Four-Year Undergraduate Programme

Bachelor of Technology

Aeronautical Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Faculty of Engineering & Technology
Bachelor of Technology in Aeronautical Engineering

1. Vision of the Department

"The vision of Aeronautical Engineering Department is to contribute positively towards the advancement of humanity through the provision of Knowledge based Solution to Scientific & Technological Challenges in the field of Aviation."

2. Mission of the Department

M1. The mission of Aeronautical Engineering Department is to define and educate a new archetype of innovative and fundamentally grounded Engineer for excellence in education, research and technological services through the proper blending of fundamentals of Aeronautical Engineering Principles and Emerging Disciplines.
M2. Department will foster the intellectual, professional and personal development of the students.
M3. The Department strives to prepare them for Career opportunities in Aviation Industry & higher Studies.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Tech. Aeronautical Engineering curriculum enables graduates to attain.

PEO 1	Pursue successful career in engineering involving professional knowledge and skills for analysis, design and solution of real time engineering problems.
PEO 2	Excel in professional career with sound fundamental knowledge and pursue life-long learning including higher education and research.
PEO 3	Demonstrate interpersonal skills, leadership ability and team building to achieve organization goals and serve society with professional ethics and integrity.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	**Engineering knowledge:**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem analysis:**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 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 public health and safety, and cultural, societal, and environmental considerations.

PLO 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.
PLO 5	**Modern tool usage:**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 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.
PLO 7	**Environment and sustainability:**	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	**Ethics:**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	**Individual and team work:**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 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.
PLO 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.
PLO 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.

5. Program Specific Learning Outcomes

PSO 1	**Demand as per recent development**	An ability to apply the principle of core engineering fundamentals of Aerodynamics, Propulsion, Structures and Flight Mechanics in the fields of Aeronautical Engineering.
PSO 2	**Software skill**	The student shall have skills to conceive, design, implement and operate Aeronautical systems.

6. Credit Framework

Semester wise Credit distribution of the Programme	
Semester-1	22
Semester-2	20
Semester-3	22
Semester-4	22
Semester-5	23
Semester-6	19
Semester-7	24
Semester-8	15
Total Credits:	**167**

Category wise Credit distribution of the Programme	
Category	**Credit**
Major Core	84
Minor Stream	00
Multidisciplinary	42
Ability Enhancement Course	8
Skill Enhancement Courses	14
Value added Courses	2
Summer Internship	4
Research Project/Dissertation	13
Total Credits:	**167**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104105	Environmental Science	Audit	1	0	0
2	303105102	Programming for Problem Solving	4	3	2	0
3	303106101	Basic Electrical Engineering	4	3	2	0
4	303109102	Elements of Mechanical Engineering	4	3	2	0
5	303191101	Mathematics-I	4	4	0	0
6	303192101	Engineering Physics-I	4	3	2	0
7	303193103	Communication Skills	2	0	0	2
		Total	**22**	**17**	**8**	**2**
Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
8	303100101	Workshop	2	0	4	0

9	303104155	Mechanics of Solids	4	3	2	0
10	303107151	Basic Electronics	4	3	2	0
11	303109101	Engineering Graphics	4	2	4	0
12	303191151	Mathematics-II	4	4	0	0
13	303193152	Advanced Communication & Technical Writing	2	0	0	2
		Total	**20**	**12**	**12**	**2**

Semester 3

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
14	303101201	Introduction to Aeronautics	3	3	0	0
15	303101202	Introduction to Aeronautics Lab	1	0	2	0
16	303101203	Basic Engineering Thermodynamics	4	3	0	1
17	303101205	Fundamentals of Fluid Mechanics	3	3	0	0
18	303101206	Fundamentals of Fluid Mechanics Lab	1	0	2	0
19	303101207	Analysis of Mechanism and Machine Elements	3	3	0	0
20	303101209	Product Realization	1	0	2	0
21	303191201	Complex Variables and PDE	4	4	0	0
22	303193203	Professional Communication Skills	2	0	0	2
		Total	**22**	**16**	**6**	**3**

Semester 4

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
23	303101251	Aerodynamics - I	3	3	0	0
24	303101252	Aerodynamics Lab	1	0	2	0
25	303101253	Aircraft Structure - I	4	3	0	1
26	303101255	Propulsion - I	4	3	0	1
27	303101257	Aircraft Materials and Processes	3	3	0	0
28	303101258	Aircraft Materials and Processes Lab	1	0	2	0
29	303101260	Surface and Solid Modelling Lab	1	0	2	0
30	303191251	Probability, Statistics and Numerical Methods	4	4	0	0
31	303193252	Professional Grooming and Personality Development	1	0	0	1
		Total	**22**	**16**	**6**	**3**

Semester 5

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut

32	303101301	Aircraft Performance	4	3	0	1
33	303101303	Aerodynamics - II	3	3	0	0
34	303101305	Vibration and Structural Dynamics	3	3	0	0
35	303101307	Aircraft Structure - II	3	3	0	0
36	303101308	Aircraft Structure Lab	1	0	2	0
37	303101309	Propulsion - II	3	3	0	0
38	303101310	Propulsion Lab	1	0	2	0
39	303101312	Summer Internship - I	2	0	4	0
40	303193304	Professionalism & Corporate Ethics	1	0	0	1
		Open Elective 01 (Compulsory Subjects:1)	2	2	0	0
		Total	**23**	**17**	**8**	**2**

Open Elective 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303105304	Cyber Security	2	2	0	0
2	303105305	Internet of Things	2	2	0	0
3	303107346	Fundamentals of Communication Engineering	2	2	0	0

Semester 6

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
41	303101351	Aircraft Stability and Control	4	3	0	1
42	303101353	Computational Fluid Dynamics	3	3	0	0
43	303101354	Computational Fluid Dynamics Lab	2	0	4	0
44	303101356	Minor Project	1	0	2	0
45	303193353	Employability Skills	1	0	0	1
46		Open Elective 02 (Compulsory Subjects:1)	2	2	0	0
47		PEC 01 (Compulsory Subjects:1)	3	3	0	0
48		PEC 02 (Compulsory Subjects:1)	3	3	0	0
		Total	**19**	**14**	**8**	**2**

Open Elective 02 (Compulsory Subjects:1)

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303100351	Programme Management and Entrepreneurship	2	2	0	0
2	303100352	Life Sciences	2	2	0	0
3	303100353	Fundamentals of Management	2	2	0	0
4	303100354	Constitution of India	2	2	0	0

PEC 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303101381	Finite Element Method	3	3	0	0
2	303101383	Heat and Mass Transfer	3	3	0	0
PEC 02						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303101385	Control Theory and Systems	3	3	0	0
2	303101387	Aircraft Systems and Instruments	3	3	0	0
Semester 7						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
49	303101401	Aircraft Design	3	3	0	0
50	303101402	Aircraft Design Lab	1	0	2	0
51	303101403	Avionics	3	3	0	0
52	303101406	Major Project - I	6	0	12	0
53	303101408	Summer Internship - II	2	0	4	0
54		Open Elective 03 (Compulsory Subjects:1)	3	3	0	0
55		PEC 03 (Compulsory Subjects:1)	3	3	0	0
56		PEC 04 (Compulsory Subjects:1)	3	3	0	0
		Total	**25**	**15**	**18**	**0**
Open Elective 03 (Compulsory Subjects:1)						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303101431	Airport Operations and Management	3	3	0	0
2	303101433	Industrial Engineering	3	3	0	0
3	303101435	Geometric Dimensioning and Tolerance	3	3	0	0
PEC 03						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303101437	Hypersonic Aerodynamics	3	3	0	0
2	303101439	Industrial Aerodynamics	3	3	0	0
PEC 04						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303101441	Introduction to Helicopters	3	3	0	0
2	303101443	Lighter than Air Systems	3	3	0	0
Semester 8						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**

57	303101451	Unmanned Aerial Systems	3	3	0	0
58	303101454	Major Project - II	6	0	12	0
59		Open Elective 04 (Compulsory Subjects:1)	3	3	0	0
60		PEC 05 (Compulsory Subject:1)	3	3	0	0
Total			**15**	**9**	**12**	**0**

Open Elective 04 (Compulsory Subjects:1)

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303101481	Aircraft Maintenance	3	3	0	0
2	303101483	Airworthiness and Regulations	3	3	0	0
3	303101485	Tribology	3	3	0	0

PEC 05

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303101487	Rocket and Missile Technology	3	3	0	0
2	303101489	Introduction to Space Technology	3	3	0	0

1.1 Detailed Syllabus

Semester 1

a. **Course Name:** Environmental Science
b. **Course Code:** 303104105
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and Biology up to 10th science level
d. **Rationale:** Basic knowledge of the environment is essential for all human beings for a good life and sustainable existence
e. **Course Learning Objective**

CLOBJ 1	Apply systems thinking to analyse the city as a system, demonstrating application
CLOBJ 2	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 3	Identify sources and stressors of water resources, demonstrating understanding
CLOBJ 4	Analyse the causes, effects, and control measures of population explosion

f. **Course Learning Outcomes:**

CLO 1	Understand the interrelation and interdependency of organisms and their interactions with the environment
CLO 2	Identify eco-friendly measures in engineering projects
CLO 3	Understand preventive steps for environmental protection.
CLO 4	Act as a responsible individual who is aware of efficient usage of resources and securing sustainable development

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**0**	**0**	**Audit**	**-**	**50**	**-**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr.	**Topics**	**Weightage %**	**Teaching hours**
1	**ENVIRONMENTAL HEALTH, ECOLOGY AND QUALITY OF LIFE** Environmental education: Objective and scope, Impact of technology on the environment, Environmental disasters: Case studies, Global environmental awareness to mitigate stress on the environment, Structure and function of an ecosystem, Ecological pyramids, Pyramid of Number, Pyramid of energy and pyramid of biomass.	**25 %**	**7**

2	**POLLUTION PREVENTION** Air & Noise pollution - Sources & their Effects, Case studies of Major Catastrophes, Structure and composition of the atmosphere, Water, Soil, Marine, Thermal & Marine Pollution: The story of fluoride contamination, Eutrophication of lakes, control measures, Measuring water quality: Water quality index, Waste water treatment (general) primary, secondary and tertiary stages, Municipal Solid waste management: Sources and effects of municipal waste, Biomedical waste, Hazardous waste	**20%**	**6**
3	**POPULATION GROWTH, GLOBAL ENVIRONMENTAL CHALLENGES & LATEST DEVELOPMENTS** Population Explosion - Causes, Effects and Control, an International initiative in population-related issues, Urbanization, Growth of the world's large cities, Water resources: Sources of water, Stress on water resources, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Variation in concentrations of GHG gases in ambient air during last millennium, Role of Environmental Information System (ENVIS) in India and similar programs run by EPA(USA), Role of soft tools like Quantum GIS, Autodesk Building Information Modeling (BIM) and City Finance Approach to Climate-Stabilizing Targets (C- FACT), Life Cycle Assessment, Bioinformatics and Optimization tools for Sustainable development.	**25%**	**7**
4	**SMART CITIES** Introduction to smart cities - about smart cities, what is a smart city, world urbanization, case studies of Songdo, Rio De Janeiro, what makes cities smart. City as a system of systems – Introduction, systems thinking, Milton Keynes Future Challenges, Rich picture as city challenges, Wicked problems, Development of smart city approach – core elements, open data, sustainability, privacy and ethics, development processes. Smart Citizens – their role, engaging citizens, IES Cities, Energy systems, Approaches for Citizen Engagement, co-creating smart cities, cities unlocked, living labs, city problems, crowdsourcing ideas, redesigning cities for citizens, all age-friendly cities, mobility on demand, motion maps, Infrastructure, Technology and Data – urban infrastructure and its technology, future of lighting, IoT, connected objects, sensing the city, NOx eating paints and air quality sensors, safest, smart citizen kit, sensing your city, Censored City, Cyber security for data power, open, shared and closed data, satellite data, open data revolution, Smart City Project Data Innovation – smart innovations, smart city ecosystem, data-driven	**30 %**	**10**

	innovations for smart cities. Standards and Capacity Building – the role of Standard, BSI smart city Standards, Hyper Cat, ITU Smart Sustainable cities, Smart City Readiness, Lessons Learnt from Amsterdam. Smart Measurements - metrics and indicators, city indicators, WCCD data portal, value proposition, integrated reporting, smart city learning and Education, urban data school.		

i. Text Book and Reference Book:

1. Textbook of Environmental Studies for Undergraduate Courses (Textbook) |By Dr. Erach Bharucha | Orient Black Swan | Second Edition, Pub. Year 2013
2. Basics of Environmental Studies By U K Khare | Tata McGraw Hill
3. Environmental Studies | By Anindita Basak | Drling Kindersley(India)Pvt. Ltd Pearson
4. Environmental Sciences | By Daniel B Botkin & Edward A Keller | John Wiley & Sons
5. Air Pollution | By M N Rao , H .V N Rao | McGraw Hill Publishing Company Limited, New Delhi
6. Environmental Engineering | By Howard S. Peavy, Donald R. Rowe, George Tchobanoglous | McGraw-Hill

a. **Course Name:** Programming for Problem Solving
b. **Course Code:** 303105102
c. **Prerequisite:** Requires Basic Knowledge of Computer
d. Rationale: This course is design to provide basic ideas of computer programming. This course also makes help to understand programming language. It will help to develop their logical abilities.
e. **Course Learning Objective:**

CLOBJ 1	Recognize and recall fundamental principles and organizations of computers, Demonstrating a foundational understanding of computer architecture and design.
CLOBJ 2	Comprehend the concepts of computer programming languages, illustrating a Grasp of syntax, semantics, and the essential components of programming languages.
CLOBJ 3	Develop algorithms for solving basic engineering problems, demonstrating the ability to apply theoretical knowledge to practical problem-solving Scenarios.
CLOBJ 4	Demonstrate proficiency in the practical application of C programming by writing, compiling, and debugging programs, showcasing the ability to Implement and troubleshoot code effectively.
CLOBJ 5	Evaluate and analyse complex computational programs written in C, Demonstrating the capacity to assess and understand intricate solutions to computational challenges.
CLOBJ 6	Develop simple projects using the C programming language, showcasing Creativity and application of learned principles to produce functional and practical software solutions.

f. **Course Learning Outcomes:**

CLO 1	Recognize the computer's basic principles and organizations.
CLO 2	Understand Concepts of Computer Programming Language.
CLO 3	Develop the algorithm for solving basic Engineering Problems.
CLO 4	Write, Compile and debug program with C Programming.
CLO 5	Analyse the Solved, Complex Computational Program written in C.
CLO 6	Develop simple projects using C Language.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	**Number System:** Introduction and type of Number system, Conversion between number system, Arithmetic operations on number system, Signed and unsigned number system Software, Computer Languages and Computer Program	2%	3
2	**Introduction to 'C' Programming:** Features of C language, structure of C Program, Flow Charts and Algorithms Types of errors, debugging, tracing/stepwise execution Of program, watching variables values in memory.	3%	3
3	**Constants, Variables and data Types:** Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, Assigning values to Variables, type def., and Defining symbolic constants.	5%	2
4	**Operators and Expression:** Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively.	10%	3
5	**Management Input and Output Operators:** Introduction, reading a character, writing a character, formatted input, formatted output.	5%	2
6	**Control structure in C:** Decision Making & branching: Decision making with If &I... Else statements, If. Else statements (Nested …. Ladder), The Switch & got statements, The turnery (? :) Operator Looping: The while statement, The break statement & The Do... While loop, The FOR loop, Jump within loops – Programs	15%	4
7	**Array:** Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.	10%	4
8	**String:** string , string storage , Built-in-string functions	10%	3
9	**User-Defined Functions:** Concepts of user defined functions, prototypes, definition of Function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing.	10%	5
10	**Structure and Unions:** Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions	10%	5
11	**Pointers:** Basics of pointers, pointer to pointer, pointer and array, Pointer to array, array of pointers , functions returning a pointer	10%	5
12	**Dynamic memory allocation:** Introduction to Dynamic memory allocation.	5%	2

13	File Management in C:Introduction to file management and its functions	5%	1

i. Text Book and Reference Book:

1. Programming in ANSI C (Textbook) By E. Balaguruswamy | Tata McGraw-Hill
2. C Programming: Test Your Skills By Ashok Kamthane
3. Computer Fundamentals By P.K.Sinha and Priti Sinha | BPB Publications | 4th Edition
4. Star C Programming STAR Certification | C Certification Exam
5. Programming with C By Byron Gottfried | Tata McGraw Hill Education
6. C The Complete Reference By Herbert Schildt
7. Let Us C By Yeshavant Kanetkar | BPB Publications

a. **Course Name:** Basic Electrical Engineering
b. **Course Code:** 303106101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Basic Electrical Engineering knowledge is fundamental as it provides a strong foundation for various engineering disciplines, promotes problem-solving skills, supports innovation, and opens doors to diverse career opportunities.
e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.
CLOBJ 2	Solve problems related to Alternating current, alternating voltage, etc., Demonstrate a clear understanding of Pure R, L C circuit and combination of RLC, Series and Parallel combination of R, L and C, etc.
CLOBJ 3	Acquire knowledge of the resistor, capacitor, and inductor and their performance characteristics for series and parallel connections.
CLOBJ 4	Understand different single phase and three phase circuits.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principles and applications of transformer, DC machines and AC machines.
CLOBJ 6	Study the use of LT Switch Gear, Fuse, MCB, ELCB etc.

