Elective Course -III

Sl. No.	Course Code	Course Title
1.	23AEPE411	Aircraft Maintenance and Repair
2.	23AEPE412	Fatigue and Damage Tolerant Design of Structures
3.	23AEPE413	Rocket Propulsion and Propellants

### \*\*Open Elective Course-III

Sl. No.	Course Code	Course Title
1.	23AEOE411	Fundamentals of Space Vehicle Systems
2.	23AEOE412	Fundamentals of Guided Missiles
3.	23AEOE413	Micro Aerial Vehicles



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## VIII Semester (2023 Scheme): Aeronautical Engineering

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Examination Marks			Duration of Exam in Hrs.	Credits
					L	T	P	CIE	SEE	Total		
1	23AEPE42X	MOOC (NPTEL/SWAYAM) 8/12 WEEKS	Professional Electives	AE	X	X	X	-	100	100	2.5	2
2	23AESE431	Internship	Internship	AE	*			100	100	200	3	12
3	23SECC432	Publication on Project Work findings	Project	AE	-	-	-	100	-	100	-	2
<b>Total Credits</b>											<b>16</b>	

### MOOC (NPTEL/SWAYAM) \*

Sl. No.	Course Code	Course Title
1	23AEPE421	Air Transportation: An Overview
2	23AEPE422	Lighter than Air Systems
3	23AEPE423	Wind Energy



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## INDEX

### VII Semester

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course title</b>	<b>Page No.</b>
1.	23AEPC401	Spacecraft Systems Engineering	1
2.	23AEPC402	Control Engineering	3
3.	23AEPE41X	Professional Elective –III*	5-11
4.	23AEOE41X	Open Elective – III**	12-17
5.	23AESE409	Project Phase-II	18
6.	23HMCC406	Constitution of India & Professional Ethics	22



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<b>Spacecraft Systems Engineering</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEPC401</b>	SEE Marks	<b>50</b>
Teaching Hours/Week (L: T: P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hours	<b>42</b>	Credits	<b>03</b>
<p><b>Course Learning Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Impart the knowledge of Spacecraft Environment and its effect on design</li> <li>2. Familiarize the concept of dynamics of spacecraft</li> <li>3. Provide knowledge on structures of spacecraft</li> <li>4. Impart the knowledge of Spacecraft Telemetry, Command, and Data Processing System</li> </ol>			
<b>Module 1: Introduction Spacecraft Environment</b>			<b>No. of Hrs.: 8</b>
<p>Payloads and Missions, A System View of Spacecraft, The Future of space vehicles, Pre-Operational Spacecraft Environments, Operational Spacecraft Environments, Environmental Effects on Design</p> <p>Textbook 1: Chapter 1.1, 1.2, 1.3, 2.2, 2.3, 2.4</p>			
<b>Module 2: Dynamics of Spacecraft</b>			<b>No. of Hrs.: 10</b>
<p>Introduction, Trajectory Dynamics, General Attitude Dynamics, Attitude Motion of Specific Types of Spacecrafts, Oscillatory Modes</p> <p>Textbook 1: Chapter 3.1 to 3.5</p>			
<b>Module 3: Spacecraft Structures</b>			<b>No. of Hrs.: 7</b>
<p>Introduction, Design Requirements, Material Selection, Analysis, Design Verification, Impact Protection, Configuration Examples, The Future of Space Structures.</p> <p>Textbook 1: Chapter 8.1 to 8.8</p>			
<b>Module 4: Spacecraft Propulsion</b>			<b>No. of Hrs.: 9</b>
<p>Propulsion Systems Classification, Chemical Rocket: Basic principles, Performance parameters, Nozzle flows, Nozzle performance &amp; design, Chemical rocket design, Electric Propulsion</p> <p>Textbook 1: Chapter 6.1 to 6.4</p>			
<b>Module 5: Electrical Power Systems and Thermal Control of Spacecraft</b>			<b>No. of Hrs.: 8</b>
<p>Power System Elements, Primary Power Systems, Secondary Power Systems: Batteries, Power Management, Distribution and Control</p> <p>Thermal environment, Thermal balance and analysis, Thermal technology and design, Thermal design verification, Satellite thermal design</p> <p>Textbook 1: Chapter 10.1 to 10.5, Chapter 11.1 to 11.8</p>			



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**Course Outcomes:** At the end of the course, the student will be able to

1. Explain the spacecraft environmental conditions and their effects on payloads, missions, and overall vehicle design.
2. Apply the principles of trajectory and attitude dynamics to analyze the motion behavior and stability characteristics of various types of spacecrafts.
3. Apply spacecraft structural design principles to develop preliminary structures and propulsive configurations.
4. Explain the major elements of a spacecraft power system, thermal systems and describe their functional roles in supporting spacecraft operations.

**Textbook:**

1. Peter Fortescue, Graham Swinerd, John Stark, “Spacecraft Systems Engineering”, A John Wiley & Sons, Ltd., Publication, 2011

**Reference Books:**

1. P. Fortescue, J. stark, and G. Swinerd, "Spacecraft Systems Engineering" AIAA Series, 2005
2. W.J. Larson and J. R. Wertz., "Space Mission Analysis and design", AIAA Series, 1998

**Web links:**

1. AIAA — “Spacecraft Design, Development, and Operations”  
<https://aiaa.org/courses/spacecraft-design-development-and-operations>
2. AIAA — “Spacecraft Design and Systems Engineering”  
<https://aiaa.org/courses/spacecraft-design-and-systems-engineering>

<b>Control Engineering</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEPC402</b>	SEE Marks	<b>50</b>
Teaching Hrs./Week (L:T: P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hrs.	<b>42</b>	Credits	<b>03</b>
<p><b>Course Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Introduce the fundamentals of control systems, including feedback, servomechanisms and various controllers.</li> <li>2. Impart the concepts of mathematical modelling of various systems, along with the transfer functions and block diagram reduction</li> <li>3. Impart concepts of time domain &amp; frequency domain techniques</li> <li>4. Familiarise the modern control theory concepts, including state space analysis for assessment of controllability and observability in linear systems.</li> </ol>			
<b>Module 1: Introduction to Control Systems and Controller</b>			<b>No. of Hrs.: 8</b>
<p>Introduction, Examples of Control Systems, Closed-Loop versus Open Loop- control, Introduction, Ziegler- Nichols Rules for Tuning PID Controllers, Design of PID Controllers with Frequency-Response Approach, Design of PID Controllers with Computational Optimization Approach, Modifications of PID Control Scheme</p> <p>Textbook 1: Chapter: 1: 1.1 to 1.3, 8.1 to 8.5</p>			
<b>Module 2: Mathematical Model of Physical Systems and Block Diagram Reduction</b>			<b>No. of Hrs.: 9</b>
<p>Mathematical Modeling of Mechanical Systems, Mathematical Modeling of Electrical Systems, Example Problem and Solutions, Block Diagrams, Analysis and Design of Feedback Systems</p> <p>Textbook 1: Chapter: 3: 3.1 to 3.3</p> <p>Textbook 2: Chapter: 5.1 to 5.3</p>			
<b>Module 3: Time Response Analysis</b>			<b>No. of Hrs.: 9</b>
<p>First-Order Systems, Second-Order Systems, Higher-Order Systems, Transient-Response Analysis with MATLAB, Routh's Stability Criterion, Effects of Integral and Derivative Control Actions on System Performance, Steady-State Errors in Unity-Feedback Control Systems, Example problems and Solutions, Root-Locus Plots, Plotting Root Loci with MATLAB, Root-Locus Plots of Positive Feedback Systems, Root-Locus Approach to Control-Systems Design.</p> <p>Textbook 1: Chapter: 5.1 to 5.8 and 6.1 to 6.5</p>			
<b>Module 4: Frequency Response Analysis</b>			<b>No. of Hrs.: 8</b>
<p>Asymptotic Approximations: Bode Plots, Introduction to the Nyquist Criterion, Sketching the Nyquist Diagram, Stability via the Nyquist Diagram, Gain Margin and Phase Margin via the Nyquist Diagram, Stability, Gain Margin, and Phase Margin via Bode Plots.</p> <p>Textbook 2: Chapter 10: 10.1 to 10.7</p>			
<b>Module 5: State-Space Analysis</b>			<b>No. of Hrs.: 8</b>

State-Space Representations of Transfer-Function Systems, Transformation of System Models with MATLAB, Solving the Time-Invariant State Equation, Some Useful Results in Vector-Matrix Analysis, Controllability, Observability, Example problems and Solutions

Textbook 1: Chapter 9: 09.1 to 9.7

**Course Outcomes:** At the end of the course, the student will be able to

1. Articulate the concepts of control systems, transfer functions, block diagrams, and system stability.
2. Develop a mathematical model to obtain the transfer function.
3. Apply time- and frequency-domain techniques to study system performance by determining steady-state response parameters and stability.
4. Apply state-space methods to determine system controllability, observability and overall dynamic behaviour.

**Textbooks:**

1. Katsushiko Ogata, “Modern Control Engineering”, Fifth Edition , Pearson, 2010.
2. Norman S Nise, “Control Systems Engineering”, Seventh Edition, Wiley, 2014.

**Reference Books:**

1. A. Nagoor Kani, “Control Systems Engineering” RBA Publications, 2014.
2. I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age Publishers, 2017.

**Web links:**

1. Basics of Control System :  
<https://youtube.com/playlist?list=PLBlnK6fEyqRhzJT87LsdQKYZBC93ezDo&si=CoHRT6GFmx09AX6Z>
2. Advanced Control Systems : <https://youtu.be/bbm79-UcNN0?si=dtkd0BgGbU8Nj71J>
3. Teaching Intelligent Control Systems with MATLAB & SIMULINK:  
<https://youtu.be/CodtJraEMLQ?si=QXUKC756NjwPA1wd>

<b>Aircraft Maintenance and Repair</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEPE411</b>	SEE Marks	<b>50</b>
Teaching Hrs./Week (L: T: P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hrs.	<b>42</b>	Credits	<b>03</b>
<p><b>Course Learning Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Provide with a foundational understanding of aircraft maintenance concepts including types of maintenance, failure rate patterns and certification requirements.</li> <li>2. Impart knowledge of inspection, repair, and fabrication techniques for metallic, plastic and composite aircraft structures using various methods.</li> <li>3. Introduce inspection and maintenance of major aircraft systems for safety practices and troubleshooting procedures.</li> </ol>			
<b>Module 1: Fundamentals of Maintenance &amp; Documentation</b>			<b>No. of Hrs.: 8</b>
<p>Types of maintenance, Redesign, Failure rate pattern, other maintenance considerations, Aviation maintenance certifications: General, Airframe, Power plant, Avionics courses</p> <p><b>Documentation for Maintenance:</b> Manufacturers documentation: Airplane maintenance manual, Fault insulation manual, illustrated parts catalogue, structural repair manual, wiring diagram manual, Master minimum equipment</p> <p>Textbook 1: Chapter – 1.6, 1.8 to 1.10, 4.6, 5.2.</p>			
<b>Module 2: Welding in Aircraft Structural Components</b>			<b>No. of Hrs.: 9</b>
<p>Equipment's used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding</p> <p><b>Sheet Metal Repair and Maintenance:</b> Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing - Riveted repair design - Damage investigation - Reverse engineering</p> <p>Textbook 2: Chapter – 7, 8 and 9.</p>			
<b>Module 3: Plastic and Composites in Aircraft</b>			<b>No. of Hrs.: 8</b>
<p>Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes. Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Non-destructive inspection of composites, Vacuum-bag process, Special precautions – Autoclaves</p> <p>Textbook 2: Chapter – 10 and 11.</p>			
<b>Module 4: Aircraft Jacking, Assembly and Rigging</b>			<b>No. of Hrs.: 9</b>
<p>Airplane jacking and weighing and C.G. Location. Balancing of control surfaces – Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor</p> <p><b>Review of Hydraulic and Pneumatic System:</b> Inspection and maintenance of landing gear</p>			

systems – Inspection and maintenance of air-conditioning and pressurisation system, Installation and Maintenance of Instruments, handling, testing and inspection

Textbook 2: Chapter – 12, 13 and 14.

<b>Module 5: Inspection and Maintenance of Auxiliary Systems</b>	<b>No. of Hrs.: 8</b>
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Fire protection systems, Ice protection system, Rain removal system, Position and warning system, Auxiliary Power Units (APUs)

**Safety Practices:** Hazardous materials storage and handling, Aircraft furnishing practices, equipment's, Troubleshooting - Theory and practices

Textbook 2: Chapter – 18 and 19.