f. **Course Learning Outcomes:**

CLO 1	Understand electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.
CLO 2	Solve basic electrical circuit problems using various laws and theorems
CLO 3	Understand the role of resistor, capacitor and inductor and their performance characteristics for series and parallel connections.
CLO 4	Discuss three phase-balanced circuits.
CLO 5	Understanding the basic concepts and working principles of transformers, DC machines and AC machines.
CLO 6	Acquire knowledge about electrical installations

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**DC Circuits** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Mesh and Node analysis, Simplifications of networks using series and parallel combinations and star-delta conversions. Superposition, The venin and Norton Theorems.	**22%**	**10**
2	**AC Circuits** Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors, examples based on theory. Study of A.C. circuits consisting of pure resistance, pure inductance, pure capacitance and corresponding voltage-current phasor diagrams and waveforms. Development of the concept of reactance, the study of series R-L, R-C, R-L-C circuit and resonance, study of parallel R-L, R-C and R-L-C circuit, concept of impedance, admittance, conductance and susceptance in case of above combinations and relevant voltage-current phasor diagrams, the concept of active, reactive and apparent power and power factor, examples based on theory. Concept of three-phase supply and phase sequence. Voltages, currents and power relations three-phase have balanced star-connected loads and delta-connected loads along with phasor diagrams, Power and power factor measurement in balanced three-phase circuits (one, two and three wattmeter methods), examples based on theory	**33%**	**15**
3	**Transformers** Magnetic effect of an electric current, right-hand thumb rule, Concept of m.m.f., flux, flux density, reluctance, permeability and field strength, their units and relationships, comparison between electrical and magnetic parameters. Fleming's left-hand rule. Self and mutual inductance, Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.	**20%**	**9**

4	**Electrical Machines** Construction, working and application of DC Motor and Generator. Generation of 3 phase rotating magnetic fields, Construction and working of a three-phase and Single phase induction motor and its types. Construction and working of Synchronous generator.	**15%**	**7**
5	**Electrical Installations** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthling. Types of Batteries, Important Characteristics for Batteries.	**10%**	**4**

i. Text Book and Reference Book:

1. Electrical Engineering Fundamentals, By V. D. Toro, Prentice Hall India, Pub. Year 1989
2. Basic Electrical Engineering, By D. C. Kulshreshtha, McGraw Hill, Pub. Year 2009
3. Fundamentals of Electrical Engineering, By Leonard S. Borrow, Oxford University Press, Pub. Year 1996
4. Electrical and Electronics Technology, By E. Hughes Pearson, Pub. Year 2010
5. Basic Electrical Engineering, By D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, Pub. Year, 2010
6. A textbook of Electrical Technology Volume 1&2, By B. L. Theraja, S. Chand Publication

a. **Course Name:** Elements of Mechanical Engineering
b. **Course Code:** 303109102
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Elements of Mechanical Engineering Course Provide students with a comprehensive foundation in the fundamental principles and concepts that form the backbone of mechanical engineering for various Engineering disciplines.
e. **Course Learning Objective:**

CLOBJ 1	Identify and basic mechanical components such as gears, bearings, Pumps, Compressor, boiler, I.C Engines.
CLOBJ 2	Understand various laws and behavior of fluid at different conditions.
CLOBJ 3	Illustrate the operational mechanisms through diagrams, models, or practical demonstrations.
CLOBJ 4	Demonstrate construction and working principles of diverse mechanical devices, such as engines, pumps, and compressors.
CLOBJ 5	Evaluate basic problems related to I.C engine, pumps, compressors and fluids.
CLOBJ 6	Analyse and discuss the interactions and relationships between various mechanical elements within a system

f. **Course Learning Outcomes:**

CLO 1	Identify basic mechanical components and their functions.
CLO 2	Understand basic Properties and behavior of various fluids.
CLO 3	Understand Construction and working of various mechanical devices
CLO 4	Apply fundamental principles to solve basic mechanical engineering problems

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**Basics of Thermodynamics** Prime Movers - Meaning and Classification; Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Internal Energy, Enthalpy, Specific Volume; Thermodynamics – Definition: Change of State, Path, Process, Cycle, Thermodynamic systems, Statement of Zeroth Law, First Law and Second Law of Thermodynamics and its Applications.	**10%**	**5**
2	**Properties of Gases** Gas Laws, Boyle's law, Charles law, Combined gas law; Gas Constant, Relation between Cp and Cv Constant Volume Process; Constant Pressure Process; Isothermal Process; Adiabatic Process; Poly-tropic Process. Examples based on above topics.	**15%**	**6**
3	**Properties of Steam** Types of Steam and Steam formation; Specific Enthalpy; Specific Volume; Dryness Fraction of Steam; Measurement of Dryness Fraction; Steam Table. Examples based on above topics.	**15%**	**6**
4	**Heat Engines** Definition of Heat Engine; Classification of Heat Engine; Carnot Cycle, Rankine Cycle, Otto Cycle and Diesel Cycle. **Internal Combustion Engines:** Two Stroke Petrol and Diesel Engine; Four Stroke Petrol and Diesel Engine; Measurement of Indicated Power and Brake Power: Numerical on calculation of Mechanical, Thermal and Volumetric Efficiency. Examples based on above topics	**20%**	**10**
5	**Energy Conversion Devices** **Steam Generators:** Definition and Classification; Cochran, Lancashire, Locomotive, Babcock and Wilcox Boiler: Construction and Working; Boiler Mounting and Accessories. **Refrigeration and Air Conditioning:** Meaning of Refrigeration; Vapor Compression Refrigeration Cycle; Vapor Absorption Refrigeration Cycle; Air conditioning; Window Air Conditioning and Split Air Conditioning.	**20%**	**5**
6	**Pumps And Air Compressors** **Pumps** Definition, Classification and Application of Pumps; Types and Operation of Rotary pump, Reciprocating Pump, Centrifugal Pump. **Air Compressors** Definition, Classification and Application of Compressors; Types and Operation of Rotary and Reciprocating Air Compressor.	**10%**	**5**
7	**Motion And Power Transmission Devices** Shaft and Axle; Belt Drive; Chain Drive; Friction Drive; Gear Drive; Clutch, Coupling and Brake.	**5%**	**3**

8	**Conventional And Non-Conventional Energy Sources** Introduction and Classification of Energy Sources; Conventional Energy Sources E.g. Solid, Liquid, Gaseous and Nuclear fuels; Calorific Value of Fuels; Non-Conventional Energy Sources E.g. Solar Energy, Wind Energy, Hydro Power, Biomass and Biomass Energy; Comparison of Conventional & Non-Conventional Energy Sources.	**5%**	**3**

i. Text Book and Reference Book:

1. "Elements of Mechanical Engineering", By S.B. Mathur, S. Domkundwar, Dhanpat Rai & Sons Publications.
2. "Thermal Engineering, By R.K Rajput", Laxmi Publications.
3. "Thermal Science and Engineering", By Dr. D. S. Kumar, S. K. Kataria and sons Publishers.
4. "Basic Mechanical Engineering", By T. S. Rajan, Wiley Eastern Ltd
5. "Fundamental of Mechanical Engineering", By G. S. Sawhney, PHI Publication New Delhi.

a. Course Name: Mathematics-I
b. Course Code: 303191101
c. Prerequisite: Knowledge of Mathematics up to 12th science level
d. Rationale: The Mathematics I syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and matrix algebra, preparing students for engineering challenges with optimized problem-solving skills.

e. Course Learning Objective:

CLOBJ 1	Develop a comprehensive understanding of definite and improper integrals, including the application of integration techniques to find areas and volumes in both Cartesian and Polar coordinates.
CLOBJ 2	Utilize differential equations to model and solve practical scenarios, demonstrating proficiency in various solution techniques.
CLOBJ 3	Analyse the convergence and divergence of sequences and series, employing tests such as the Alternating Series Test and Ratio Test
CLOBJ 4	Analyse matrix operations and determinants, exploring their properties and applications in solving systems of linear equations.
CLOBJ 5	Apply Fourier series for representing periodic functions, verifying Dirichlet's conditions.
CLOBJ 6	Solve optimization problems using multivariable calculus concepts, such as Lagrange's multiplier.

f. Course Learning Outcomes:

CLO 1	Develop understanding of fundamental mathematical concepts
CLO 2	Formulate and solve mathematical models for real-world engineering problems,
CLO 3	Integrate knowledge from different mathematical topics to analyze and solve complex engineering problems
CLO 4	Critically analyze mathematical results, interpret their engineering significance, and make informed decisions based on mathematical outcomes, fostering a deeper understanding of the subject.
CLO 5	Clearly and effectively communicate mathematical ideas, solutions, and reasoning, both in written and oral formats, demonstrating effective communication skills.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	**UNIT 1 Improper Integral & Application of Definite Integral:** Evaluation of definite and improper integrals, Beta and Gamma functions and their properties Area bounded by curves in Cartesian and Polar form, Area of a region bounded by function, Area of a region bounded by curves in Parametric form, Volume by slicing, Volume of solid by revolution.	8%	5
2	**UNIT 2 First order Ordinary Differential equation:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Claimant's type, Applications	15%	9
3	**UNIT 3 Matrices:** Matrices & Determinants with Properties, Linear Independence, Rank of Matrix, System of Linear Equations, Consistency of System, Solution of system of Linear Equations by Gauss Jordan and Gauss- Elimination Method, Eigen values, Eigenvectors, Symmetric, Skew- symmetric, and orthogonal Matrices, Eigen bases, Diagonalization, Cayley Hamilton Theorem and its Applications, Diagonalization, Orthogonal Transformation, Quadratic form.	25%	15
4	**UNIT 4 Sequences and Series:** Basic of Sequences, Bounded and Monotonic Sequences, Series, Convergence of sequence and series, Geometric series, P- series, Cauchy's Integral Test, Comparison Test, Alternating Series, Absolute and Conditional convergence, Ratio test, Cauchy's Root Test, Power series, Taylor's and Maclaurin's series.	17%	10
5	**UNIT 5 Fourier Series:** Fourier Series of 2 periodic functions, Dirichlet's conditions for representation by a Fourier series, Fourier Series of a function of period 2 , Fourier Series of even and odd functions, Half range series.	10%	6
6	**UNIT 6 Multivariable Calculus (Differentiation):** Functions of Several Variables, Limit, Continuity, Partial Derivatives, Homogeneous function, Euler's Theorem for homogeneous function, Modified Euler's Theorem, Chain Rule, Implicit function, Jacobian, Tangent plane and Normal line, Maximum and Minimum Values, Lagrange 's Multiplier, Taylor's and Maclaurin's Series for functions of two variables.	25%	15

i. **Text Book and Reference Book:**

1. **Calculus and Analytic Geometry (Textbook) |** By G.B. Thomas and R.L. Finney | Addison Wesley
2. **Calculus with early transcendental functions |** By James Stewart | Cengage Learning
3. **Higher Engineering Mathematics |** By B. S. Grewal | Khanna Publications
4. **Elementary Linear Algebra (Textbook) |** By Howard Anton, Chris Rorres | Willy India Edition | 9th Edition
5. **Advanced Engineering Mathematics (Textbook) |** By Erwin Kreyszig | Willey India Education
6. **A text book of Engineering Mathematics |** By N.P. Bali and Manish Goyal | Laxmi Publications

a. **Course Name:** Engineering Physics-I
b. **Course Code:** 303192101
c. **Prerequisite:** Knowledge of Physics and some basic concepts in Mathematics like Differentiation, integration, limit, differential equation, vector calculus up to 12thscience level.
d. **Rationale**: Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.
e. Course Learning Objective:

CLOBJ 1	Understand and explain the elastic properties of materials. Analyze the tensile stress-strain curve and its implications for material behavior. Evaluate shear strength in both perfect and real crystals.
CLOBJ 2	Investigate thermo-electric effects and their applications. Examine the Weidman-Franz law and its significance. Explore phonons and their role in heat transfer. Analyze different modes of heat transfer and specific heat of solids. Compare and contrast the Einstein and Debye models for solids.
CLOBJ 3	Gain a qualitative understanding of statistical mechanics. Differentiate between Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics.
CLOBJ 4	Analyze transverse waves on a string and harmonic waves. Investigate reflection, transmission, standing waves, and Eigen frequencies.
CLOBJ 5	Explore Einstein's theory of matter-radiation interaction. Understand absorption, spontaneous, and stimulated emission of radiation. Identify characteristics and components of lasers. Classify types of lasers, including ND: YAG Laser, CO2 Laser, and Semiconductor Diode Laser. Examine applications of lasers in various fields.
CLOBJ 6	Understand fluid flow, viscosity, and apply the continuity equation. Analyze Euler and Bernoulli's equations in fluid mechanics

f. Course Learning Outcomes:

CLO 1	Acquire a deep understanding of fundamental principles and concepts in classical mechanics, electromagnetism, thermodynamics, and modern physics.
CLO 2	Develop proficiency in applying mathematical techniques to solve physics problems
CLO 3	Gain familiarity with experimental methods, laboratory equipment, and techniques for conducting physics experiments.
CLO 4	Apply theoretical knowledge to solve a variety of physics problems
CLO 5	Integrate knowledge from different branches of physics to understand interdisciplinary phenomena and real-world applications.
CLO 6	Evaluate the appropriateness of theoretical models in explaining physical phenomena and predict outcomes.

g.Teaching Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	**UNIT- I :** Properties of Material Mechanical Properties: Elastic properties, Model of elastic behavior, tensile stress strain curve, shear strength of perfect and real crystals. Thermal Properties: Thermo-electric effects, Weidman-Franz law, Phonons, Modes of heat transfer, Specific heat of solids, Einstein and Debye Model, Qualitative idea about Maxwell- Boltzmann, Bose Einstein, Fermi-Dirac statistics	20%	9
2	UNIT- II: Motion in a Plane Transformation of coordinates, Newton's laws and its completeness in describing particle motion, Problems including constraints and friction, Motion of a rigid body in the plane; Rotation in the plane; Angular momentum about a point of a rigid body in planar motion	20%	9
3	**UNIT-III** : Classical Mechanics Degrees of freedom, Constraints and constraint forces, Lagrange's equations of motion, Conservation law, Euler's laws of motion, Non inertial frames of reference; Centripetal and Coriolis accelerations; Fluid Mechanics: - Flow of fluids, Viscosity, Continuity equation, Euler and Bernoulli's equations	20%	9
4	**UNIT'IV** : Waves &Vibration Transverse wave on a string, Wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, Standing waves and their Eigen frequencies, longitudinal waves and the wave equation, Acoustics waves and speed of sound, Phase velocity and group velocity	20%	9
5	**UNIT V:** Lasers Einstein's theory of matter-radiation interaction, Absorption, Spontaneous and Stimulated Emission of Radiation, Characteristics of Laser, Components of Laser, Types of Laser: Nd:YAG Laser, CO2 Laser, Semiconductor Diode Laser, Applications of Lasers.	20%	9

i. Reference Books:

1. Engineering Mechanics by MK Harbola
2. Engineering Mechanics – Dynamics by JL Meriam
3. Mechanical Vibrations by JP Den Hartog
4. University Physics by Sears AndZemansky | Pearson Pu

a. **Course Name:** Communication Skill
b. **Course Code:** 303193103
c. **Prerequisite:** Knowledge of English Language studied till 12th standard
d. **Rationale:** Basic Communication Skills are essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will demonstrate the ability to communicate ideas clearly and effectively
CLOBJ 2	Students will develop strategies for building positive interpersonal relationships, fostering effective collaboration and teamwork.
CLOBJ 3	Students will develop active listening skills, including the ability to comprehend, interpret, and respond appropriately to spoken messages.
CLOBJ 4	Students will exhibit proficiency in written communication, crafting clear, concise, and well-organized messages across various formats (emails, reports, memos, etc.).
CLOBJ 5	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content, and confident delivery.
CLOBJ 6	Students will understand and utilize various digital communication tools and platforms, demonstrating proficiency in virtual communication.

f. **Course Learning Outcomes:**

CLO 1	Understand the importance of creative and critical thinking.
CLO 2	Expand vocabulary with proper pronunciation.
CLO 3	Comprehend the basics of English grammar.
CLO 4	Read & write effectively for a variety of contexts.
CLO 5	Develop confidence in speaking skills.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
					CE		**Theory**	**P**	
0	**2**	**0**	**2**	-	100	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topic	Weightage %	Teaching hours
1	**Crazy Scientist**: • The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	5%	2
2	**Phonetics**: • IPA Introduction (listening tracks) • Phonic Sounds • Pronunciation Practice including transcription	10%	4
3	**Vocabulary Building & Word Formation Process**: • Compounding, clipping, blending, derivation, creative respelling, coining and borrowing • Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided)	10%	2
4	**Speaking Activity : Role play on Critical Thinking (Life boat)** • This activity topic gears towards making students do role play based on various scenarios. • It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it. • It aims to improve students' convincing skills.	10%	4
5	**Picture Description & Picture Connector** • Enable students to use vocabulary and useful expression to describe the picture. • In this class the students will be trained to form logical connections between a set of pictures which will be shared with them. • This geared towards building creativity and presentation skills.	15%	2
6	**Mine Activity: Usage of Preposition:** • Students will learn to use proper propositions by active participation in the activity.	8%	2
7	**Worksheets on Identifying Common Errors in Writing::** • Sentence structure • Punctuations • Subject-Verb Agreement • Noun-Pronoun Agreement	12%	2
8	**Reading Skills:** • The art of effective reading and its various strategies to be taught to the learners and practice exercises be given on reading comprehension.	10%	2
9	**Speech and spoken Exchanges; Extempore:** • Students will learn the correct usage of spoken language as different from the written form. It will help the students in extempore speech. • This will be done by making the students give variety of impromptu speeches in front of the class: 1 minute talk on simple topics. • To change the average speakers in the class to some of the best Orator.	10%	4