**Course Outcomes:** At the end of the course, the student will be able to

1. Describe aircraft maintenance types, failure patterns, certification requirements, and the use of standard maintenance documents.
2. Explain welding processes, sheet-metal, plastic repairs, composite repair methods and related inspection and NDT techniques used in aircraft structural maintenance.
3. Solve for welding and composite repair parameters for aircraft structural maintenance.
4. Describe the inspection and maintenance of major aircraft systems, along with essential safety procedures and troubleshooting practices in aircraft maintenance.
5. Apply airplane jacking and weighing procedures, determine the centre of gravity, and perform control surface and rotor balancing for operational and maintenance parameters.

**Textbooks:**

1. Kinnison, H.A, “Aviation Maintenance Management”, 2<sup>nd</sup> edition, Mc Graw Hill, 2013.
2. Michael J. Kroes, “Aircraft Maintenance and Repair”, 7<sup>th</sup> edition, Mc Graw Hill, 2013.

**Reference Books:**

1. Friend, C.H., “Aircraft Maintenance Management”, Longman, 1992.
2. Mc Kinley, J.L. Bent R.D, “Maintenance and Repair of Aerospace Vehicles”, Northrop Institute of Technology, Mc Graw Hill, 1967.

**Web links:**

1. Aircraft Maintenance Adventures: <https://youtu.be/LbIodTtHeXM?si=5BjVVMYFRbgbsOY0>
2. Airplane Heavy Maintenance: <https://youtu.be/jA2Gp48UmsE?si=EL4I26srPllaSkMX>
3. Wheel Replacement on A320: [https://youtu.be/UyXMpKqp7l8?si=w9cN5\\_dVkkh-omU](https://youtu.be/UyXMpKqp7l8?si=w9cN5_dVkkh-omU)
4. Inside Factory Producing World’s Largest European Aircraft: <https://youtu.be/EWbEXCrdRYk?si=U2Rm1e4aRTKdгнаA>

<b>Fatigue and Damage Tolerant Design of Structures</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEPE412</b>	SEE Marks	<b>50</b>
Teaching Hours/Week (L: T: P)	<b>3:0:0</b>	Exam Hrs.	<b>3</b>
Total Hours	<b>42</b>	Credits	<b>3</b>
<p><b>Course Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Familiarize the fundamental concepts of structural fatigue and its characteristic behaviour under cyclic loading.</li> <li>2. Impart knowledge on fatigue life estimation methods for components subjected to constant and variable amplitude loading.</li> <li>3. Introduce mechanics of fracture to study crack growth in materials and predict the fatigue crack growth of a component using fracture mechanics</li> <li>4. Impart knowledge on fatigue testing methods, design philosophies, and environmental influences affecting fatigue performance and durability.</li> </ol>			
<b>Module 1: Design for Fatigue strength</b>			<b>No. of Hrs.: 9</b>
<p>Introduction, Historical overview of fatigue, Phases in fatigue life – crack initiation, crack growth, final fracture, S N Diagram, Effect of Modifying Factors on Endurance Limit Low-cycle and High-cycle Fatigue, Notch Sensitivity, Endurance Limit—Approximate Estimation, Reversed Stresses—Design for Finite and Infinite Life, Cumulative Damage in Fatigue, Soderberg and Goodman Lines.</p> <p>Textbook 1: Chapter 1.1, 1.2, 1.3</p> <p>Textbook 2: Chapter 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12.</p>			
<b>Module 2: Fatigue Strain Life Approach</b>			<b>No. of Hrs.: 8</b>
<p>Monotonic Tension Test and Stress–Strain Behavior, Strain-Controlled Test Methods, Cycle-Dependent Material Deformation and Cyclic Stress–Strain Behavior, Strain-Based (<math>\epsilon</math>-N) Approach to Life Estimation, Determination of Strain–Life Fatigue Properties, Mean Stress Effects, Surface Finish and Other Factors Influencing Strain–Life Behavior, Dos and Don'ts in Design.</p> <p>Textbook 1: Chapter 5</p>			
<b>Module 3: Fundamentals of Linear Elastic Fracture Mechanics and Applications to Fatigue Crack Growth</b>			<b>No. of Hrs.: 8</b>
<p>LEFM Concepts, Loading Modes, Stress Intensity Factor, K Expressions for Common Cracked Members, Superposition for Combined Mode I Loading, Crack Tip Plastic Zone, Fracture Toughness — <math>K_{Ic}</math>, <math>K_{IIc}</math>, Fatigue Crack Growth, <math>da/dN-\Delta K</math>, Sigmoidal <math>da/dN-\Delta K</math> Curve, Constant Amplitude Fatigue Crack Growth Test Methods, <math>da/dN-\Delta K</math> for <math>R = 0</math>, Crack Growth Life Integration Example with No Mean Stress Effects. Mean stress effect, Cyclic Plastic Zone Size, Crack Closure, Small Fatigue Cracks and LEFM Limitations.</p> <p>Textbook 1: Chapter 6.1 to 6.8</p>			

<b>Module 4: Fatigue from Variable Amplitude Loading</b>	<b>No. of Hrs.: 9</b>
<p>Spectrum Loads and Cumulative Damage, Damage Quantification and the Concepts of Damage Fraction and Accumulation, Cumulative Damage Theories, Palmgren-Miner Linear Damage Rule, Nonlinear Damage Theories, Load Interaction and Sequence Effects, Cycle Counting Methods, Rain flow Method, Other Cycle Counting Methods, Life Estimation Using the Stress–Life Approach Life Estimation Using the Strain–Life Approach, Crack Growth and Life Estimation Models.</p> <p>Textbook 1: Chapter 9</p>	
<b>Module 5: Fatigue Design, Testing and Environmental Effects on Fatigue</b>	<b>No. of Hrs.: 8</b>
<p>Fatigue Design and Testing - Evolution of design philosophies - Safe life, Fail-safe, Damage tolerance, Introduction to Fatigue &amp; Damage Tolerance evaluation, recommended practices to improve fatigue design, Case studies on aircraft structures. Fatigue Loading, Test Machines and Specimens. Corrosion Fatigue, Fretting Fatigue, Low-Temperature Fatigue, High-Temperature Fatigue.</p> <p>Textbook 1: Chapter 2.2, Chapter 4.1, Chapter 11.1,11.2, 11.3,11.4</p>	
<p><b>Course Outcomes:</b> At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Explain fatigue failure mechanism, S-N behavior, modifying factors and cumulative damage concepts in structural components under cyclic loading.</li> <li>2. Apply stress-life (S-N) and strain-life (<math>\epsilon</math>-N) approaches to estimate fatigue life of components subjected to cyclic loading using suitable fatigue design criteria.</li> <li>3. Explain linear elastic fracture mechanics concepts, stress intensity factors, crack growth behavior and cumulative damage principles under variable amplitude loading.</li> <li>4. Apply fracture mechanics relationships, cycle-counting techniques and damage accumulation models to estimate fatigue crack growth and fatigue life of components subjected to variable amplitude loading.</li> <li>5. Explain fatigue design philosophies, testing methods, and the impact of environmental factors including corrosion, fretting and temperature on fatigue performance.</li> </ol>	
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. R. I Stephens, A Fatemi, R.R Stephens, Henry O, F, “Metal Fatigue in Engineering”, 2<sup>nd</sup> Edition, Wiley Interscience,2000.</li> <li>2. V.B. Bhandari, “Design of Machine Elements”, 2<sup>nd</sup> Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2020.</li> </ol>	
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. W. Barrois and L. Ripley, “Fatigue of Aircraft Structures”, Pergamon Press, Oxford, 1983.</li> <li>2. Jaap Schijve, “Fatigue of Structures &amp; Materials”, 2<sup>nd</sup> Edition Jaap, Springer, 2004.</li> <li>3. Julie A Bannantine, Jess J Comer &amp; James, “Fundamentals of Metal Fatigue Analysis”, Prentice-Hall, Pearson, 1990.</li> <li>4. C. G. Sih, “Mechanics of Fracture”, Vol.1, Sijthoff and Noordhoff International Publishing Co., Netherland, 1989.</li> <li>5. T. L. Anderson, “Fracture Mechanics – Fundamentals &amp; Applications”, 3<sup>rd</sup> Edition Taylor &amp; Francis group, 2005.</li> </ol>	



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## Web links:

1. Fatigue Testing: [https://youtu.be/XkJ\\_VyLEcps](https://youtu.be/XkJ_VyLEcps)
2. Fatigue Failure: [https://youtu.be/o-6V\\_JoRX1g](https://youtu.be/o-6V_JoRX1g)
3. Fatigue Failure Case Study: <https://youtu.be/8xN0xolGGqo>
4. Variable Amplitude Loading: [https://www.efatigue.com/training/Chapter\\_9.pdf](https://www.efatigue.com/training/Chapter_9.pdf)
5. Fatigue Crack growth: [https://youtu.be/6y\\_PF0\\_Hr9k](https://youtu.be/6y_PF0_Hr9k)

<b>Rocket Propulsion and Propellants</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEPE413</b>	SEE Marks	<b>50</b>
Teaching Hrs./Week(L: T:P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hrs.	<b>42</b>	Credits	<b>03</b>
<p><b>Course Learning Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Discuss the fundamental performance metrics of solid and liquid propulsion systems</li> <li>2. Introduce the fundamentals of rocket propulsion, propellant types, and the basic combustion behavior of solid and liquid propellants.</li> <li>3. Impart the knowledge of flame, combustion principles to analyze and model the burning-rate behavior in solid propellants, including the concept of the pressure exponent.</li> <li>4. Familiarize students with the operational aspects of different liquid-propellant system concepts, including various types of feed systems.</li> <li>5. Impart the knowledge of hybrid propulsion and green propellants for space applications</li> </ol>			
<b>Module 1: Rocket Propulsion Performance</b>			<b>No. of Hrs.:8</b>
<p>Introduction - thrust, exhaust velocity, nozzle theory, and thermodynamic relations- ideal rocket analysis, summary of thermodynamic relations, isentropic flow through nozzles- Nozzle configurations - real nozzles, influence of chamber geometry, nozzle throat and throat conditions, nozzle types, thrust and thrust coefficient, characteristic velocity and specific impulse, influence of chamber geometry, calculation of rocket motor performance parameters.</p> <p>Textbook 1: Chapter 2.1,2.2,2.3, and 3.1 to 3.5</p>			
<b>Module 2: Solid Propellant Rocket</b>			<b>No. of Hrs.:9</b>
<p><b>Solid Propellant:</b> propellant characteristics- detonation and deflagration, propellant ingredients-inorganic oxidizers, fuels, binders, burning rate modifiers, plasticizers, curing agents, energetic binders and plasticizers organic oxidizers and explosives, additives, particle-size parameters, other propellant categories- gas generator propellants, low smoke propellants, igniter propellants. liners, insulator, and inhibitor</p> <p>Textbook 1: Chapter 12.1, 12.2,12.4,12.5,12.6</p>			
<b>Module 3: Combustion of Solid Propellants</b>			<b>No. of Hrs.:9</b>
<p>Propellant burning rate – classification of solid rocket motor, burning rate relation with pressure, burning relation with temperature. Basic performance relations- burning time, and action time Propellant grain and grain configuration, Combustion of solid propellant-physical and chemical process, ignition process- different zones of combustion. prediction of burning rate for solid rocket motor propellants.</p> <p>Textbook 1: Chapter 11.1 to 11.3, 13.1,13.2</p>			
<b>Module 4: Liquid Propellant Rocket</b>			<b>No. of Hrs.:8</b>