10	**Book Review:** • The learners will identify the central idea of the book, author's style and approach towards the book. • This will enable the learners to express their point of view and hone their creativity and writing skills.	10%	4

i. Reference Books:

1. Understanding and Using English Grammar Betty Azar & Stacy Hagen; Pearson Education
2. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
3. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press
4. Technical Communication : Principles And Practice Sangeetha Sharma, Meenakshi Raman; Oxford University Press
5. Practical English Usage MICHAEL SWAN
6. A Remedial English Grammar for Foreign Student F.T. WOOD
7. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
8. Oxford Practice Grammar, John Eastwood; Oxford University Press

Semester-2

a. **Course Name:** Workshop
b. **Course Code:** 303100101
c. **Prerequisite:** Zeal to learn the subject.
d. **Rationale:** The workshop practice is the backbone of the real industrial trades which helps to develop and enhance relevant technical hands-on experience of using various tools and instruments related to various trades. The use of workshop practices in day to day industrial as well domestic life helps to solve the problems. Further, it also deals with basic introduction of system components of electrical and electronic systems, and provides hands on practice in assembling, interconnecting, testing, and repairing such system by making use of various tools used in electrical and electronic workshop. Electronic systems are built on printed circuit board (PCB) and breadboard. One need to use source instruments (power sources and signal sources), and appropriate measuring instruments to study behavior of a system.

e. Course Learning Objective:

CLOBJ 1	Provide an overview of the principles, scope, and importance of mechanical engineering, including its various sub-disciplines and applications.
CLOBJ 2	Emphasize and enforce safety protocols, practices, and procedures to ensure a safe working environment within a mechanical workshop.
CLOBJ 3	Measurement Techniques and Instruments: Familiarize students with various measurement techniques and instruments used in mechanical engineering, emphasizing precision and accuracy in measurements.
CLOBJ 4	Introduce students to basic manufacturing processes such as machining, casting, forming, and welding, providing insights into how different materials are shaped and manipulated.
CLOBJ 5	Hands-on Experience with Tools and Equipment: Familiarize students with basic tools, machines, and equipment commonly used in mechanical engineering through hands-on activities and demonstrations in a workshop setting.

f. Course Learning Outcomes:

CLO 1	Comprehend the safety measures required to be taken while working in workshop.
CLO 2	Select the appropriate tools required for specific operation.
CLO 3	Understand the different manufacturing technique for production out of the given raw material.
CLO 4	Understand applications of machine tools, hand tools and power tools.
CLO 5	Understand the importance of the safety measures to be taken while working in the laboratory and safety standards
CLO 6	Understand working principle of various electrical & electronics measurement equipment. Also, the safety measures to be taken while working in the laboratory And safety standards.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**-**	**4**	**2**	**-**	**-**	**40**	**-**	**60**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. Electronic Principles by Albert Paul Malvino | TMH
2. Electronic Devices by Thomas L. Floyd | Pearson, Prentice Hall "Linear Systems and Signals" by B.P. Lathi.
3. Electronic Devices and Circuits by David A. Bell | Oxford Publication
4. Electronic Devices and Circuits by Jacob Millman and Halkias | Tata McGraw Hill Publication New Delhi.
5. Shop Theory by Anderson James & Earl E. Tatro | Macmillan/McGraw-Hill School.
6. Workshop Technology by Bava H. S. | Tata McGraw Hill Publishing Co. Ltd.
7. Elements of Workshop Technology Vol. I By Hajra Chaudhary S.K. | Asia Publishing House.
8. Workshop Technology by Chapman, W.A.J. ELBS Low Price Text | Edward Donald Pub. Ltd.
9. Basic Machine Shop Practice Vol. I & II By Tejwani, V.K. | Tata McGraw Hill Pub. Co.
10. Workshop Technology Vol. I & II By Arora, B.D. | Satya Prakashan, New Delhi" Signals and Systems" by Simon Haykin and Barry Van Veen.

a. **Course Name:** Mechanics of Solids
b. **Course Code:** 303104155
c. **Prerequisite:** System of units, Laws of motion, Basic idea of force, Concept of centroid Fundamentals of stress, strain and their relationships
d. **Rationale:** Mechanics of Solids is conceptual applications of principles of mechanics in Engineering.
e. **Course Learning Objective:**

CLOBJ 1	Comprehend the concepts of stress, strain, and deformation in solid materials under various loading conditions, and apply this understanding to analyze structural behavior.
CLOBJ 2	Gain insight into the mechanical properties of materials such as elasticity, plasticity, and failure mechanisms, and their implications in designing resilient and safe structures.
CLOBJ 3	Analyze structural components, including beams, columns, and trusses, under different loading scenarios using principles of mechanics of solids, determining stresses, and deformations.
CLOBJ 4	Develop proficiency in constructing shear force and bending moment diagrams to understand internal forces and moments in structural elements, crucial for design and analysis.
CLOBJ 5	Calculate deflections and assess stability criteria for structural elements, recognizing critical conditions that impact structural integrity and safety.
CLOBJ 6	Apply principles of mechanics of solids to design structural elements, ensuring they meet safety standards, considering factors such as material selection, loading conditions, and design codes.

f. **Course Learning Outcomes:**

CLO 1	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of Engineering.
CLO 2	Determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.
CLO 3	Apply principles of statics to determine reactions & internal forces in statically determinate beams.
CLO 4	Know basics of friction and its importance through simple applications.
CLO 5	Understand behavior & properties of engineering materials.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous

Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	**INTRODUCTION:** Forces/Equilibrium of Rigid body, Scalar and vectors, system of forces, resultant force, Statics of particles. Free-body diagrams. Equilibrium of particle in two dimensions, Resultants of three or more concurrent forces, Resolution of a force into components. Rectangular components of a force. Resultants by rectangular components, Concurrent force system in space: Resolution of a force into rectangular components in space, Coplanar Non-Concurrent Force Systems, Moments about Points and Axes, Equilibrium, Non-coplanar Non-concurrent Forces.	15%	5
2	**CENTROID MOMENT OF INERTIA:** Distributed forces: Centroid and center of gravity. Determination of centroid of lines and areas using integral technique, Determination of centroid of composite wires and areas, Centroid of volumes. Theorems of Pappus-Guldinus and its applications, Second moment of areas, Definition of moment of inertia. Determination of moment of areas by integration, Parallel axis theorem for Moment of Inertia. MI of composite areas, Concept of Mass moment of inertia of bodies.	15%	5
3	**BEAMS:** Definitions, types of beams, types of loading, types of supports. Determination of reactions for simply, Supported and over hanging beams. Relation between distributed load, Shear force and Bending Moment, Shear force and Bending moment in beams with diagrams	20%	6
4	**FRICTION:** The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Analysis of systems involving dry frictions such as ladders spheres etc., Belt Friction, Analysis of flat and v-belt.	25%	8
5	**SIMPLE STRESSES & STRAINS:** Basics of stress and strain: 3-D state of stress (Concept only), Normal/axial stresses: Tensile & compressive Stresses: Shear and complementary shear Strains, Linear, shear, lateral, thermal and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio.	25%	8

i. Text Book and Reference Book:

1. Statics and Dynamics Beer, F.P. and Johnston, E.R. Vector mechanics for engineers; Tata McGraw-Hill.
2. Engineering Mechanics: Statics and Dynamics J.A Desai and B.B Mistry; Popular Prakashan.
3. Engineering Mechanics: Statics and Dynamics R.C Hibbeler; Prentice Hall of India.
4. Engineering Mechanics: Statics and Dynamics S Rajsekaran; Vikas Publication.
5. Engineering Mechanics S.S. Bhavikatti and K. G. Rajashekarappa; Wiley 'Eastern Ltd.

6. Engineering Mechanics J.L. Meriam, and L.G.Kraige; John Wiley and sons, New York

Course Name: Basic Electronics

a. **Course Code:** 303107151
b. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
c. **Rationale:** The course provides introductory treatment of the field of Basic of Electronics to the students of various branches of engineering.

d. **Course Learning Objective:**

CLOBJ 1	To study basics of semiconductor & devices and their applications in different areas.
CLOBJ 2	Compare design issues, advantages, disadvantages and limitations of basic electronics components.
CLOBJ 3	To study and analyze different biasing techniques to operate transistor.
CLOBJ 4	Study the DC regulated power supply with different voltage regulator ICs.
CLOBJ 5	Study the use of sensors and transducers.

e. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

f. **Course Content:**

Sr.	**Topics**	**Weightage %**	**Teaching hours**
1	Diode Theory and Its Applications Introduction to Ideal Diode, Effect of temperature Ideal diodes, unbiased diode and Forward and reverse bias of Diode. PIV, surge current, Diode as Uncontrolled switch. Rectifiers: Half wave, Full wave and bridge wave. IDC, VDC and Irms Measurements. Ripple factor, PIV rating. Choke and Capacitor input filter rectifiers, Clipper and Clamper circuits, Voltage multiplier: Half wave voltage double and full wave voltage double	15%	10
2	Special Purpose Diodes Construction of Zener diode, Characteristics of Zener diode, Application of Zener Diode as Voltage Regulator, load line, Optoelectronic devices (LED and Photo Diode), Seven Segment Display, Scotty diode and its Application, Varactor Diode and its Application, Understanding Datasheets.	15%	6

3	Transistor Fundamentals and its Biasing techniques Construction of BJT, working principle of BJT, Characteristics & specifications of BJT (PNP & NPN transistors), Biased and unbiased BJT, Configuration of transistor, concept of gain & BW, Operation of BJT in cut-off, saturation & active regions (DC analysis), BJT as switch, Transistor as an amplifier, Voltage divider bias and analysis, VDB load line and Q point.	30%	15
4	DC Regulated Power Supply Voltage Regulator-Basic series and shunt regulator, Types of voltage regulator IC: Fixed and adjustable positive and negative linear voltage regulator, IC linear fixed voltage regulator (78XX, 79XX, LM340 Series), Linear Adjustable Regulator (IC LM317, LM337, and IC 723 IC regulator), DC Regulated Power supply, Switched mode power supply (SMPS).	20%	6
5	Introduction to Sensors and Transducers Introduction to sensors and Transducers, Comparison between sensors and Transducers, Applications of Sensors and Transducers, Types of Electronic sensors, Types of Transducers.	20%	6

g. Text Book and Reference Book:

1. Electronic Principles | By A. P. Malvino | Tata McGraw Hill Publication New Delhi
2. Electronic Devices and Circuits | By Jacob Millman and Halkias | Tata McGraw Hill Publication New Delhi.
3. Electronic Devices and Circuits | By Robert L. Boylestad and Louis Nashelesky | Pearson, Prentice Hall.
4. Electronic Devices | By Thomas L. Floyd | Pearson, Prentice Hall
5. Linear Electronic Circuits and Devices By James Cox, Delmar Publication.
6. Electronic Devices and Circuits | By David A. Bell | Oxford Publication

a. **Course Name:** Engineering Graphics
b. **Course Code:** 303109101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12^{th} science level
d. **Rationale:** "Engineering Graphics" course Provide students with a comprehensive foundation in the fundamental principles and concepts that form the backbone of mechanical engineering for various Engineering disciplines.
e. **Course Learning Objective:**

CLOBJ 1	Identify and name common drafting tools and their uses.
CLOBJ 2	Interpret engineering drawings and symbols.
CLOBJ 3	Demonstrate the ability to create accurate engineering drawings using industry-standard software.
CLOBJ 4	Solve engineering design problems by applying geometric and spatial concepts.
CLOBJ 5	Generate accurate and professional engineering drawings independently.
CLOBJ 6	Design and create 3D models of engineering components using computer-aided design (CAD) tools.

f. **Course Learning Outcomes:**

CLO 1	Identify and recall common drafting tools and their uses.
CLO 2	Interpret and explain engineering drawings and symbols.
CLO 3	Demonstrate the application of industry-standard software to create accurate Engineering drawings.
CLO 4	Solve engineering design problems by applying geometric and spatial concepts.
CLO 5	Generate accurate and professional engineering drawings independently.
CLO 6	Design and create 3D models of engineering components using computer-aided design (CAD) tools.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
2	-	4	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage %	Teaching hours

1	**INTRODUCTION TO ENGINEERING GRAPHICS** Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Introduction to Drawing Standards BIS-SP-46, Representative Fraction, Types of Scales (Plain and Diagonal Scale), Dimensioning Terms and Notations, Types of Arrowheads, Lines, Lettering, Numbering and Dimensioning	5%	0
2	**ENGINEERING CURVES:** Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves - Conics, Spirals, Involutes and Cycloids with Tangents and Normal	10%	5
3	**PRINCIPLES OF PROJECTIONS:** Types of Projections - Oblique, Perspective, Orthographic and Isometric Projections; Introduction to Principal Planes of Projections, Projections of Points located in all four Quadrants; Projections of lines inclined to one of the Reference Plane and inclined to two Reference Planes.	10%	4
4	**PROJECTIONS OF PLANES:** Projections of various planes – Polygonal, Circular and Elliptical Shape inclined to one of the Reference Plane and inclined to two Reference Planes; Concept of Auxiliary Plane of Projections.	10%	4
5	**PROJECTIONS OF SOLIDS AND SECTIONS OF SOLIDS:** Classifications of basic Solids, Projections of Solids - Right Regular Prism, Pyramid, Cone, Cylinder, Tetrahedron and Cube inclined to one of the Reference Plane and inclined to two Reference Planes; Frustum of Prism, Pyramid and Cone inclined to one of the Reference Plane; Types of Cutting Planes - Auxiliary Inclined Plane, Auxiliary Vertical Plane, Horizontal Cutting Plane, Profile Cutting Plane; Sections of Solids resting on H.P/V.P and Inclined to only one of the Reference Planes; Sectional Views, True Shape of the Sections	20%	10
6	**DEVELOPMENT OF SURFACES:** Methods of Development of Lateral Surfaces of Right Regular Solids, Parallel Line Development and Radial Line Development, Applications of Development of Surfaces.	10%	5
7	**ORTHOGRAPHIC PROJECTIONS:** Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection method; Full Sectional Orthographic Views – Side and Front, Offset Cutting views	15%	0
8	**ISOMETRIC VIEW/DRAWING AND ISOMETRIC PROJECTIONS:** Conversion of Orthographic Views into Isometric Projection, View or Drawing; Isometric Scale.	15%	0
9	**OVERVIEW OF COMPUTER AIDED DRAFTING TOOL:** Introduction to Computer Aided Drafting Software; Preparation of Orthographic Projections and Isometric Views Using Drafting Software	5%	0

i. Text Book and Reference Book:

1. Engineering Drawing N.D. Bhatt & V.M. Panchal; Charotar Publishing House

2. ENGINEERING GRAPHICS P. J. Shah; S. Chand & Co., New Delhi Publications.
3. Graphic Science and Design French, T.E. Vierck, C.J & Foster; Tata McGraw Hill Publications.
4. Fundamentals of Engineering Drawing Luzadder; W. J & Duff Prentice Hall Publications.
5. Engineering Drawing and Graphics Venugopal k; New Age International Private Limited Publishers.

a. Course Name: Mathematics-II
b. Course Code: 303191151
c. Prerequisite: Knowledge of Mathematics up to 12th science level
d. Rationale: The Mathematics I syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. Course Learning Objective:

CLOBJ 1	Define and identify ordinary differential equations of higher order. Classify ODEs based on homogeneity and linearity. Solve homogeneous linear ODEs of higher order with constant coefficients, and variable coefficients.
CLOBJ 2	Solve homogeneous linear ODEs of higher order with constant coefficients, variable coefficients
CLOBJ 3	Apply the Method of Undetermined Coefficients to solve nonhomogeneous ODEs. Utilize the Solution by Variation of Parameters for solving nonhomogeneous ODEs. Explore applications of ODEs in real-world scenarios.
CLOBJ 4	Understand power series solutions for ordinary points and regular Singular points. Explore properties and applications of Legendre polynomials and Bessel functions.
CLOBJ 5	Define Laplace transform and its inverse. Understand the linearity property of Laplace transforms. Solve ordinary differential equations using Laplace transforms.
CLOBJ 6	Define Fourier Integral and its applications. Explore Fourier Cosine and Sine Integrals.

f. Course Learning Outcomes:

CLO 1	Demonstrate the ability to translate physical or engineering problems into mathematical equations and solve them.
CLO 2	Develop analytical and critical thinking skills through the process of solving complex mathematical problems.
CLO 3	Understand and interpret mathematical solutions in the context of the given problems.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms.
CLO 5	Present mathematical arguments and solutions in a logical and organized manner.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	UNIT 1 : Higher order ordinary differential equations: Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEs with Constant Coefficients, Euler–Cauchy equations, Nonhomogeneous ODEs, Method of Undetermined Coefficients, Solution by Variation of Parameters, Applications	8%	5
2	UNIT 2 : Power Series: Power series solutions at ordinary point and regular singular point; Legendre polynomials, Bessel functions of the first kind and their property	15%	9
3	UNIT 3 : Laplace Transform: Laplace Transform and inverse Laplace transform, Linearity, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals, ODEs, UNIT Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Laplace transform of periodic functions, Short Impulses, Dirac's Delta Function, Convolution, Integral Equations, Differentiation and Integration of Transforms, Solution of ordinary differential equation by Laplace transform	25%	15
4	UNIT 4: Fourier Integral: Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral	17%	10
5	UNIT 5: Vector Calculus: Gradient of scalar field, Directional Derivative, Divergence and curl of Vector field, Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	10%	6
6	UNIT 6: Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals (Cartesian)	25%	15

i. Text Book and Reference Book:

1. Calculus and Analytic Geometry (Textbook) | By G.B. Thomas and R.L. Finney | Addison Wesley
2. Calculus with early transcendental functions | By James Stewart | Cengage Learning
3. Higher Engineering Mathematics | By B. S. Grewal | Khanna Publications
4. Elementary Linear Algebra (Textbook) | By Howard Anton, Chris Rorres | Willy India Edition | 9th Edition
5. Advanced Engineering Mathematics (Textbook) | By Erwin Kreyszig | Willey India Education

Course Name: ADVANCED COMMUNICATION & TECHNICAL WRITING

a. **Course Code:** 303193152
b. **Prerequisite:** Knowledge of English language studied till 12th standard
c. **Rationale:** Communication confidence laced with knowledge of English grammar is essential for all engineers**.**
d. **Course Learning Objective:**

CLOBJ 1	Students will be able to demonstrate the ability to adapt writing style to different audiences and purposes.
CLOBJ 2	Students will create comprehensive technical documents such as reports, essay, review and project proposals.
CLOBJ 3	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content and confident delivery.
CLOBJ 4	Student will explore and apply technical communication through various mediums (video, web content, multimedia)
CLOBJ 5	Students will be able to Incorporate advanced document design principles for clarity and readability.
CLOBJ 6	Students will be able to deliver different types of speeches.

e. **Course Learning Outcomes:**

CLO 1	Develop four basic skills
CLO 2	Construct grammatically correct sentences.
CLO 3	Develop and deliver professional presentation skills (
CLO 4	Develop the skills of critical thinking.
CLO 5	Compare different types of written communication.

f. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	-	100	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

g. **Course Content:**

Sr.	**Topic**	**Weightage %**	**Teaching hours**
1	Developing Effective Listening Skills: To help students understand the meaning and importance of Good listening skills, learning the traits of being a good listener through activity and listening audio tracks.	10%	2

2	Error analysis: To provide insights into the complicated processes of language development as well as a systematic way for identifying, Describing and explaining errors. (Tenses, Voices, Reported speech)	10%	4
3	Delivering different types of speeches: Students will understand and use the different patterns for structuring speeches Welcome / Introductory speech Vote of Thanks speeches Farwell speeches	10%	2
4	Professional Presentatis: Students will learn Combating stage fright Preparing power point presentation Delivering PPT	10%	5
5	Essay writing: Students will overcome the common pitfalls in the task of essay writing by understanding Basics of Paragraph development and paragraph jumble Types of essays Characteristic features of essays Guiding Principles	10%	4
6	Reading Comprehension: Employing Different Reading Skills Activity Practice	10%	2
7	Project Proposal: To equip students with the various elements required to prepare a winning proposal.	5%	2
8	Misplaced Modifiers: Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	5%	1
9	Movie Review: A movie show followed by writing a review. To provide an exposure to students how to express their opinions about some film or documentary with unbiased and objective approach.	10%	2
10	Narrative Writing: Narrative writing helps them explore different characters and settings. To help students clarify their thinking, and teach them to express that in writing in an organized way.	5%	2
11	Writing Reports: Process of writing Order of writing Final draft & checklist for reports Sample reports: Memorandum Letter report	10%	2
12	Critical Thinking: Need, relevance and Significance of Critical Thinking Logic in problem solving and decision making(activities) Moral Reasoning (Case Studies)	5%	1

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press
3. Practical English Usage MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student F.T. WOOD
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar,John Eastwood; Oxford University Press
7. Technical Communication : Principles And Practice Sangeetha Sharma, Meenakshi Raman; Oxford University Press

Semester 3

a. **Course Name:** Introduction to Aeronautics
b. **Course Code:** 303101201
c. **Prerequisite:** Zeal to Learn the Subject.
d. **Rationale:** The subject gives basic principles and understanding of Aircraft Science, Airplane structure & operation of engines used in Aeronautics.
e. **Course Learning Objective:**

CLOBJ 1	Explore the evolution of aviation, study various flight vehicles, analyze aircraft systems, instruments, and understand UAV applications.
CLOBJ 2	Understand atmospheric structure, air foil principles, lift production theories, Newton's laws, and forces on aircraft, coefficients, drag types, and stability concepts.
CLOBJ 3	Explore aircraft components, study fuselage, wings, empennage, landing gear, power plants, materials, and anticipate future aircraft construction methods.
CLOBJ 4	Examine primary and secondary flight controls, understand control surfaces, mixing, and delve into helicopter flight controls, autopilot, and stability aspects.
CLOBJ 5	Investigate historical context, power plant classification, and comprehend thrust generation mechanisms in reciprocating engines, turbines, ramjets, and rocket propulsion.

f. **Course Learning Outcomes:**

CLO 1	Understand the history, flight vehicles and aircraft systems.
CLO 2	Understand the fundamentals of aerodynamics involved in airplane performance.
CLO 3	Understand the structures of flight vehicles.
CLO 4	Acquire the knowledge of controls of an aircraft.
CLO 5	Understand application of propulsion systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

h. **Course Content:**

Unit No.	**Topic**	**Weightage %**	**Teaching hours**

1.	**History & Background** History of Flight, Different types of flight vehicles, Types of Aircraft Systems and Instruments, UAVs and its application.	12%	5
2.	**Introduction to Aerodynamics** Structure of the Atmosphere, Airfoil, Airfoil Nomenclature, Types of Airfoil, NACA Series, Theories in the Production of Lift, Newton's Basic Laws of Motion, Forces Acting on the Aircraft, Coefficients of lift and drag at various angles of attack, Lift/Drag Ratio, Types of Drag, Types Wings, Aspect Ratio, Taper Ratio, Wingtip Vortices, Axes of an Aircraft, Moment and Moment Arm, Speed Ranges, Stalls, Boundary Layer, Shock Waves, Stability and its types.	30%	12
3.	**Introduction to Aircraft Structures** Introduction, Nomenclature of Aircraft , Fuselage and its types, Wings, Empennage, Landing Gear, Power plant, Subcomponents, Structural components of Helicopter, Rocket and RLV, Aircraft Materials, Construction of Future Aircraft.	20%	8
4.	**Flight Controls** Introduction, Flight Control Systems **Primary Flight Controls-** Ailerons, Elevator, Rudder, Mixing of control surfaces. **Secondary Flight Controls**-Flaps, Leading Edge Devices, Spoilers, Trim Tabs, Balance Tabs, Servo Tabs, Antihero Tabs, Ground Adjustable Tabs, Adjustable Stabilizer, Canard and Autopilot, Helicopter Flight Controls.	18%	7
5.	**Introduction to Aircraft Propulsion** History, Classification of Power plant, Thrust, Reciprocating Engines, Propeller, Turbine Engines, Ramjet Engine, Rocket Engines (Solid, Liquid and Hybrid Propellant)	20%	8

i. Text Book and Reference Book:

1. Introduction to Flight by John D Anderson,Tata Mc Graw Hill Book Company
2. Flight without Formula by A C Kermode, Pearson Education
3. Pilot's Handbook of Aeronautical Knowledge by Federal Aviation Administration
4. Fundamentals of Flight by R S Shevell, Pearson Education

a. **Course Name:** Introduction to Aeronautics Lab
b. **Course Code:** 303101202
c. **Prerequisite:** Zeal to learn the subject.
d. **Rationale:** The subject gives exposure to students to design, fabricate and fly models. It not only gives a primary introduction to the world of aerodynamics, designing, electronics, engine technology, wood crafting and the technology of new materials but also provides a hands-on experience necessary for developing a practical aptitude.

e. **Course Learning Objective:**

CLOBJ 1	Master aeromodelling basics, exploring principles, design, and applications in aviation hobbyist communities.
CLOBJ 2	Classify model aircraft types, distinguishing features, and functionalities, from gliders to powered planes.
CLOBJ 3	Dissect airplane components, understanding roles of wings, fuselage, and control surfaces in flight dynamics.
CLOBJ 4	Analyze forces impacting flight: lift, weight, thrust, and drag, comprehending their influence on aircraft dynamics.
CLOBJ 5	Apply flight principles, including lift generation and control surfaces, in building diverse aircraft models for practical learning.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic concepts of aeromodelling and its scope.
CLO 2	Explain the various types of model aircraft and their components.
CLO 3	Understand the forces and scientific laws that apply to flight.
CLO 4	Apply the fundamental knowledge to fabricate the various models of an Aircraft.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content**

List of Practical	
1.	Study the overview of Aeromodelling.
2.	Study the model aircraft and their different types.
3.	Study the various components of an Airplane.

4.	Study the various forces acting on an Airplane.
5.	Study the principles of flight
6.	Building the various models of an Aircraft.

i. Text Book and Reference Book:

1. Aeromodelling Made Easy by Siddharth M. Sharma.
2. Basic Aeromodelling by R. H. Warring
3. How to Build and Fly Electric Model Aircraft by Robert Schleicher.
4. Building and Detailing Model Aircraft by Pat Hawkeye

a. **Course Name:** Basic Engineering Thermodynamics
b. **Course Code: 303101203**
c. **Prerequisite:** Fundamental Knowledge of Basic Thermodynamics Properties, Process etc.
d. **Rationale:** Engineering Thermodynamic concepts enable the definition and analysis of thermodynamic systems, which is vitally important to the aeronautical engineer under different operating conditions.
e. **Course Learning Objective:**

CLOBJ 1	Develop a foundational understanding of thermodynamics, exploring microscopic and macroscopic perspectives, thermodynamic systems, properties, and processes, along with essential concepts like equilibrium, phase transitions, and the zeroth law.
CLOBJ 2	Master the first law's application to closed systems, gaining insights into energy changes during cycles and state transformations. Analyze non-flow and flow processes, steady flow energy equations, and applications in both steady and unsteady flow scenarios.
CLOBJ 3	Explore the limitations of the first law, grasp the second law principles through Kelvin-Planck and Claudius statements, and delve into entropy, Carnot cycles, and thermodynamic temperature scales.
CLOBJ 4	Develop skills in partial differentiation and understand fundamental thermodynamic relations, including Maxwell's equations, T-ds equation, and the comparison between the first and second laws.
CLOBJ 5	Gain insights into gas laws, including Avogadro's law, ideal gas equation, and Dalton's law. Understand the behavior of gas mixtures, analyzing apparent molecular weight, specific heats, and adiabatic mixing.
CLOBJ 6	Explore various thermodynamic cycles, such as Carnot, Rankine, and gas power cycles (Otto, Diesel, and Brayton). Understand the factors influencing cycle efficiency and make informed comparisons between different cycles.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic systems and processes used in thermodynamics.
CLO 2	Understand various laws of thermodynamics and its applications.
CLO 3	Apply the knowledge of entropy and available energy in heat-based appliances.
CLO 4	Analysis of the properties of real gases and mixtures under different atmospheric conditions.
CLO 5	Evaluate problems based on various Gas and Vapor cycles.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**1**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-

Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**Introduction** Microscopic & macroscopic point of view, Thermodynamic system and control volume, Thermodynamic properties, Processes and Cycles, Thermodynamic equilibrium, Quasi-static process, Pure substance, Vapor-liquid-solid phase in a pure substance, p-v-T surface, Critical and Triple point of pure substance, Work and Heat Transfer, Point function and Path function, Temperature and zeroth law of thermodynamics, Continuum.	**15%**	**5**
2	**First law of Thermodynamics** Introduction, First law for a closed system undergoing a cycle, First law of thermodynamics for a closed system undergoing a change of state energy, Energy-A property of the system, PPM1, Non-flow process and flow process, flow process and control volume, Steady and unsteady flow process, Steady Flow Energy Equation and its applications, Unsteady flow processes: filling And emptying process.	**20%**	**8**
3	**Second Law of Thermodynamics and Entropy** Limitations of first law of thermodynamics, Kelvin-Planck and Claudius statements and their equivalence, PMM2, Carnot cycle, Carnot theorem, Corollary of Carnot theorem, Thermodynamic temperature scale. Claudius theorem, Property of entropy, Inequality of Claudius, Entropy changes in in an open system, Reversible and Irreversible process, Principle of increase of entropy, Third law of thermodynamics, Concept of Exergy.	**25%**	**10**
4	**Thermodynamics Relations** Fundamentals of Partial Differentiation, Maxwell's Equation, T-ds Equation, Difference in heat capacities, Ratio of ˚ heat capacities, Available energy, Unavailable energy, Comparison of the first and second law of thermodynamics, Reversibility and Irreversibility.	**10%**	**5**
5	**Gases and Vapor Mixtures** Avogadro's law, Equation of state, Ideal gas equation, Daltons law and Gibbs-Dalton law, Volumetric analysis of a gas mixture, The apparent molecular weight and gas constant, Specific heats of a gas mixture, Adiabatic mixing of perfect gases, Gas and vapor mixtures	**10%**	**6**
6	**Thermodynamics Cycles** Introduction, Carnot cycle, Rankine cycle, Modified Rankine cycle, Variables affecting the efficiency of Rankine cycle, Comparison of Rankine and Carnot cycles, Introduction to gas power cycle, Carnot cycle, Otto cycle, Diesel cycle, Brayton Cycle. generate course learning objectives for this course chapter vise in short	**20%**	**8**

i. Text Book and Reference Book:

1. " Engineering Thermodynamics" by By P. K. Nag

2. “Engineering Thermodynamics “by Khurmi R S.
3. “Thermodynamics “by J.P. Holman.
4. “Engineering Thermodynamics “by R K Rajput.
5. “Thermodynamics (Textbook)”, by R. Yadav

a. **Course Name:** Fundamentals of Fluid Mechanics
b. **Course Code:** 303101205
c. **Prerequisite:** Fundamentals Knowledge of various thermal, physical properties of fluid
d. **Rationale:** The subject gives exposure to various fluids principles, the behavior of Fluid under different conditions, and types of flow generation, which is required in Engineering for analysis purposes.

e. **Course Learning Objective:**

CLOBJ 1	Define and classify fluids, explore fluid mechanics principles, properties, and behaviors, covering capillarity, surface tension, compressibility, and stress measurements in fluid flows.
CLOBJ 2	Understand Pascal's law, forces on fluid systems, pressure measurement, buoyancy, and stability in floating bodies, focusing on partially and fully submerged bodies and meta centric heights.
CLOBJ 3	Learn types of flow, continuity equation, one- and two-dimensional flow, velocity, acceleration, potential lines, and dynamics, including Euler's equation and Bernoulli's equation for incompressible flow applications.
CLOBJ 4	Study qualitative aspects, viscosity, Naiver-Stokes equations, energy equation, and solutions like Plane Poiseuille flow, Coquette flow, and Hagen-Poiseuille flow.
CLOBJ 5	Apply the concept of boundary layer concepts, momentum equation by Von Karman, laminar and turbulent layers, and methods to control boundary layer separation.
CLOBJ 6	Analyze the problems by Buckingham's theorem, non-dimensional groups, geometric, kinematic, and dynamic similarity, with applications in scaling experiments and model testing.

f. **Course Learning Outcomes:**

CLO 1	Understand the fundamentals of fluid Mechanics and respective properties of fluid.
CLO 2	Understand the behavior of fluid under static and dynamic conditions
CLO 3	Apply various governing equation to solve the fluid mechanics problems.
CLO 4	Analysis the flow with various measurement techniques and instruments used in fluid mechanics.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**Introduction of Fluids** Definition and types of fluids, the science of fluid mechanics, fluid properties, capillarity, surface tension, compressibility, units and dimensions, Normal and shear stresses in fluid flows and measurement of fluid velocity	**7%**	**4**
2	**Fluid Statistics** Pascal's law, types of forces on a fluid system, measurement of pressure, use of manometers and gauges, Buoyancy, forces on partially and fully submerged bodies, forces on curved surfaces, stability of floating bodies, center of gravity and meta centric heights.	**15%**	**6**
3	**Kinematics of Fluid Flow** Types of flow, Stream line, Path line, Streak line, Stream tube, Continuity equation, One- & Two-dimensional flow, Velocity & Acceleration at a point, Potential lines, Flow net, Stream function, Velocity potential, Circulation and Vortex motion. Dynamics of Fluid Flow; One-dimensional method for flow analysis, Euler`s equation of motion, Derivation of Bernoulli`s equation for incompressible flow & its applications, Condition on velocity for incompressible flow, Laplace's equation.	**25%**	**10**
4	**Viscous Flow** Qualitative aspects of viscous flows, viscosity, Naiver stoke's equations in vector form, viscous flow energy equation, some exact solutions of Navier stoke's equations; Plane Poiseuille flow, Couette flow, Hagen - Poiseuille flow.	**15%**	**6**
5	**Boundary Layer Theory** Introduction, Boundary layer Definitions and Characteristics, Momentum Equation for Boundary Layer by Von karman, Laminar Boundary Layer, Turbulent Boundary Layer, Boundary Layer Separation and its control.	**30%**	**12**
6	**Dimensional Analysis and Similitude** Buckingham's theorem, non-dimensional groups, Geometric, Kinematic and Dynamic similarity, Applications	**8%**	**4**

i. Text Book and Reference Book:

1. Fluid Mechanics and Hydraulic Machines By Dr. R K. Bansal | Laxmi Publications
2. "Fluid Mechanics and Hydraulic Machines By R.K. Rajput | S.Chand & Co
3. Fluid Mechanics by F. M. White | Tata McGraw - Hill Publishing Co. Ltd.
4. “Engineering Fluid Mechanics by D. S. Kumar | S K KATARIA & SONS-NEW DELHI.
5. Engineering Fluid Mechanics By K. L. Kumar | S. Chand Limited

a. **Course Name:** Fundamentals of Fluid Mechanics Lab
b. **Course Code:** 303101206
c. **Prerequisite:** Fundamentals Knowledge of various thermal properties of fluid.
d. **Rationale:** The subject gives exposure to various fluids principles, the behavior of Fluid under different conditions and types of flow generation, which is required in Engineering for analysis purposes
e. **Course Learning Objective:**

CLOBJ 1	Demonstrate the principles of fluid dynamics by experimentally verifying Bernoulli's Theorem using different apparatuses, highlighting the relationship between fluid velocity, pressure, and elevation.
CLOBJ 2	Measure the metacentric height of a floating body to assess its stability, crucial in naval architecture, through experimentation and understanding the fluid mechanics principles involved.
CLOBJ 3	Determine the discharge coefficients of V-notch and rectangular-notch weirs, crucial for accurate flow rate measurements, ensuring precision in various hydraulic applications.
CLOBJ 4	Calibrate Venturi and Orifice meters to accurately measure fluid flow rates, establishing a reliable calibration for these widely used instruments in fluid dynamics and engineering applications.
CLOBJ 5	Experimentally determine the viscosity of a liquid using a viscometer, providing insights into fluid properties and behavior, with applications in industries such as chemical engineering and material science.

f. **Course Learning Outcomes:**

CLO 1	Understand the fundamental of the Apparatus required in the laboratory.
CLO 2	Understand the application of Bernoulli's Principle.
CLO 3	Apply the equation and measurement techniques to calculate the fluid properties
CLO 4	Analyze experimental data and develop Empirical equations.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content**

List of Practical	
1	Study the different apparatuses used for the experiment.
2	Experimental verification of Bernoulli's Theorem.

3	Determination of metacentric height of a Floating Body.
4	Determination of the discharge coefficient of V-Notch.
5	Determination of the discharge coefficient of Rectangular-Notch.
6	Calibration of Venturi and Orifice Meters.
7	Determination of viscosity of liquid using Viscometer.
8	Friction losses in Pipes.
9	Verification of the Froude's Model Law.
10	To calibrate the wind tunnel by using a Pitot tube.

i. Text Book and Reference Book:

1. Fluid Mechanics and Hydraulic Machines By Dr. R K. Bansal | Laxmi Publications
2. "Fluid Mechanics and Hydraulic Machines By R.K. Rajput | S.Chand & Co
3. Fluid Mechanics by F. M. White | Tata McGraw - Hill Publishing Co. Ltd.
4. “Engineering Fluid Mechanics by D. S. Kumar | S K KATARIA & SONS-NEW DELHI.
5. Engineering Fluid Mechanics By K. L. Kumar | S. Chand Limited

a. **Course Name:** Analysis of Mechanism and Machine Elements
b. **Course Code:** 303101207
c. **Prerequisite:** Inclination to learn mathematics, basic knowledge of differential equations and difference equations, strength of material, mechanics of solid
d. **Rationale:** This course provides a fundamental grasp of Mechanism and Machine Link principles, covering kinematic pairs, degrees of freedom, and velocity analysis. Students explore force analysis, including static and dynamic principles, and gain practical insights into joints (riveted and welded). The curriculum also encompasses shaft design, addressing diverse load scenarios and industry standards. In essence, the course equips students with a comprehensive understanding of mechanical systems, preparing them for real-world engineering applications.
e. **Course Learning Objective:**

CLOBJ 1	Understand kinematic pairs, degrees of freedom, and the Grubler criterion.
CLOBJ 2	Differentiate absolute and relative motion, conduct velocity analysis, and explore acceleration components.
CLOBJ 3	Learn static force analysis principles, apply D'Alembert's principle, and analyze engine forces.
CLOBJ 4	Examine riveting methods, compare welded joints, and analyze stresses on joints.
CLOBJ 5	Explore shaft types, analyze stresses, and apply ASME codes for shaft design.

f. **Course Learning Outcomes:**

CLO 1	Understand the principal and various laws useful for analyzing any mechanism.
CLO 2	Understand various theorems used for solving various problems of kinematics and dynamics.
CLO 3	Carry out the force analysis for any dynamics problems.
CLO 4	Explain various balancing methods used in locomotives and prime movers.
CLO 5	Design the riveted and welded joints required for joining the wall structure elements for the airframe.
CLO 6	Design of structural elements, which are subjected to torsional and bending moments.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**Introduction to Mechanism and Machine:** Link, Kinematic pair & Chain, classification of kinematic pairs, Degrees of freedom, Kutzbach's equation, Grubler criterion, inversions of four bar chain, slide crank mechanism & double slider crank mechanism.	15%	6
2	**Velocity and Acceleration Analysis** **Velocity analysis:** Absolute & relative motion, vectors, the motion of a link, Velocity analysis of four-link mechanism & slider crank mechanism, the angular velocity of links, the velocity of rubbing, I- center method, Kennedy's theorem, and centrode. **Acceleration analysis:** Acceleration, Acceleration analysis of the four-link mechanism & slider crank mechanism, Corioli's acceleration component, crank & slotted lever mechanism	25%	10
3	**Force Analysis:** Static force analysis: Introduction to static force analysis, superposition, and principle of virtual work. Dynamic force analysis: D Alembert's principle, dynamic analysis of slider cranks chain, velocity & acceleration of piston, engine force analysis, the inertia of connecting rod.	20%	8
4	**Riveted and Welded Joints Riveted Joints:** Methods of riveting, types of the rivet head, types of riveted joints, the efficiency of riveted joints and riveted joints for structural use. Welded Joints-Advantages & Disadvantages of welded joints over riveted joints, types of welded joints, the strength of transverse fillet welded joints, the strength of parallel fillet welded joints, stresses on welded joints.	20%	9
5	**Design of Shafts** Types of shafts, the material of shafts, ASME codes for shaft design, stresses in the shaft, design of shafts subjected to twisting moment only, design of shafts subjected to bending moment only, design of shafts subjected to combined twisting & bending, design of shafts subjected to axial load in addition to combined twisting & bending. Combined twisting & bending, design of shaft on the basis of rigidity.	20%	9

i. Text Book and Reference Book:

1. Theory of Machine by R. S. Khurmi and J. K. Gupta | S. Chand

2. Theory of Machines and Mechanisms by J E Shigley | Oxford University Press

3. Design of Machine Elements by R S Khurmi | S.Chand Publication

4. Design of Machine Elements by V B Bhandari | McGraw Hill.

a. **Course Name:** Product Realization
b. **Course Code:** 303101209
c. **Prerequisite:** Basic knowledge of Workshop.
d. **Rationale:** The subject builds the ability of the student to have hands-on exposure to different tools and methods to create an innovative product that would bring value to society.
e. **Course Learning Objective:**

CLOBJ 1	Understand the holistic product realization process, covering conception, design, and implementation.
CLOBJ 2	Evaluate materials for product development based on mechanical properties and application suitability.
CLOBJ 3	Explore and apply various machining technologies essential for product refinement.
CLOBJ 4	Master the systematic stages of product development, from ideation to final production.
CLOBJ 5	Demonstrate the ability to create a product, integrating materials, machining technologies, and following the development process.

f. **Course Learning Outcomes:**

CLO 1	Understand the importance and steps to developing products.
CLO 2	Understand the different materials required to develop the product.
CLO 3	Understand the different machining required to develop the product.
CLO 4	Apply the technologies to create the product.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**50**	**-**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Text Book and Reference Book:**

1. "Product Design and Development" by Karl T. Ulrich and Steven D. Eppinger.
2. "Materials Selection in Mechanical Design" by Michael F. Ashby.
3. "Engineering Design: A Systematic Approach" by Gerhard Pahl and Wolfgang Beitz.

a. Course Name: Complex Variables and PDE
b. Course Code: 303191201
c. Prerequisite: Knowledge of Mathematics up to 12th science level
d. Rationale: The Mathematics I, Mathematics-II syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. Course Learning Objective:

CLOBJ 1	Understand complex numbers in polar form, powers, and roots. Apply complex variable differentiation principles, including Cauchy-Riemann equations.
CLOBJ 2	Master contour integrals and apply the Cauchy-Goursat theorem. Utilize Cauchy Integral formula, Liouville's theorem, and Maximum-Modulus theorem.
CLOBJ 3	Express functions through power series, including Taylor and Maclaurin Series. Analyze zeros, singularities, and residues using the Cauchy Residue theorem.
CLOBJ 4	Solve first-order linear and nonlinear PDEs using Charpit's Method.
CLOBJ 5	Solve linear partial differential equations using complementary function and particular integral method.
CLOBJ 6	Apply separation of variables to solve problems, classify second-order linear equations, and model solutions for Heat, Wave, and Laplace equations.

f. Course Learning Outcomes:

CLO 1	Demonstrate proficient problem-solving skills, translating real-world problems into mathematical formulations and applying appropriate techniques for solutions.
CLO 2	Develop integrated analytical and critical thinking skills by engaging with a wide range of mathematical structures, proofs, and problem-solving techniques presented throughout the entire syllabus.
CLO 3	Understand and interpret mathematical solutions within the context of specific problems, recognizing the practical applications of discrete mathematics in diverse fields covered in all units.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms, adapting communication styles to the diverse topics covered in each unit.
CLO 5	Present mathematical arguments and solutions in a unified, logical, and organized manner, emphasizing clarity, coherence, and precision across all units.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	**Complex Numbers:** Polar Form of Complex Numbers, Powers and Roots Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius Transformations and their properties.	26%	15
2	**Complex Variable - Integration :** Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof)	18%	11
3	**Functions Given by Power Series** Taylor and Maclaurin Series, Laurent's series; Zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Residue Integration Method	16%	10
4	**Algebraic Structures and Morphism:** Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form	17%	10
5	**First Order Partial Differential Equations:** First order partial differential equations, solutions of first order linear and nonlinear PDEs, Charpit's Method	16%	10
6	**Second and Higher Order Partial Differential Equations:** Solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	24%	14

I. Text Book and Reference Book:
Text books:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill.

2. E. Kreyszig, Advanced Engineering Mathematics, Willey India Edition.

Reference Books:

1. R. Huberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
2. D. G. Zill, P. D. Shanahan, a First Course in Complex Analysis with Applications, Jones and Bartlett Publishers.
3. P. O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage
4. I. Sneddon, Elements of Partial Differential Equations, McGraw Hill.

a. **Course Name:** PROFESSIONAL COMMUNICATION SKILLS
b. **Course Code:** 303193203
c. **Prerequisite:** Knowledge of English language in practical life
d. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism
e. **Course Learning Objective:**

CLOBJ 1	Students will be able to demonstrate the ability to communicate clearly and persuasively in oral presentations.
CLOBJ 2	Students will Practice active listening techniques to enhance understanding in professional interactions.
CLOBJ 3	Students will write professional emails, memos, and reports with clarity and conciseness.
CLOBJ 4	Students will understand and practice professional etiquette in various business settings.
CLOBJ 5	Students will be able to demonstrate skills in resolving conflicts and negotiating effectively.
CLOBJ 6	Students will use digital communication tools and platforms effectively.

f. **Course Learning Outcomes:**

CLO 1	To develop advanced communication skills
CLO 2	To become more proficient in formal writing
CLO 3	To apply interpersonal communication skills to be more productive at the workplace
CLO 4	To identity set and achieve the goals with the help of time management
CLO 5	To use with range of vocabulary to communicate effectively

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	-	100	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr.	**Content**	**Weightage %**	**Teaching hours**

1	**Technical Writing: Email etiquette & Email writing Letter Writing (Types of Letters & Layout):** Trains students on detailed email and letter writing etiquette. Students will be able to write formal letters following certain stipulated formats. They will learn different types of letters for different official purposes.	**10%**	**4**
2	**Interpersonal Communication at Workplace: Dynamics of communication:** To develop the confidence to handle a wide range of demanding situation more effectively at the workplace To enable the students to analyse their own interpersonal communication style.	**10%**	**2**
3	**Debate: The three minute debate planner:** To enable the students to generate effective critical thinking into primary issues in the given topic. Students will be able to resolve controversies and recognize strengths and weaknesses of arguments.	**10%**	**4**
4	**Goal setting & Tracking:** To enable the students to define strategies or implementation steps to attain the identified goals and make progress every day.	**10%**	**2**
5	**Time Management & Task Planning (Case –study):** To enable the students to identify their own time wasters and adopt strategies to reduce them. To enable students to clarify and priorities their objective and goals by creating more planning time	**5%**	**2**
6	**Reading Comprehension: Intermediate level:** To enable the students develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	**10%**	**2**
7	**Listening Skills:** Small everyday conversation and Comprehension Provides practice on understanding accents and day to day conversations Listening to English conversations in different context.	**10%**	**2**
8	**Information design and writing for print and online media: Blog Writing:** To enable students to design information that is targeted to specific audiences in specific situation to meet defined objectives. To create blogs and share their own knowledge and experience to the world.	**5%**	**2**
9	**Advanced Vocabulary Building:** The students will expand their vocabulary so as to enhance their proficiency in reading and listening to academic texts, writing, and speaking. The students will attain vocabulary to comprehend academic and social reading and listening texts. The students will develop adequate speaking skills to communicate effectively.	**10%**	**4**
10	**Picture Perception:** To prepare the students for a test for basic intelligence and IQ, generally done on the first day of SSB (Sashastra Seema Bal is one of India's Central Armed Police Forces)	**5%**	**2**
11	**Appreciation, Apology and Acknowledgement letters:** To enable the students to maintain productive business relationship through different types of letters. To enable the students to express their feelings without speaking out loud.	**10%**	**2**
12	**The Art of Negotiation:** To enable the students to reach an agreement for mutual benefits	**5%**	**2**

	through negotiation. To enable the students to learn a process by which compromise or agreement is reached while avoiding argument and dispute.		