<p><b>Liquid Propellant rocket engine:</b> propellants, propellant feed systems-gas pressure feed systems and turbo-pump feed systems, and propellant tanks.</p> <p><b>Liquid Propellants:</b> propellant properties, liquid oxidizers, liquid fuels, liquid monopropellants, gelled propellants, gaseous propellant, safety, and environmental concerns</p> <p>Textbook 1: Chapter 6.1 to 6.4 and 7.1 to 7.7</p>	
<b>Module 5: Hybrid Propellant Rocket</b>	<b>No. of Hrs.:8</b>
<p>Introduction, combustion chamber, propellants for hybrid rocket propellant engines, grain configuration, combustion of hybrid, ignition of hybrid propellants</p> <p><b>Green propellants:</b> oxidizers, fuels, monopropellants. environmental and operational advantages</p> <p>Textbook 2: Chapter 9.1-9.6</p>	
<p><b>Course Outcomes:</b> At the end of the course, the students will be able to</p> <ol style="list-style-type: none"> <li>1. Enumerate the working principles of solid and liquid rocket propulsion system</li> <li>2. Illustrate the working principles of hybrid propulsion system and green propellants</li> <li>3. Compute the influence of operational parameters, such as pressure, temperature, and particle size, on the burning rate of composite solid propellants.</li> <li>4. Solve the combustion behavior and flame structure of solid and liquid propellants</li> <li>5. Apply the fundamental performance parameters of a rocket engine to select an appropriate propellant type for a specified mission profile</li> </ol>	
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. Sutton, G.P., Biblarz, O., “Rocket Propulsion Elements”, 9th edition, Wiley India Pvt. Ltd. 2016</li> <li>2. Dwarka Prasad Mishra, “Fundamentals of Rocket Propulsion”, 1<sup>st</sup> edition CRC Press, 2017</li> </ol>	
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Ramohalli, K.N., Rao, P., “Solid Rocket Propulsion Technology”, Mercury Learning &amp; Information, 2013.</li> <li>2. Kubota, N., “Combustion of Liquid and Solid Propellants”, CRC Press, 2015.</li> <li>3. K. Ramamurthi, “Rocket Propulsion”, 2nd edition, Trinity, 2016</li> </ol>	
<p><b>Weblinks:</b></p> <ol style="list-style-type: none"> <li>1. Rocket Engines: <a href="https://youtu.be/gz8Li0ODeA">https://youtu.be/gz8Li0ODeA</a></li> <li>2. Introduction to Solid Propellant Rockets: <a href="https://youtu.be/OJtThkzI6PI">https://youtu.be/OJtThkzI6PI</a></li> <li>3. NPTEL courses:             <ol style="list-style-type: none"> <li>(a) Aerospace Propulsion' by Prof. P.A. Ramakrishna,</li> <li>(b) Jet and Rocket Propulsion' by Prof. A. Kushari, and</li> <li>(c) Rocket Propulsion' by Prof. K. Ramamurthi and Prof. V.N. Rao</li> </ol> </li> </ol>	

<b>Fundamentals of Space Vehicle Systems</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEOE411</b>	SEE Marks	<b>50</b>
Teaching Hrs./Week (L: T: P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hrs.	<b>42</b>	Credits	<b>03</b>
<p><b>Course Learning Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Introduce fundamental environments and mission types associated with space vehicles across various orbital regimes.</li> <li>2. Familiarize principles and design considerations of propulsion, structural, thermal and GNC subsystems in spacecraft.</li> <li>3. Impart the knowledge of subsystems, their performance and operational challenges of space vehicle systems.</li> </ol>			
<b>Module 1: Spacecraft Environment and Missions</b>			<b>No. of Hrs.: 8</b>
<p><b>Spacecraft Environment:</b> Introduction, Earth Environment, Launch Environment, Atmospheric Environment, Space and Upper Atmosphere Environment  <b>Missions:</b> Introduction, Low Earth Orbit, Medium-Altitude Earth Orbit, Geosynchronous Earth Orbit, Lunar and Deep Space Missions</p> <p>Textbook 1: Chapter 2.1 to 2.5, 3.1 to 3.5</p>			
<b>Module 2: Space Vehicle Propulsion Systems</b>			<b>No. of Hrs.: 9</b>
<p>Introduction, Rocket Propulsion Fundamentals: thrust equation, Specific Impulse, Nozzle Expansion, Nozzle Contour, Engine Cooling, Launch Vehicle Selection: Solid vs Liquid Propellant</p> <p>Textbook 1: Chapter 5.1, 5.3</p>			
<b>Module 3: Structures and Thermal Control</b>			<b>No. of Hrs.: 9</b>
<p><b>Structures:</b> Introduction, Spacecraft Concepts, Mass Properties, Structural Loads, Materials  <b>Thermal Control:</b> Introduction, Spacecraft Thermal Environment, Thermal Control Methods, Heat Transfer Mechanisms</p> <p>Textbook 1: Chapter 8.1, 8.3 to 8.5, 8.7, 9.1 to 9.4</p>			
<b>Module 4: Guidance and Navigation</b>			<b>No. of Hrs.: 8</b>
<p><b>Attitude Determination:</b> Introduction, Basic Concepts and Terminology: Attitude, Attitude Jitter, Space Vehicle Disturbance Torques: Aerodynamic Torque, Magnetic Torque, Miscellaneous Disturbance Torques</p> <p>Textbook 1: Chapter 7.1, 7.2, 7.5</p>			
<b>Module 5: Control</b>			<b>No. of Hrs.: 8</b>
<p>Passive Attitude Control: Spin Stabilization, Gravity-Gradient Stabilization, Aerodynamic and Solar Pressure Stabilization, Active Control: Feedback Control Concepts, Momentum Wheels, Attitude Determination: Concepts, devices, System Design Considerations</p> <p>Textbook 1: Chapter 7.6 to 7.9</p>			

**Course Outcomes:** At the end of the course, the student will be able to

1. Describe the spacecraft operational environments including Earth, launch, atmospheric, and space environments and their impact on mission planning.
2. Explain the propulsion, structures and thermal control concepts in spacecraft.
3. Apply the thrust equation, specific impulse concepts, and vehicle selection criteria to evaluate propulsion choices for different mission profiles.
4. Apply structural load, material properties, and mass property concepts to compute the suitability of various spacecraft structural configurations.
5. Explain the basic concepts of spacecraft attitude determination and control, including attitude terminology, disturbance torques, passive and active stabilization methods, and system design considerations.

**Textbooks:**

1. Griffin, Michael D. and James R. French, “Space Vehicle Design”, 2<sup>nd</sup> Edition, AIAA education series, 2004.
2. Ranjan Vepa, “Space Vehicle Maneuvering, Propulsion, Dynamics and Control”, 1st Edition, Springer, 2024.

**Reference Books:**

1. Yaguang Yang, “Spacecraft Modeling, Attitude Determination, and Control”, 2<sup>nd</sup> Edition, CRC Press is an imprint of Taylor & Francis Group, 2025.
2. Miguel A. Aguirre “Introduction to Space Systems” 1st Edition, Springer, 2013.

**Web links:**

1. Introduction to Spacecraft GN&C:  
<https://youtu.be/X4L3s3xTIsA?si=f6muBkkyhOSSvX8T>
2. Attitude Determination: <https://youtu.be/OqSB8Bo3RYU?si=3Qz-TfqmVrgKh11A>
3. Spacecraft Structures: <https://youtu.be/dqErjtCVP5c?si=TI dip1ZognElAtnJ>
4. Spacecraft Subsystems: [https://youtu.be/iXRjHp\\_p1n4?si=N3s5bpqMhyK9jkq6](https://youtu.be/iXRjHp_p1n4?si=N3s5bpqMhyK9jkq6)

<b>Fundamentals of Guided Missiles</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEOE412</b>	SEE Marks	<b>50</b>
Teaching Hrs./Week (L: T: P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hrs.	<b>40</b>	Credits	<b>03</b>
<p><b>Course Learning Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. To introduce the basic concepts, classification, and applications of guided missile systems.</li> <li>2. To impart knowledge in the missile aerodynamics for the calculation of forces acting on it</li> <li>3. To explain the fundamental principles of propulsion system used in missile system</li> <li>4. To introduce the fundamental principles of strategic and tactical missile guidance—including command, beam rider, and homing techniques</li> <li>5. To provide an overview of strategic, cruise missile systems and modern missile navigation technologies.</li> </ol>			
<b>Module 1: Introduction to Missile Systems</b>			<b>No. of Hrs.: 08</b>
<p>Introduction, Strategic Missiles: ballistic and cruise missiles, Tactical Missiles: tactical battlefield missiles, tactical missiles against moving targets, anti-tank missiles, shoulder fixed weapons guided missile subsystems, airframe, Propulsion System: rocket motors, jets, propulsion phases, control system, War Head: high explosive war head and blast war head, Fuse: contact and proximity, Case studies of tactical and strategic intercepts</p> <p>Textbook:1 Chapter 1(Sections 1.1-1.6,1.8-1.10)</p>			
<b>Module 2: Missile Aerodynamics</b>			<b>No. of Hrs.: 08</b>
<p>Introduction, flight regimes, Airflow over body/Wing: lift and drag, momentum theory of airfoil, form drag, friction drag , lift coefficient and drag coefficient, supersonic flow, Mach line, and Mach angle: normal shock, wave drag, oblique shock, lift and drag for a supersonic wing , Flow Around a Supersonic Missile: lift due to nose cone, base drag, Supersonic Airfoil Shapes: supersonic wing planforms, linear aerodynamics, downwash effect, measurement of airspeed</p> <p>Textbook: 2 Chapter 3(Sections 3.1-3.8)</p>			
<b>Module 3: Propulsion System</b>			<b>No. of Hrs.: 08</b>
<p>Introduction, Functions: booster, sustainers, velocity profile of the missile, Classification of Engines: rocket motors, Liquid Propellant Rockets: cryogenic and solid propellants, Solid Propellant Rocket: burning rate, factors affecting burning rate, Igniters for solid Rocket Motors: low voltage electro explosive device, high voltage electro explosive device, Jet engines: turbojet, turbofan, ramjet, rocket-ramjet, scramjet</p> <p>Textbook:1 Chapter 4 (Section 4.1-4.6)</p>			
<b>Module 4: Guidance System</b>			<b>No. of Hrs.: 08</b>

Introduction, strategic missile guidance, tactical missile guidance, command guidance, beam rider guidance, homing guidance, anti-tank missile guidance, anti-ship missile guidance, anti-submarine missile guidance, microcomputers onboard the missiles	
Textbook:1 Chapter 13 (Section 13.1 - 13.5)	
<b>Module 5: Navigation System</b>	<b>No. of Hrs.: 08</b>
Introduction, principle, navigation in three coordinates-stabilised platform system, strap down system, preferred earth-based co-ordinate system, methods of inertial guidance- global positioning system, terrain comparison system (TERCOM), terminal guidance, hyperbolic navigation. kalman filtering, augmented proportional navigation	
Textbook:1 Chapter 14(Section 14.1 - 14.3, 14.6, 14.7)	
<p><b>Course Outcomes:</b> At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Outline the fundamentals and classification of missile systems.</li> <li>2. Apply basic aerodynamics to missile systems.</li> <li>3. Apply the characteristics of diverse propulsion systems to missiles.</li> <li>4. Illustrate the principles of strategic and tactical guidance in selection of missile configurations.</li> <li>5. Identify the specific roles and mechanisms of GPS, TERCOM, and terminal guidance to missiles systems.</li> </ol>	
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1.Mohan, S. R., Fundamentals of Guided Missiles, 1st Edition, Defence Research &amp; Development Organisation (DRDO), Monographs / Special Publication Series, 1999.</li> </ol>	
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Zarchan, P., Guided Missile Engineering, 2nd Edition, AIAA Education Series, American Institute of Aeronautics and Astronautics, 2012.</li> <li>2. Sutton, George P. and Biblarz, Oscar, Rocket Propulsion Elements, 8th Edition, John Wiley &amp; Sons, Inc., USA, 2010.</li> </ol>	
<p><b>Web links:</b></p> <ol style="list-style-type: none"> <li>1. Rocket Aerodynamics <a href="https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/rocket-aerodynamics/">https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/rocket-aerodynamics/</a></li> <li>2. ISRO Launch vehicles <a href="https://www.drishitias.com/daily-news-analysis/isro-s-launch-vehicles">https://www.drishitias.com/daily-news-analysis/isro-s-launch-vehicles</a></li> <li>3. NPTEL Weblink: <a href="https://nptel.ac.in/courses/101108054">https://nptel.ac.in/courses/101108054</a></li> </ol>	