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S And Lata P; New Delhi Oxford University Press
3. Practical English Usage MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student F.T. WOOD
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar, John Eastwood; Oxford University Press
7. Quantitative Aptitude for Competitive Examinations Dr. R.S. Aggarwal

SEMESTER-4

a. **Course Name:** Aerodynamics - I
b. **Course Code:** 303101251
c. **Prerequisite:** Basic Knowledge of Fluid Mechanics.
d. **Rationale:** The course will provide strong foundation on incompressible flow, which will be useful for creating foundation of designing an aircraft. The students will learn basic concepts of Forces acting an aircraft and the basic theories. Student will understand the application of various theories in predicting the performance of aircraft.
e. **Course Learning Objective:**

CLOBJ 1	Understand aerodynamic forces, pressure distribution, and airflow effects on airfoils, exploring stalling, drag characteristics, and pitching moments in low-speed conditions.
CLOBJ 2	Understand potential flow principles, circulation, and their application to diverse body shapes.
CLOBJ 3	Examine airfoil airflow, lift generation, and drag characteristics using circulation principles.
CLOBJ 4	Analyze wing behaviors, focusing on downwash, lift distribution, and induced drag for various wing shapes.
CLOBJ 5	Understand the interaction of airflow with airfoils and wings by integrating theories, analyzing lift, drag, and stability in varied aerodynamic scenarios.

f. **Course Learning Outcomes:**

CLO 1	Understand the fundamentals of aerodynamics.
CLO 2	Analyze the effect of the flow on different bodies.
CLO 3	Formulate and apply appropriate aerodynamics models to predict the forces on and performance of 3 –Dimensional configuration.
CLO 4	Perform analytical and experimental aerodynamic analysis.
CLO 5	Apply the concepts of aerodynamics to design airfoil and wing.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage %	Teaching hours
1	**Low speed Aerodynamics:** Aerodynamic forces and moments, Incompressible Flow in a duct: The Venturi and Low-Speed Wind Tunnel, Pitot Tube: Measurement of Air Speed, Pressure coefficient, Centre of pressure and aerodynamic center, Effect of incidence on pressure distribution, The lift Curve, Airfoil stalling, Drag, Types of drag, Drag Polar, Alembert's Paradox, Pitching moment, Span wise Flow variation, Downwash.	**15%**	**8**
2	**Potential Flow:** Angular Velocity, Vorticity and Strain, Circulation, Kutta Joukowsky Theorem, Stream Function, Velocity Potential, Elementary flows: Uniform flow, Source Flow, Doublet Flow, Vortex Flow, Principles of Superposition, Combination of uniform flow with a source and sink, Half body, Rankine oval body, Non-lifting flow over circular cylinder, lifting flow over a cylinder.	**25%**	**12**
3	**Thin Airfoil Theory:** Low speed flow over an Airfoil - Vortex Sheet, The Kutta Condition, Kelvin's Circulation Theorem, and Classical Thin Airfoil Theory - The Symmetrical Airfoil, The Cambered Airfoil and Viscus Flow: Estimating Skin Friction Drag, Transition, Flow Separation, The Vortex Panel Numerical Method for Lifting flow over bodies.	**30%**	**12**
4	**Finite Wings:** Introduction: Downwash and Induced Drag, The vortex filament, The Biot-Savart Law and Helmholtz's Theorem. Prandtl's classical lifting line theory. Elliptical lift distribution, General Lift distribution, Effect of Aspect Ratio. Numerical Lifting line method. Lifting surface and VLM, Applied aerodynamics over the delta wing	**30%**	**13**

i. Text Book and Reference Book:

1. "Fundamentals of Aerodynamics" by John D Anderson
2. "Aerodynamics for Engineering" Students by E L Houghton and P W Carpenter
3. "Aerodynamics" by L J Clancy | Sterling Book House Indian Edition
4. "Theoretical Aerodynamics" by Milne Thomson

a. **Course Name:** Aerodynamics Lab
b. **Course Code:** 303101252
c. **Prerequisite**: Basic Knowledge of Fluid Mechanics
d. **Rationale:** Aerodynamics is one of the core areas in the field of aviation. The concepts of aerodynamics are vitally important to the aeronautical engineer.
e. **Course Learning Objective:**

CLOBJ 1	Understand the fundamental aerodynamic concepts and their real-world applications.
CLOBJ 2	Explain different wind tunnel types and their specific roles in practical aerodynamic assessments.
CLOBJ 3	Understand the fundamental principles governing elementary flow patterns in aerodynamics.
CLOBJ 4	Develop precise techniques for calibrating subsonic wind tunnels, ensuring accurate experimental results.
CLOBJ 5	Analyze lift, drag coefficients, pressure distributions, and visualize flow patterns over symmetrical/cambered airfoils and a circular cylinder.

f. **Course Learning Outcomes:**

CLO 1	Understanding and application of different experimental setups used in Aerodynamics laboratories.
CLO 2	Investigate the variation of surface pressure over the bluff and slender bodies
CLO 3	Predict and calculate the aerodynamic forces over an airfoil/wing.
CLO 4	Perform analytical and experimental aerodynamic analysis.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

List of Practical	
1	**To study fundamentals of aerodynamics.**
2	Introduction to different types of wind tunnel and their applications.
3	To study basic elementary flow.
4	Calibration of subsonic wind tunnel.
5	Determination of aerodynamic forces and moments over the cambered airfoil.
6	Determination of co-efficient of lift and co-efficient of drag over the cylinder.

7	Determination of co-efficient of lift and co-efficient of drag over symmetrical airfoil.
8	Pressure distribution over a circular cylinder at different free stream velocities.
9	Pressure distribution over a symmetrical airfoil at different angle of attack.
10	Flow visualization over symmetrical airfoil and cambered airfoil.

h. Course Content

i. Text Book and Reference Book:

1. "Fundamentals of Aerodynamics" by John D Anderson
2. "Aerodynamics for Engineering" Students by E L Houghton and P W Carpenter
3. "Aerodynamics" by L J Clancy | Sterling Book House Indian Edition "Theoretical Aerodynamics" by Milne Thomson

a. **Course Name:** Aircraft Structure-1
b. **Course Code: 303101253**
c. **Prerequisite:** Basic concepts of Mechanics of Solids and Engineering Mechanics.
d. **Rationale:** Aero structure is useful to apply fundamental principal of Mechanics to solve various filed problem at elementary level.
e. **Course Learning Objective:**

CLOBJ 1	Understand and apply principles of bending, shear, and stress distribution in beams, optimizing for real-world engineering applications.
CLOBJ 2	Comprehend 3D stress and strain, analyze principal stresses on various planes using Hooke's law, and utilize Mohr's circle.
CLOBJ 3	Understand torsional behavior in shafts, calculate torsional rigidity, and analyze combined bending and torsion scenarios, crucial for designing resilien aircraft components.
CLOBJ 4	Evaluate material failure using principal stress, strain energy theories, and Mohr's circle, ensuring safe aircraft design and addressing diverse stress conditions.
CLOBJ 5	Grasp concepts of static determinacy, indeterminacy, and employ methods like Maxwell's Reciprocal Theorem and Castiglioni's Theorem for structural analysis.
CLOBJ 6	Analyze elastic curve equations, calculate slope and deflection using methods like double integration, Macaulay's method, and moment area method.

f. **Course Learning Outcomes:**

CLO 1	Understand the aircraft structural components and their behavior under the different loading condition.
CLO 2	Apply the fundamental knowledge of stresses and strain in aircraft structural components.
CLO 3	Analysis the aircraft structural components and predict failure.
CLO 4	Analysis the different types of structural members under different loading conditions.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				T	**CE**	**P**	**T**	**P**	
3	**1**	**0**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**Symmetrical Bending and Shearing of Beams:** Introduction, Theory of simple bending, position of neutral axis, section modulus, Practical application of bending equation, Beam of heterogeneous materials, Beams of uniform strength, Shearing stress variation, Variation of shear stress in beam cross- section, Shear stress distribution for typical sections.	10%	5
2	**Principal Stresses and Strains** Hooks law for 3D body, plane stress and strain condition, Principal stresses, principal planes, Two-dimensional stress system, stresses on an inclined plane, Mohr's circle.	10%	5
3	**Torsion of Shafts** Introduction, Torsion of shafts, Torsion Equation, Hollow circular shafts, Torsional rigidity, Importance of angle of twist and various stresses in shafts, Shafts in series and parallel, Combined Bending and Torsion.	15%	7
4	**Theories of Failure** Introduction, Maximum Principal Stress Theory, Maximum Shear Stress or Stress Difference Theory, Strain Energy Theory, Shear Strain Energy Theory, Maximum Principal Strain Theory.	15%	8
5	**Determinate and Indeterminate Structures and its Analysis Method** Concepts of statically Determinate and Indeterminate structures, Concept of kinematic Indeterminacy, Principle of Superposition, Maxwell's Reciprocal Theorem, Strain Energy due to axial, bending and torsional loads, Castiglioni's Theorem, Unit load method or Virtual load method, Application to Beams, Truss, Frames, Rings, etc.	25%	10
6	**Slope and Deflection of Determinate Beam** Differential equation of the elastic curve, the relation between moment slope and deflection, double integration method, Macaulay's method, Conjugate beam method, moment area method applied to the beam.	25%	10

i. Text Book and Reference Book:

1. "Aircraft Structure for Engineering Students" by THM Megson & Edward Arnold.
2. "Aircraft Structures" by David J Peery and J J Azar.
3. "Analysis of Structure Vol. 1" by S S Bhavikatti.
4. "Mechanics of structure Vol. 1" by S B Junarkar.
5. "Theory and Analysis of Flight Structures", by R M Rivello | Tata McGraw Hill

a. **Course Name:** Propulsion-I
b. **Course Code:** 303101255
c. **Prerequisite:** Fundamental knowledge of Thermodynamics & Fluid Mechanics
d. **Rationale:** The subject covers the analysis of various components responsible for producing thrust in airplanes. Also, it performs each component of the jet propulsion system.
e. **Course Learning Objective:**

CLOBJ 1	Understand the basics of turbomachines and positive displacement engines. Explore internal combustion engine processes, focusing on spark ignition (SI) and compression ignition (CI) engines, including 4-stroke and 2-stroke engines.
CLOBJ 2	Apply the knowledge of propeller theories, including Ideal Froude Momentum theory and blade element theory. Solve numerical problems and make propeller selections based on charts. Explore fixed/variable pitch, constant speed propellers, ducted propellers, and materials.
CLOBJ 3	Learn the principles of axial and centrifugal flow compressors. Examine geometry, working principles, velocity triangles, H-S diagrams, losses, efficiency, and performance characteristics. Understand low hub-tip ratio, supersonic and transonic stages
CLOBJ 4	Study axial and radial turbine principles. Analyze stage velocity triangles, impulse and reaction stages, and blade to gas speed ratio, losses, efficiencies, and performance charts. Explore elements of radial turbine stages, outward flow radial stages, and their performance characteristics.
CLOBJ 5	Gain a comprehensive understanding of propulsion systems, including turbomachines and positive displacement engines. Explore the internal combustion engine process, propeller theories, compressor principles, and turbine concepts for applications in aerospace and transportation engineering.

f. **Course Learning Outcomes:**

CLO 1	Understand the mechanism of flow through the Gas Turbine engine.
CLO 2	Explain the working and construction of the main components of the Gas Turbine engine.
CLO 3	Analysis of the basic losses involved in turbo machines.
CLO 4	Apply the application for the propulsion of jet engines.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**1**	**0**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage %	Teaching hours
1	**Introduction to Propulsion System** Introduction of Turbomachines and positive displacement machine, The internal combustion engine process, brief historical sketch, spark ignition and compression ignition, (SI And CI) engines, 4-stroke and 2-stroke engines.	16%	7
2	**Propellers Theory** Ideal Froude Momentum theory, blade element theory, numerical problems, use of propeller charts. Selection and choice of propellers. Fixed/variable pitch and constant speed propellers, Relative merits and applications, Ducted propellers, prop-fan, Helicopter Rotor in Hover and climbing. Materials for Propellers.	20%	10
3	**Compressors Theory Axial Flow Compressors:** Introduction. Geometry and working principle, Stage velocity Triangles, H-S diagram. Flow through blade row, Stage losses and efficiency, Work done factor, Low hub-tip ratio, Supersonic and transonic stages, and Performance characteristics. **Centrifugal Flow Compressors:** Introduction and different parts of a centrifugal compressor, Principles of operation. H-S diagram. Nature of impeller flow, Slip factor, Diffuser, Volute casing, Performance characteristics and losses in centrifugal compressor.	30%	14
4	**Turbine Theory Axial Turbine:** Introduction, Stage velocity triangle, Single impulse stage, Multistage velocity compounded impulse and Multistage pressure compounded impulse, Reaction stages, Blade to gas speed ratio, Losses and efficiencies, Performance charts, Low hub-tip ration stage. **Radial Turbine:** Elements of a radial turbine stage, Stage velocity triangles, H-S diagram, Stage losses, Outward flow radial stage and Performance characteristics.	32%	14

i. Text Book and Reference Book:

1. Compressors Turbines and Fans By S M Yahya
2. Elements of Gas Turbine Propulsion by Mattingly.
3. Steam & Gas turbines By R Yadav.
4. Aircraft Propulsion, System Technology & Design By Gordon C Oates
5. Gas turbine Theory By Cohen & Rogers

a. **Course Name:** Aircraft Materials and Processes
b. **Course Code:** 303101257
c. **Prerequisite:** Fundamental Knowledge of materials and workshop.
d. **Rationale:** The course is designed to give a detailed understanding of various materials and machining processes. Also, the subject gives details about the production machines and different tools.
e. **Course Learning Objective:**

CLOBJ 1	Understand aircraft material properties, selection, and testing for optimal performance in structures and engines.
CLOBJ 2	Gain insights into the principles and applications of heat treatments, wood, rubber, fabrics, dope, and paint in aircraft manufacturing.
CLOBJ 3	Master composite material applications, fabrication techniques, and mechanical behaviors for lightweight and durable aerospace components.
CLOBJ 4	Acquire knowledge of casting processes, welding techniques, and their applications in aircraft manufacturing.
CLOBJ 5	Develop proficiency in operating machines (lathe, milling, grinding), sheet metal operations, and riveting for aircraft construction.

f. Course Learning Outcomes:

CLO 1	Study of different types of Engineering Materials.
CLO 2	Understand different types of composite materials & methods of manufacturing the composite materials
CLO 3	Understand about different types of casting processes.
CLO 4	Study of the principle of different types of welding processes.
CLO 5	Understand about classification and working of basic machines & machine tools.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

h. Course Content:

Sr.	Topics	Weightage (%)	Teaching hours
1	**Introduction to Aircraft Materials** General properties of materials, Definition of terms, Requirements of aircraft materials, Testing of aircraft materials, Inspection methods, Application and trends in usage in aircraft structures and engines, Selection of materials for use in aircraft, heat treatments, wood, rubber, Fabrics & dope and paint used in aircraft manufacturing.	**20%**	**10**
2	**Composite Materials** Introduction to Composite material, Advantages of Composite Materials and Structures, Applications of Composite Materials in the Present world, Fibers, Matrix, Preppers, Filler and Other Additives, Lamina and Laminate, General Characteristics of FRPS, Micromechanics and Micromechanics, Properties of Typical Composite Materials, Mechanical Behavior of Composite Materials. Contact molding: Mold preparation, Spray-up, Hand lay-up, Compression molding methods: Matched die molding, Forming methods employing gas pressure, Centrifugal Casting, Pultrusion, and Filament Winding.	**30%**	**12**
3	**Casting and Welding** General principles of various Casting Processes: Sand casting, die-casting, centrifugal casting, Investment casting. Welding Techniques: Arc welding, Gas welding, Friction welding, Laser welding, Electron Beam welding, TIG welding, MIG welding, Soldering And brazing techniques.	**25%**	**10**
4	**Machines, Sheet Metal, Grinding and Rivet Operation** General Principles (with schematic diagram only) of working of Lathe and types of Lathe, Shaper Machine, Milling Machine, Grinding Machine, Drilling Machine, Sheet metal operations: Shearing, Punching, Bending, Forming, Spinning, Drawing etc., Types of rivets & its operations.	**25%**	**10**

i. Text Book and Reference Book:

1. Aircraft Materials By C G K Nair | Interline
2. Mechanics of Composite Materials and Structures (Textbook) By Madhujit Mukhopadhyay | Universities press
3. Production Technology by P C Sharma

a. **Course Name:** Aircraft Materials and Processes Lab
b. **Course Code:** 303101258
c. **Prerequisite:** Basic understanding of engineering workshop
d. **Rationale:** The course is designed to provide practical exposure to Casting, Welding Sheet Metal Operation and Machining Processes.
e. **Course Learning Objective:**

CLOBJ 1	Demonstrate a comprehensive understanding of aircraft materials, their classifications, properties, and applications in aviation engineering.
CLOBJ 2	Develop hands-on proficiency in key manufacturing processes relevant to aircraft construction, including casting, arc welding, lathe machining, shaping, drilling, milling, grinding, and sheet metal operations.
CLOBJ 3	Practice and prioritize safety protocols during aircraft materials and processes experiments, ensuring a secure working environment for oneself and others.
CLOBJ 4	Acquire the skills required for job preparation using various machinery, such as lathe machines, shaper machines, and milling machines, to meet industry standards.
CLOBJ 5	Demonstrate precision techniques in aircraft manufacturing, particularly in drilling, grinding, and riveting operations, to ensure accuracy and quality in aircraft components.
CLOBJ 6	Develop problem-solving skills by applying knowledge gained in the lab experiments to address challenges commonly encountered in aircraft materials and processes, fostering a practical and analytical mindset.

f. **Course Learning Outcomes:**

CLO 1	Study the various aircraft materials.
CLO 2	Study the different types of casting processes.
CLO 3	Understand the principles of different types of welding processes.
CLO 4	Study the classification and working of basic machine tools.
CLO 5	Apply the concept of sheet metal operation.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content**

List of Practical	
1	Introduction to aircraft materials.
2	Demonstrate and perform the casting process.