<b>Micro Aerial Vehicles</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23AEOE413</b>	SEE Marks	<b>50</b>
Teaching Hrs./Week (L: T: P)	<b>3:0:0</b>	Exam Hrs.	<b>03</b>
Total Hrs.	<b>42</b>	Credits	<b>03</b>
<p><b>Course Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Provide an overview of micro aerial vehicle (MAV) development, mission requirements, and historical evolution.</li> <li>2. Introduce elements of aerodynamics, propulsion, and design specific to fixed-wing micro aerial vehicles.</li> <li>3. Familiarize students with MAV design methodologies, including experimental and numerical approaches.</li> </ol>			
<b>Module 1: Overview of Micro Aerial Vehicle Development</b>			<b>No. of Hrs.: 8</b>
<p>Introduction, Historical Perspective, Radio-Controlled Model Airplanes, Small and Micro Unmanned Air Vehicles, Micro-Air-Vehicle Development.</p> <p>Textbook 1: Chapter 1 – 1.1, 1.2</p>			
<b>Module 2: Elements of Aerodynamics, Propulsion, and Design</b>			<b>No. of Hrs.: 8</b>
<p>Rigid Wings, Flexible and Adaptive Wings, Propulsion, MAV Design Using Experimental Database, Numerical Approach to MAV Design.</p> <p>Textbook 1: Chapter 2 – 2.1 to 2.6</p>			
<b>Module 3: Autopilot Integration into Micro Aerial Vehicles</b>			<b>No. of Hrs.: 9</b>
<p>MAV Designs and Specifications, Flight-Control System, Stability and Control Design for Micro Air Vehicles, Flight Testing.</p> <p>Textbook 1: Chapter 3 – 3.1 to 3.5</p>			
<b>Module 4: Rigid-Wing Micro Aerial Vehicles</b>			<b>No. of Hrs.: 9</b>
<p>NRL and DARPA MAV Programs, Development of the Micro Tactical Expendable (MITE) Configuration, Detailed Design of the MITE, Flight Experimentation and Design Evolution, Stability and Flight Control, MITE Demonstrations and Transition to Operational Systems.</p> <p>Textbook 1: Chapter 4 – 4.1 to 4.7</p>			
<b>Module 5: Flexible and Adaptive Wing Micro Aerial Vehicles</b>			<b>No. of Hrs.: 8</b>
<p>Description of the MAV, Wind-Tunnel Characterization of Flexible Wings, Modeling of Flexible Wings, Flight Testing.</p> <p>Textbook 1: Chapter 5 – 5.1, 5.2, 5.4 to 5.6</p>			
<p><b>Course Outcomes:</b> At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Explain the motivation, historical evolution, and developmental aspects of micro aerial vehicles in relation to mission requirements.</li> <li>2. Explain the aerodynamic, propulsion, and design principles of micro aerial vehicles with reference to rigid-wing configurations and established MAV programs.</li> </ol>			

3. Explain autopilot integration, stability and control concepts, and adaptive-wing characteristics of micro aerial vehicles, including flight testing considerations.
4. Apply rigid-wing micro aerial vehicle design concepts to analyze configuration development, stability, and flight control characteristics.
5. Apply flexible and adaptive wing design methodologies to evaluate micro aerial vehicle performance and operational behavior.

**Textbooks:**

1. Thomas J. Mueller, James C. Kellogg, Peter G. Ifju, Sergey V. Shkarayev, “Introduction to the Design of Fixed-Wing Micro Air Vehicles”, AIAA Education Series, 2007.
2. Rafiq Ahmad, Abdul Rashid, “Unmanned Aerial Vehicle Design and Technology”, Springer Nature, 2021.

**Reference Books:**

1. Kimon P. Valavanis, George J. Vachtsevanos, “Handbook of Unmanned Aerial Vehicles”, Springer, 2015.
2. Reg Austin, “Unmanned Aircraft Systems: UAVs Design, Development and Deployment”, John Wiley & Sons, 2010.

**Web links:**

1. AIAA – Micro Air Vehicles and Unmanned Systems <https://www.aiaa.org/>
2. NASA – Aeronautics Research and Unmanned Aircraft Systems <https://www.nasa.gov/aeronautics>
3. DARPA – Micro Air Vehicle Research Programs <https://www.darpa.mil/work-with-us/programs/micro-air-vehicles>
4. MIT Open Course Ware – Aeronautics and Astronautics <https://ocw.mit.edu/courses/aeronautics-and-astronautics/>

<b>Project Phase-II</b>			
Semester	<b>VII</b>	CIE Marks	<b>100</b>
Course Code	<b>23AESE409</b>	SEE Marks	<b>100</b>
Teaching Hrs./Week (L: T:P)	<b>0:0:12</b>	Mode	<b>Experiential</b>
		Credits	<b>06</b>
<p><b>Objectives:</b></p> <ol style="list-style-type: none"> <li>To enable students to execute, validate, and communicate the engineering solution to the identified problem conceptualized in Project Phase – I</li> <li>To motivate students to extend their project work toward research publications, patent filing, funding proposals, or technology transfer, where applicable</li> </ol>			
<p><b>General Guidelines for CIE procedure:</b></p> <ol style="list-style-type: none"> <li>The Department project coordinator will take the responsibility of monitoring all the activities related to the project execution.</li> <li>The HOD shall constitute project evaluation/review committee(s) &amp; the composition shall be as follows: <ol style="list-style-type: none"> <li>HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee</li> <li>Project Coordinator shall be member - Convener</li> <li>Project guide shall be the member</li> <li>One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)</li> </ol> </li> <li>Project teams must implement the problem identified using the proposed methodology through systematic experimentation and/or simulation leading to a functional solution or validated outcome in consultation with their project guide.</li> <li>Each project team shall maintain a project diary and record their project progress at regular interval of time. This shall carry signature of the students and the project guide.</li> <li>Marks may be equally or proportionally distributed among team members based on contribution assessed by the guide and committee.</li> <li>A student shall obtain minimum of 40% of the total CIE marks to gain eligibility for SEE</li> </ol>			

## General Guidelines for SEE procedure:

1. The Department project coordinator will take the responsibility of all the requirements for successful conduction of the SEE.
2. SEE for project work will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations.
3. Project teams must present their projects that have been executed and completed with a functional solution or validated outcome during the SEE.
4. Each project team shall bring to the SEE a project report that shall carry signature of the students, project guide, HOD and the Principal. Plagiarism, data fabrication, or copying of work will result in stringent disciplinary action and /or penalties. (Note: Any disciplinary actions or penalties will be as per institutional policy.)
5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the examiners.
6. A student shall obtain minimum of 40% of the total SEE marks to pass this course.

## Deliverables:

1. Comprehensive Project Report comprising of:
  - Abstract
  - Introduction
  - Literature Survey
  - Problem Definition
  - Proposed Methodology
  - Design
  - Implementation
  - Results and discussion
  - References
  - Appendices

The project report shall be prepared in the prescribed format provided by the institute.

2. A plagiarism report shall be obtained from the Department of Library. Acceptable similarity threshold is generally below 20%, and hence, the plagiarized content shall not exceed 20%. Similarity above 20% will require resubmission after proper revisions.

**Review and Evaluation for CIE:**

1. There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

<b>Review - 1</b>	
Phase wise execution of proposed solution	20 Marks
Use of modern tools for proposed solution	10 Marks
Contribution as an individual and team member	10 Marks
Total	<b>40 Marks</b>
<b>Review - 2</b>	
Complete Implementation and Demonstration of Modules	15 Marks
Report Quality & Formatting	15 Marks
Total	<b>30 Marks</b>
<b>Presentation</b>	
Presentation	20 Marks
Team work	10 Marks
Total	<b>30 Marks</b>
<b>Grand Total</b>	<b>100 Marks</b>

2. First review shall be conducted after one month from the start of the semester
3. Every department shall develop rubrics to assess performance of the students based on the above given parameters

**Evaluation for SEE:**

1. There shall be a presentation for SEE. Total of 100 SEE marks is distributed as follows:

<b>SEE</b>	
Execution of proposed solution	40 Marks
Evaluation of Project Report	30 Marks
Project presentation & Question and Answer	30 Marks
Total	<b>100 Marks</b>

**Course Outcomes:** At the end of the course, the student will be able to:

1. Execute the problem identified using the methodology proposed through systematic design, development, experimentation, and/or simulation, leading to a functional solution or validated outcome
2. Translate theoretical concepts into practical implementation while considering constraints such as feasibility, cost, sustainability, safety, ethics, and societal relevance
3. Exhibit the resourcefulness to act independently as well as collaboratively within a team in overcoming technical challenges encountered during project execution
4. Plan tasks effectively, manage time and resources, meet defined milestones, and adhere to deadlines, reflecting professional engineering practice
5. Prepare a comprehensive project report that clearly documents design decisions, implementation details, experimental results, analysis, and conclusions using standard technical writing practices
6. Confidently present the project work through reviews, demonstrations, seminars, and viva-voce examinations, addressing questions from peers, faculty, and examiners

<b>Constitution of India &amp; Professional Ethics</b>			
Semester	<b>VII</b>	CIE Marks	<b>50</b>
Course Code	<b>23HMCC406</b>	SEE Marks	<b>50</b>
Teaching Hours/Week (L: T: P)	<b>1:0:0</b>	Exam Hrs.	<b>02</b>
Total Hours	<b>13</b>	Credits	<b>01</b>
<p><b>Course Objectives:</b> This course is designed to</p> <ol style="list-style-type: none"> <li>1. Introduce the foundational principles and features of the Indian Constitution</li> <li>2. Familiarize the Fundamental Rights and Directive Principles.</li> <li>3. Provide an understanding of Union and State government policies and Electoral Process.</li> <li>4. Develop awareness on Sustainable development goals, energy conservation and climate change</li> <li>5. Inculcate Ethical responsibilities and Code of Conduct.</li> </ol>			
<b>Module 1: Introduction to the Indian Constitution</b>			<b>No. of Hrs.: 2</b>
Definition and Significance of the Constitution, Making of the Constitution, Constituent Assembly, Preamble, Salient features of the India Constitution, Amendments, other Provisions and Citizenship			
<b>Module 2: Fundamental Rights and Duties</b>			<b>No. of Hrs.: 3</b>
Fundamental Rights: Right to Equality, Right to Freedom, Right to Life & Personal Liberty, Right against Arbitrary arrest and Preventive Detention, Right against Exploitation, Right to Religion, Cultural & Educational Rights and Right to Constitutional Remedies, Restrictions and Limitations, Directive Principles of State Policy and its relevance in the society, Fundamental Duties of Citizens			
<b>Module 3: Union and State Government Structure</b>			<b>No. of Hrs.: 3</b>
<p><b>Union Govt: Union Legislature-</b> Parliament-Lok Sabha and Rajya Sabha, Sessions of Parliament, Parliamentary System, Parliamentary Committees, Important Parliamentary Terminologies.</p> <p><b>Union Executive-</b> President, Prime Minister, Union Cabinet, Union Council of Ministers.</p> <p><b>Union Judiciary-</b>Supreme Court of India, Judicial Review and Judicial Activism.</p> <p><b>State Govt: State Legislature-</b> State Legislative Assembly, State Legislative council,</p> <p><b>State Executive-</b> Governor, Chief Minister, State Cabinet, State Council of Ministers,</p> <p><b>State Judiciary-</b> High Court and Subordinate Courts.</p> <p><b>Elections:</b> Election Commission of India, Process and Laws.</p>			
<b>Module 4: Ethics and Sustainable Development</b>			<b>No. of Hrs.: 3</b>
Ethics: Values and types, Honesty, Trust, Integrity and Reliability in Engineering, Sustainable development goals, energy conservation, sustainable developments, Environmental Ethics: climate change and ethical responsibility.			
<b>Module 4: Professional Ethics for Engineers</b>			<b>No. of Hrs.: 2</b>
Scope & Aims, Code of Ethics, Professional responsibility, Accountability, Research Ethics, Clash of Ethics (example with respect to technology), Conflicts of Interest, Risks, Safety, Liability and Corporate Social Responsibility.			

**Course Outcomes:** At the end of the course, the student will be able to

1. State the preamble and the basic features of the Indian Constitution
2. Explain the Fundamental Rights, Directive Principles of State Policy and their relevance in contemporary Indian society
3. Compare the functioning of the Union and State legislature, Executive and Judiciary
4. Classify Ethical, Virtues and explain sustainable development goals and climate change
5. Outline the Aims, Code of Ethics, and principles of Corporate Social Responsibility

**Textbooks:**

1. Raja Ram, M., “Constitution of India & Professional Ethics”, 3rd Edition, New Age International Publishers, 2015
2. Dr. Tharanath, Santhosh Prabhu & Suma Suresh Kogilgeri, “Constitution of India & Professional Ethics”, Pristine Publishing House, 2018
3. Sharma Brij Kishore, “Introduction to the Constitution of India”, 8th Edition, PHI Learning Pvt. Ltd., 2011
4. Charles E Harris, Michael S. Pritchard & Michael J. Rabins “Engineering Ethics: Concepts and Cases”, 1st Edition, IEEE / Cengage 2018
5. Iqbal, Jaquir, “SDG – Sustainable Urban Development: Challenges, Achievements & Opportunities”, 1st Edition, Global Vision Publishing House, 2013

**Weblinks:**

1. Making of the Indian Constitution - <https://www.youtube.com/watch?v=Z5nQ4xea9ts>
2. Parts, Articles and Schedules of the Indian Constitution - <https://www.youtube.com/shorts/TJRdYarLPYI>
3. The Indian Constitution - <https://www.youtube.com/watch?v=vXvLSXlmkyM>
4. Professional Engineering Ethics - <https://www.youtube.com/watch?v=SVz6Q7EoBJM>
5. Sustainable Development Goals- <https://www.youtube.com/watch?v=qAIolKgDPrA>