3	Preparation of a job using arc welding processes.
4	Preparation of a job using a lathe machine.
5	Demonstration of shaper machine operations.
6	Demonstration of drilling machine operations.
7	Demonstration of milling machine operations.
8	Demonstration of grinding machine operations
9	Demonstration of sheet metal operations.
10	Demonstrate and perform the riveting operations.

i. Text Book and Reference Book:

1. "Aircraft Materials "by C G K Nair.
2. " Mechanics of Composite Materials and Structures (Textbook)" by Madhujit Mukhopadhyay
3. " Production Technology " by P. C. Sharma

a. **Course Name:** Surface and Solid Modelling Lab
b. **Course Code:** 303101260
c. **Prerequisite:** Basic concept of Engineering Graphics
d. **Rationale:** The main objective of this Solid modelling tool unites the 3D parametric features with 2D tools. Besides providing an insight into the design content, the subject gives an idea about use of modelling tools for real world problems.
e. **Course Learning Objective:**

CLOBJ 1	Comprehend the sequential process involved in CAD modeling, ensuring proficiency in creating accurate and efficient digital representations.
CLOBJ 2	Understand the principles of feature-based modeling, enabling efficient creation and modification of 3D models with a focus on design intent.
CLOBJ 3	Apply CAD knowledge to solve real-world problems, utilizing modeling tools effectively for practical design solutions in diverse engineering applications.
CLOBJ 4	Create 3D models with the capability for real-time analysis, ensuring designs are functional, optimized, and meet specified requirements.
CLOBJ 5	Develop skills in preparing assembly drawings from various parts, aligning designs with the Master Production Schedule for efficient manufacturing implementation.

f. **Course Learning Outcomes:**

CLO 1	Know about the fundamentals of CAD.
CLO 2	Understand the steps involved in modeling.
CLO 3	Understand the concepts of feature-based modeling
CLO 4	Apply the knowledge and solve real-world problems with the use of modeling tools.
CLO 5	Create a 3D model that can be analyzed and implemented in real-time.
CLO 6	Prepare assembly drawings from the different parts for the Master Production Schedule.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

List of Practical	
1	An Introduction to CATIA V5R21.
2	Drawing sketches on a sketcher workbench-I

3	Drawing sketches in sketcher workbench-II.
4	part Design Workbench-I
5	Part Design Workbench-II
6	Part Design Workbench-III
7	Surface Design Workbench-I
8	Surface Design Workbench-II
9	Surface Design Workbench-III
10	Surface Design Workbench-IV

i. Text Book and Reference Book:

1. "CATIA V5 Surface Design with Applications" by Jaechool Koh
2. "CATIA V5 6R-2014" by Sham Tickoo

a. Course Name: Probability Statistics and Numerical Method
b. Course Code: 303191251
c. Prerequisite: Knowledge of Mathematics up to 12th science level
d. Rationale: The Mathematics I, Mathematics-II syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. Course Learning Objective:

CLOBJ 1	Understand fundamental concepts of probability, probability spaces, conditional probability, and Bayes' Rule for making informed statistical decisions.
CLOBJ 2	Analyze discrete and continuous random variables, compute expectations and variances, and explore key distributions such as Binomial, Poisson, and Normal.
CLOBJ 3	Develop skills in hypothesis testing, including large sample tests for proportions, means, standard deviations, and chi-square tests for goodness of fit and independence.
CLOBJ 4	Demonstrate proficiency in numerical methods for solving linear equations, finding roots of algebraic and transcendental equations using techniques like Gauss-Jacobi, Gauss-Seidel, Bisection, Newton-Raphson, and Regula-Falsi.
CLOBJ 5	Master the concepts of finite differences, interpolation using Newton's Forward and Backward Difference Formula, Newton's Divided, and Lagrange's Formula for Unequal Intervals.
CLOBJ 6	Gain expertise in numerical integration techniques such as the Trapezoidal rule, Simpson's 1/3rd and 3/8th Rules, Gaussian Quadrature, and solve ordinary differential equations using methods like Taylor's series, Euler, Modified Euler, and Runge-Kutta of the fourth order for first and second-order equations.

f. Course Learning Outcomes:

CLO 1	Demonstrate proficient problem-solving skills, translating real-world problems into mathematical formulations and applying appropriate techniques for solutions.
CLO 2	Develop integrated analytical and critical thinking skills by engaging with a wide range of mathematical structures, proofs, and problem-solving techniques presented throughout the entire syllabus.
CLO 3	Understand and interpret mathematical solutions within the context of specific problems, recognizing the practical applications of discrete mathematics in diverse fields covered in all units.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms, adapting communication styles to the diverse topics covered in each unit.
CLO 5	Present mathematical arguments and solutions in a unified, logical, and organized manner, emphasizing clarity, coherence, and precision across all units.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching hours
1	**Correlation, Regression and Curve Fitting :** Correlation and Regression – Rank correlation, Curve Fitting by The Method of Least Squares- Fitting of Straight Lines, Second Degree Parabolas and More General Curves	18%	8
2	**Probability and Probability Distributions:** Probability Spaces, Conditional Probability, Bayes' Rule, Discrete and Continuous Random Variables, Independent Random Variables, Expectation and Variance of Discrete and Continuous Random Variables, Distribution and Their Properties: Binomial Distribution, Poisson Distribution, Normal Distribution	23%	10
3	**Testing of Hypothesis:** Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. Test for single mean, difference of means, Test for ratio of variances, Chi-square test for goodness of fit and independence of Attributes.	25%	15
4	**Solution of a System of Linear Equations**, Roots of Algebraic and Transcendental Equations: Gauss-Jacobi and Gauss-Seidel Methods,Solution of Polynomial and Transcendental Equations Bisection Method, Newton-Raphson Method and Regula-Falsi Method	17%	10
5	**Finite Differences and Interpolation:** Finite Differences, Relation between Operators, Interpolation using Newton's Forward and Backward Difference Formula. Newton's Divided and Lagrange's Formula for Unequal Intervals.	10%	6
6	**Numerical Integration:** Trapezoidal rule, Simpson's 1/3rd and 3/8th Rules, Gaussian Quadrature Formulae.	5%	2

i. Text Book and Reference Book: Text books:

1. B. S. Grewal, "Numerical Methods in Engineering & Science with Programs in C and C++", Khanna Publishers.
2. C.E. Froberg, "Introduction to Numerical Analysis", Addison-Wesley.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003 (Reprint).
4. S.C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics" , Sultan Chand & Sons

Course Name PROFESSIONAL GROOMING & PERSONALITY DEVELOPMENT

a. **Course Code:** 203193252
b. **Prerequisite:** Knowledge of English language in practical life
c. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism
d. **Course Learning Objective:**

CLOBJ 1	Students will develop clear and articulate verbal communication skills.
CLOBJ 2	Students will enhance non-verbal communication, including body language and facial expressions.
CLOBJ 3	Students will be able to understand the importance of personal grooming and hygiene in a professional setting.
CLOBJ 4	Students will be able to understand and apply proper business etiquette in various professional settings.
CLOBJ 5	Students will be able to develop emotional intelligence to understand and manage one's own emotions and those of others.
CLOBJ 6	Students will be able to cultivate leadership qualities and skills to inspire and influence others positively.

e. **Course Learning Outcomes:**

CLO 1	Identity and develop soft skills required for personal and professional growth.
CLO 2	Develop professional etiquette & desired behavior at the workplace
CLO 3	Speak and participate effectively in oral organizational communication
CLO 4	Improve comprehensive skills for reading.
CLO 5	Know how to be assertive in professional environment

f. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**1**	**0**	**1**	-	100	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

g. **Course Content:**

Sr.	**Topic**	**Weightage %**	**Teaching hours**
1	**Self-Development and Assessment:** Various self-assessments for personal and professional development skills that are relevant to career development:	**25%**	**4**

	Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Guess, Think, Communicate, Relate, and Dream		
2	**Corporate Etiquette:** Tips and guide to develop personality and gain various etiquettes manners, case studies and activities. Telephone etiquette for foreign business trips Etiquette for small talks Respecting privacy earning to say 'No'	**25%**	**4**
3	**Public Speaking:** It's process of communicating information to an audience and is helpful in career advancement. Effective Public speaking skills includes: Choosing appropriate pattern Selecting appropriate method Art of persuasion Making speeches effective Delivering different types of speeches	**20%**	**4**
4	**Reading Skills Activity & Reading Comprehension:** Aims to improve students' Comprehensive Skills in English Language by getting them involved in reading activity and providing practice for reading comprehension.	**15%**	**2**
5	**Listening Skills- Inquiry Based Listening Questions:** Aims to improve students' listening skills in English Language providing them practice of various types of inquiry based listening tracks. Students will listen and will be able to find out details from the conversations.	**15%**	**1**

h. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S and Late P; New Delhi Oxford University Press
3. Practical English Usage MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student F.T. WOOD
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar, John Eastwood; Oxford University Press

Semester 5

a. **Course Name:** Aircraft Performance
b. **Course Code:** 303101301
c. **Prerequisite:** Fundamentals of Aerodynamics and Introduction to Aeronautics.
d. **Rationale:** The main objective of this course is to understand the performance characteristics behind the fixed aircraft. Aircraft performance signifies the physical phenomenon associated with mostly aircraft wings and their performance for steady and accelerated flight.
e. **Course Learning Objective**

CLOBJ 1	Develop a comprehensive understanding of various altitude, study of the standard atmosphere. Deriving the Relation between geo-potential and geometric altitudes through hydrostatic equation.
CLOBJ 2	Analyze various types of drags and Methods of Estimation of drag polar of vehicles from low speed to hypersonic speeds. Review of variation of thrust of power operation and SFC with altitude and the velocity for various air breathing engines.
CLOBJ 3	Derive the various equations applicable for the aircraft performance in steady flight condition. Apply those equations for various steady flight performances.
CLOBJ 4	Derive the various equations applicable for the aircraft performance in unsteady flight condition. Apply those equations for various unsteady flight performances.
CLOBJ 5	Understand the characteristics of various types of high lift devices.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate a good understanding of the aircraft wing aerodynamic forces and their management in cruising flight.
CLO 2	Define the combinations of aircraft aerodynamic features and propulsion methods for different cruising requirements.
CLO 3	Describe the relationships between the performance prescriptions and the power and thrust requirements for steady flight.
CLO 4	Evaluate the aircraft maneuvers in accelerated flight.

g. **Teaching & Examination Scheme:**

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
3	1	0	4	60	0	20	0	20	100

h. **Course Content:**

Unit No.	Topic	Weightage %	Teaching hours
1	**Standard Atmosphere** Definition of altitude, The hydrostatic equation, Relation between geo-potential and geometric altitudes, Definition of standard atmosphere, Pressure, Density & temperature altitudes.	**10%**	**5**
2	**Drag Polar** Various types of drags; Methods of Estimation of drag polar of vehicles from low speed to hypersonic speeds. Review of variation of thrust of power operation and SFC with	**20%**	**8**

	altitude and velocity for various air breathing engines. Transonic wave drag and methods of reduction. V-n Diagram.		
3	**Airplane Performance (Steady Flight)** Four forces of Flight, Equation of Motion, level flight, thrust required (drag), The fundamentals parameters: thrust to weight ratio, wing loading, drag polar and lift to drag ratio, thrust available for propeller driven aircraft, jet propelled aircraft and maximum velocity, Power required, Power available for propeller and jet engines, rate of climb, gliding flight, service and absolute ceilings, time of climb, Range & endurance for a propeller driven and jet propelled airplane, Effect of wind.	**35%**	**17**
4	**Accelerated Flight** Introduction, level turn, Pull-up & pull-down maneuvers, Limiting case for large load- factor, Take-off and Landing performance, Gliding performance.	**25%**	**10**
5	**High Lift Systems** Plain flap, Split flap, Leading edge slat, Single – slotted flap, Double slotted flap, Double – slotted flap in combination with a leading-edge slat.	**10%**	**5**

i. Text Books and reference book:

1. Aircraft Performance & Design" by John D. Anderson, Jr.
2. Performance, Stability, Dynamics, and Control of Airplanes" by Bandu N. Pamadi
3. Aircraft Performance: Theory and Practice" by Martin Eshelby

a. **Course Name : Aerodynamics II**
b. **Course Code : 303101303**
c. **Prerequisite:** Fluid mechanics, Thermodynamics, Aerodynamics.
d. **Rationale:** Aerodynamics is one of the core areas in the field of aviation. The concepts of aerodynamics are vitally important to the aeronautical engineer. CFD is one of the advance tools to solve the problems of aerodynamics involving fluid flow.
e. **Course Learning Objective:**

CLOBJ 1	Understand the fundamentals of perfect gas behavior, internal energy, enthalpy, and the First/Second Laws, forming the basis for grasping compressible flow concepts.
CLOBJ 2	Master governing equations, explore compressibility implications, stagnation conditions, and isentropic relations, facilitating advanced comprehension.
CLOBJ 3	Analyze complexities, including shock waves, normal shock equations, and measurement in compressible subsonic and supersonic flows.
CLOBJ 4	Examine oblique shock relations, interactions, Prandtl-Meyer expansion waves, applying theories to supersonic airfoils and blunt body shock waves.
CLOBJ 5	Understand quasi-one-dimensional flow equations, explore nozzle flows, and apply concepts like the velocity potential equation and critical Mach number.

f. **Course Learning Outcomes:**

CLO 1	Understand compressible flow basics and thermodynamics.
CLO 2	Analyze normal shock-wave properties.
CLO 3	Analyze oblique shock relations and Prandtl's-Meyer expansion waves.
CLO 4	Understand governing equations for nozzle flows. Apply linear theory, critical Mach numbers, and practical concepts in compressible flow scenarios

g. **Teaching & Examination Scheme:**

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
3	0	0	3	60	0	20	0	20	100

h. **Course Content:**

Unit No.	Topic	Weightage %	Teaching Hrs.
1	**Aspects of Compressible Flow** A Brief Review of Thermodynamics: Perfect Gas, Internal Energy and Enthalpy, First Law of Thermodynamics, Entropy and the Second Law of Thermodynamics, Isentropic Relations. Compressibility, Governing Equations for Inviscid, Compressible Flow, Stagnation Conditions, Some Aspects of Supersonic Flow: Shock Waves	**20%**	**10**
2	**Normal Shock Waves** The Basic Normal Shock Equations, Speed of Sound, Special Forms of the Energy Equation, Calculation of Normal Shock-Wave Properties, Measurement of Velocity in a Compressible Flow- Subsonic	**30%**	**12**

	Compressible Flow, Supersonic Flow.		
3	**Oblique Shock and Expansion Waves** Oblique Shock Relations, Supersonic Flow over Wedges and Cones, Shock Interactions and Reflections, Detached Shock Wave in Front of a Blunt Body, Prandtl's-Meyer Expansion Waves, Shock-Expansion Theory: Applications to Supersonic Airfoils.	**20%**	**10**
4	**Compressible Flow through Nozzles and Linear Theory** Governing Equations for Quasi-One-Dimensional Flow, Nozzle Flows. Introduction- the velocity potential equation, the linearized velocity potential equation, Prandtl's Glassed compressibility correction, Improve compressibility corrections, Critical Mach Number, Drag Divergence -Mach number, The Area rule and supercritical A/F.	**30%**	**13**

i. Text Books and reference book:

1. Fundamentals of Aerodynamics" by John D. Anderson, Jr.
2. Modern Compressible Flow: With Historical Perspective" by John D. Anderson, Jr.
3. Elements of Gasdynamics" by H.W. Lipmann and A. Roshko

a. Course Name : Vibration and Structural Dynamics

b. Course Code : 303101305

c. Prerequisite: Fundamental Knowledge of Engineering Mechanics & Strength of Material.

d. Rationale: The main objective of this course is to understand the working of the Vibration and Structural Dynamics. This subject addresses the understanding and functioning of the different Vibration and its mechanics regarding the system.

e. Course Learning Objective:

CLOBJ 1	Understand the fundamental principles of Single Degree of Freedom (SDOF) systems, covering free vibration, equation of motion, and various types of vibrations.
CLOBJ 2	Differentiate between undamped and damped vibrations, analyzing natural frequencies and critically damped vibrations with practical examples.
CLOBJ 3	Explore free vibration concepts, including types of damping, differential equations, and logarithmic decrement, as well as force vibration topics such as sources of excitation, harmonic forces, and vibration isolation.
CLOBJ 4	Analyzing Multi-degree-of-freedom (MDOF) systems, focusing on two-degree-of-freedom systems, forced vibrations, harmonic vibrations, semi-definite systems, and vibration absorbers.
CLOBJ 5	Study continuous systems, including lateral vibration of strings, longitudinal vibration of bars, and transverse vibration of beams.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts of analysis of aircraft structures and its requirements according to the dynamic analysis.
CLO 2	Understand different dynamic loading phenomenon.
CLO 3	Analyze for maximum multi degree of freedom system i.e. aircraft structure.
CLO 4	Analyze for damped, un-damped and critically damped system.
CLO 5	Evaluate for force vibration problems in real life.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
3	0	0	3	60	0	20	0	20	100

h. Course Content:

Sr.	Topics	Weightage %	Teaching Hrs.
1	**Single Degree of Freedom** Introduction, Equation of motion, Single-Degree of Freedom (SDOF), free vibration of SDOF, Methods of vibration analysis, Types of vibration, Sinusoidal motion, Beat.	**15%**	**5**
2	**Undamped and Damped Vibration** Undamped vibration introduction, Natural frequency, undamped frequency, relation between damped and undamped frequency, critically	**20%**	**9**

	damped vibration, Examples on damped and undamped Vibration.		
3	**Free and Force Vibration** Free Vibration: Introduction, Types of damping, Differential equation of damped free vibration, Logarithmic decrement, Examples on free vibration. Force Vibration: Source of excitation, Equation of motion with harmonic force, Response of Rotating unbalance system, Support motion, Vibration Isolation, Transmissibility, Forced vibration with coulomb, structural and viscous damping, Vibration measuring Instruments.	**30%**	**14**
4	**Multi-Degree of Freedom** Two-degree of freedom (TDOF), Vibration of undamped two degree Freedom of system, Forced vibrations, Damped free vibrations, Forced Harmonic vibration, Semi-definite system, Vibration absorber, Lagrange's equation, Include Case Studies, Research Findings	**20%**	**9**
5	**Continuous system** Lateral vibration of string, Longitudinal vibration of bars, and Transverse vibration of beams. Integration of Practical Applications	**15%**	**5**

i. Text Books Reference Book:

1. Mechanical Vibration| By V P Singh
2. Engineering Vibration | By Inman D J | Pearson Education
3. Vibration Fundamentals & Practice | By S S Rao
4. Introductory Course on Theory and Practice Mechanical Vibration | By Rao J.S., & Gupta, K. | New Age International (P) Ltd.
5. Mechanical Vibration Theory and Practice | By Shrikant Bhave | Pearson Education

a. **Course Name : Aircraft Structure-II**
b. **Course Code : 303101307**
c. **Prerequisite:** Fundamental knowledge of Aircraft structure-I and Mechanics of materials
d. **Rationale:** The main objective of this subject is to study the behavior of various aircraft structure components under different types of loads. It is also useful to apply the fundamental principle of mechanics to solve various field problems at a higher level, especially for Aircraft structures.
e. **Course Learning Objective:**

CLOBJ 1	Attain proficiency in executing the principles of solid and structural mechanics that can be used to design and analyze aerospace structures.
CLOBJ 2	Analyze the thin-walled aircraft structures required for design of aerospace vehicles.
CLOBJ 3	Acquire knowledge and practical experience in Aero elastic problems
CLOBJ 4	Identify and utilize specialized skills like analysis of thin-walled aircraft structures under torsion, shear and bending loads from the concepts of theory of elasticity
CLOBJ 5	Comprehend and apply design knowledge for various aircraft internal components.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts of analysis of aircraft structures and its requirement.
CLO 2	Analyze the stress in unsymmetrical sections in Aircraft components.
CLO 3	Analyze for Flexural Shear Stress in different parts of airplane.
CLO 4	Analyze for Torsional Shear Stress in components of the aircraft.
CLO 5	Calculate the bucking stresses in aircraft structural components.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
3	0	0	3	60	0	20	0	20	100

h. Course Content:

Sr. No.	Topic	Weightage %	Teaching Hrs.
1	**Introduction** Introduction, importance of strength to weight ratio, Basic Structural Elements in Aircraft Structure, Wing and Fuselage constructions. Aircraft loads-classification.	**10%**	**4**
2	**Theory of Elasticity** Basic elasticity, Notations, plane stress, plane strain, Two dimensional problems in elasticity: Stress functions, Equation of equilibrium.	**10%**	**4**

3	**Thin-Walled Beams** Introduction to Symmetrical and Unsymmetrical Bending, Stress distribution, Chaperon's 3 moment equation and moment Distribution method for indeterminate beams.	**22%**	**10**
4	**Shear in Beams** Shear stress in Beams, Flexural Shear flow in thin-walled beams, Shear flow and shear center for open and closed beam Sections due to bending alone, Compatibility equation for stress and strain, ,Airy stress function	**23%**	**10**
5	**Torsion of Beams** Introduction to torsion of solid sections, torsion of open and closed thin-walled beam sections, Bredt-Batho formula.	**15%**	**6**
6	**Structural Instability** Euler buckling of columns inelastic stability of columns, effect of Initial imperfections and energy method for the calculation of buckling loads in columns.	**10%**	**4**
7	**Induced stresses** Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation	**10%**	**4**

i. Text Books and Reference Book:

1. Megson T H G, `Aircraft Structures for engineering students' Butterworth-Heinemann publisher, 5th edition, 2012.
2. James M. Gere & Barry J Goodno 'Mechanics of Materials', Cengage Learning Custom Publishing; 8th edition, 2012.
3. Timoshenko and Goodie, "Theory of Elasticity" , McGraw Hill. 5th edition, 2015.
4. Lakshmi Narasaiah, "Aircraft Structures" , Published by CRC Press, 1st edition, 2012

a. **Course Name : Aircraft Structure Lab**
b. **Course Code : 303101308**
c. **Prerequisite: Fundamental knowledge of Solid mechanics lab**
d. **Rationale :** This subject integrates theoretical knowledge with hands-on skills in aircraft structure and various stress analysis concepts, ensuring students acquire practical expertise vital for a successful career in the aerospace industry
e. **Course Learning Objective:**

CLOBJ 1	Apply various stress analysis concepts for different loading conditions.
CLOBJ 2	Demonstrate strain measurements using strain gauges.
CLOBJ 3	Master retraction system of landing gear.
CLOBJ 4	Utilize indeterminate pin jointed framework for determining forces in the members.
CLOBJ 5	Execute various loading operations in order to calculate the location of shear center.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic concepts of analysis of aircraft structures and its requirement.
CLO 2	Analyze the stress in unsymmetrical sections in Aircraft components.
CLO 3	Analyze for Flexural Shear Stress in different parts of airplane.
CLO 4	Analyze for Torsional Shear Stress in components of the aircraft.
CLO 5	Calculate the bucking stresses in aircraft structural components.

g. **Teaching & Examination Scheme:**

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					**TOTAL**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	
0	0	2	1	0	30	0	20	0	50

h. **Course Content:**

List of Practical	
1	Understand the different types of structural members and loading patterns on Aircraft structural components.
2	Calculate the deflection of beams under different loading condition.
3	Calculate the strain of a cantilever beam under different loading conditions.
4	Calculate the location of the shear center for the Z-section beam.
5	Calculate the location of the shear center for the D-section beam.
6	Calculate the location of the shear center for the L-section beam.
7	Calculate the Buckling load for pin jointed column structure.
8	Determine the forces in the members of an indeterminate pin-jointed framework.
9	Determine the stresses in a cantilever beam in combined bending and torsion.
10	Study the retraction system of a landing gear.

i. Text Books and Reference Book:

1. Mechanics of Materials" by James M Gere and Barry J Goodno.
2. Aircraft Structure Laboratory Manual" by Siva Vijayakumar
3. Aircraft Structure for Engineering students" by T H G Megson
4. Elements of machine design" by N.C.Pandya , C.S.Shah
5. Aircraft Materials and Analysis" by Tariq Siddiqui

a. Course Name : Propulsion - II

b. Course Code : 303101309

c. Prerequisite: Foundational Knowledge in Aerospace and Thermodynamics Required.

d. Rationale: The main objective of this course is to understand the Integral for designing efficient aircraft propulsion, covering aerodynamics, combustion, and thrust generation principles in detail.

e. Course Learning Objective:

CLOBJ 1	Gain a comprehensive understanding of gas turbine engines, covering their components, working principles, and performance factors.
CLOBJ 2	Develop proficiency in assessing and optimizing aerodynamics for diffusers, inlets, nozzles, and combustion chambers in aircraft propulsion.
CLOBJ 3	Acquire expertise in gas turbine combustion chambers, understanding design principles, combustion processes, and performance optimization.
CLOBJ 4	Master the theories and applications of nozzles, analyzing flow characteristics and optimizing efficiency for enhanced propulsion.
CLOBJ 5	Apply principles of ramjet propulsion, covering its fundamentals, aerodynamics, combustion processes, and efficiency optimization for practical high-speed applications.

f. Course Learning Outcomes:

CLO 1	Achieve in-depth understanding of fundamental principles, performance factors, and the skills to analyze and optimize engine efficiency in aircraft power plants.
CLO 2	Attain expertise in aerodynamics for aircraft diffusers and inlets, optimizing performance, efficiency, and pressure recovery.
CLO 3	Gain in-depth knowledge of gas turbine combustion chambers, covering design, combustion processes, and optimization for enhanced efficiency.
CLO 4	Develop expertise in aircraft nozzle theory, including understanding various nozzle types, analyzing flow characteristics, and optimizing efficiency metrics for improved propulsion.
CLO 5	Acquire expertise in fundamental principles, aerodynamics, combustion processes, and efficiency optimization for high-speed applications.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					TOTAL
				External		Internal			
L	T	P		T	P	T	P	CE	
3	0	0	3	60	0	20	0	20	100

h. Course Content:

Unit No.	Topic	Weightage %	Teaching Hrs.
1	**Fundamentals of Gas Turbine Engines for Aircraft Power Plant** Introduction and Gas Turbine Cycle, Components of Gas Turbine Engines, Air-Breathing and Non-Air Breathing Propulsion Systems, Enhancing Gas Turbine Efficiency, Fundamental Thrust Equation and Factors Affecting Thrust, Effect of Pressure, Temperature, and Velocity on Thrust, Thrust Augmentation	**25%**	**12**

	Techniques, Types of Aircraft Power Plants and Performance Characteristics.		
2	**Diffusers and Inlets** Introduction to Diffusers and Inlets: Definition, significance, and historical evolution. Basics of Diffusers: Function, types, and applications. Aerodynamics of Aircraft Inlets, Classification of Inlets: Overview of inlet types, discussing advantages and disadvantages. Diffuser Performance Characteristics: Analysis of efficiency, pressure recovery, and key parameters.	**20%**	**9**
3	**Gas Turbine Combustion Chamber and Burner** Introduction to Combustion Chambers: Definition, role, and historical evolution. Types of Combustion Chambers: Overview of designs: can- type, annular, and others. Combustion Process: Understanding combustion and flame stabilization. Principles for optimal air-fuel mixing and its impact on efficiency. Evaluation of key metrics: efficiency, stability, and completeness.	**20%**	**8**
4	**Nozzle Theory** Introduction to Gas Turbine Nozzles: Definition, role, and historical de elopement. Fundamentals of Nozzle Operation: Principles governing gas turbine nozzle operation. Types of Gas Turbine Nozzles: Overview of designs: convergent, convergent-divergent, and variable geometry. Nozzle Flow Characteristics: Analysis of flow patterns and characters tics. Flow Expansion and Energy Conversion: Exploration of the expan soon process and its role in energy conversion. Efficiency and Perform ace Metrics: Evaluation of efficiency metrics: pressure recovery, velocity distribution. Choking and Critical Conditions.	**20%**	**7**
5	**Ramjet Propulsion** Introduction to Ramjet Engines: Definition and basic principles. Opera ting Principles of Ramjet Engines: Fundamental operating principles, i including air compression and combustion. Aerodynamics of Ramjet In lets: Analysis of airflow and aerodynamics within ramjet inlets. Comb ustion Process in Ramjet Engines: Detailed study of combustion price sses, including ignition mechanisms and flame stabilization. Thrust Ge neration in Ramjet Engines. Nozzle Design and Exhaust Flow and Effic iency and Performance Metrics.	**15%**	**6**

i. Text Books and Reference Book:

1. Fundamentals of Compressible Flow by S M Yahya | New Age International Publishers.
2. Elements of Gas Turbine Propulsion by Mattingly | Tata McGraw Hill.

3. Gas turbine Theory by Cohen & Rogers | Longman Green & Co. Ltd, Orient.
4. Aircraft Propulsion by Mayur R Anvekar | Phi Learning Pvt Ltd.
5. Aircraft Propulsion, System Technology & Design by Gordon C Oates | AIAA Publications.

a. Course Name : Propulsion Lab

b. Course Code : 303101310

c. Prerequisite: Foundational Knowledge in Aerospace and Thermodynamics Required.

d. Rationale: The main objective of this course is to understand the Integral for designing efficient aircraft propulsion, covering aerodynamics, combustion, and thrust generation principles in detail.

e. Course Learning Objective:

CLOBJ 1	Study various types of gas turbine engines to grasp their distinct designs and operational features.
CLOBJ 2	Provide a detailed explanation of the line diagram for the R-15 B-300 engine, highlighting its key components.
CLOBJ 3	Experimentally determine the adiabatic efficiency of an axial compressor under standard temperature and pressure conditions.
CLOBJ 4	Investigate and identify the characteristics of a nozzle concerning fluid pressure differences, demonstrating their practical implications.
CLOBJ 5	Determine the thrust development of a propeller and calculate the helical tip speed to understand its operational characteristics.

f. Course Learning Outcomes:

CLO 1	Gain a comprehensive understanding of different gas turbine engine types, discerning their unique designs and operational features.
CLO 2	Achieve mastery in interpreting the line diagram of the R-15 B-300 engine, elucidating its key components and functions.
CLO 3	Demonstrate proficiency in determining the adiabatic efficiency of the axial compressor under standard temperature and pressure conditions.
CLO 4	Identify and comprehend the characteristics of a nozzle in relation to fluid pressure differences, showcasing practical demonstrations.
CLO 5	Gain expertise in determining propeller thrust development and calculating the helical tip speed, applying theoretical knowledge to practical scenarios.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
0	0	2	1	0	30	0	20	0	50

h. Course Content:

List of Practical	
1	Study different types of gas turbine engines to understand their unique designs and operational characteristics.
2	Explain the line diagram of the R-15 B-300 engine.
3	Determine the adiabatic efficiency of the axial compressor at normal temperature and pressure conditions.
4	Study and Identify the characteristics of a nozzle in relation to fluid pressure differences and demonstrate them.
5	Determine the thrust development of the propeller and find the helical tip speed of the propeller.
6	Study the functioning and operation of the Ramjet combustion system.
7	To examine and understand the distinctive characteristics of free and wall jet phenomena.

8	Determine the adiabatic efficiency of the axial compressor at normal temperature and pressure conditions.

i. Text Books and Reference Book:

1. Fundamentals of Compressible Flow by S M Yahya | New Age International Publishers.
2. Elements of Gas Turbine Propulsion by Mattingly | Tata McGraw Hill.
3. Gas turbine Theory by Cohen & Rogers | Longman Green & Co. Ltd, Orient.
4. Aircraft Propulsion by Mayur R Anvekar | Phi Learning Pvt Ltd.
5. Aircraft Propulsion, System Technology & Design by Gordon C Oates | AIAA Publications.

a. **Course Name** Professionalism & Corporate Ethics

b. Course Code: 303193304

c. **Prerequisite:** Basic knowledge of SWOT analysis and understanding of the fundamentals of communication are essential.

d. **Rationale:** Soft skills and ethics are essential for career growth.

e. Course Learning Objective:

CLOBJ 1	Student will define and articulate the principles of professionalism in a corporate context.
CLOBJ 2	Student will be able to develop the ability to analyse ethical dilemmas and make informed decisions.
CLOBJ 3	Student will apply ethical decision-making models to real-world business scenarios
CLOBJ 4	Student will evaluate the impact of corporate activities on various stakeholders, including the community and the environment.
CLOBJ 5	Student will be able to understand and practice proper business etiquette in various communication channels.
CLOBJ 6	Student will be able to develop skills in resolving conflicts ethically and professionally.

f. Course Learning Outcomes:

CLO 1	Identity and develop soft skills required for personal and professional growth.
CLO 2	Develop professional etiquette & desired behavior at the workplace
CLO 3	Speak and participate effectively in oral organizational communication
CLO 4	Improve comprehensive skills for reading.
CLO 5	Know how to be assertive in professional environment

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	1	0	1	-	100	-	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	**Topic**	**Weightage %**	**Teaching Hrs.**

1	**Ethics in Engineering**: • Scope of engineering ethics • Accepting & sharing responsibility • Responsible professionals and ethical corporations • Resolving ethical dilemmas • Case studies	**20%**	**5**
2	**Group Discussion**: • Communication core • Definition, types, process, guidelines • Mock round -1	**15%**	**3**
3	**Introduction to B-School Tests**: Students will be able to solve verbal questions from the following exams. In these sessions students will learn to distinguish between national & international level of Management exam. • GMAT • CAT	**15%**	**2**
4	**Listening Skills- Advanced Level**: Demonstrate ability to listen more than two minutes of audio clips & solve questions based on it.	**10%**	**1**
5	**Preparing Brochures**: Students will learn how to establish the purpose of writing & determine audience they are writing for.	**15%**	**2**
6	**Agenda & Minutes of Meeting**: Students will be able to explain what an agenda & minutes of meeting are and why they are useful.	**15%**	**1**
7	**Reading Comprehension; Intermediate level**: Students will develop their ability to skim for main idea(s). They will able to make use of contextual clues to infer meaning of unfamiliar words from context and will be able to solve questions based on it.	**10%**	**1**

Reference Books:

1) Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2) Ethics in Engineering Practice and Research
3) Caroline Whit beck, Cambridge University Press
4) Technical Communication : Principles And Practice
5) Sangeetha Sharma, Meenakshi Raman; Oxford University Press
6) How to prepare for verbal ability and reading comprehension for the CAT
7) Arum Sharma, Meenakshi Upadhyay, TATA McGraw HILL

Semester 6

a. Course Name: Aircraft Stability and Control

b. Course Code: 303101351

c. Prerequisite: Fundamentals of Aerodynamics and Introduction to Aeronautics.

d. Rationale: The main objective of this course is to understand the performance characteristics behind the fixed aircraft. Aircraft performance signifies the physical phenomenon associated with mostly aircraft wings and their performance for steady and accelerated flight.

e. Course Learning Objective:

CLOBJ 1	Defining the basic concepts of stability and control. Criteria for satisfying the longitudinal static stability and control. Contributions of various parts of aircraft to longitudinal static stability and control.
CLOBJ 2	Understanding the concepts of longitudinal stick-free static stability and control. Learning the concepts of Elevator effectiveness. Understanding the relationship between stick force and hinge moment.
CLOBJ 3	Various effects caused by rolling, yawing and sideslip. Criteria for satisfying the lateral-directional static stability and control. Contributions of various parts of aircraft to lateral-directional static stability and control.
CLOBJ 4	Analyzing the dynamic stability of aircraft by deriving the equation of motions and estimation of stability derivatives.
CLOBJ 5	Understand the characteristic equation for longitudinal motion and its solution. Solving the roots of characteristic equation and obtaining the types of motions indicated by them.

f. Course Learning Outcomes:

CLO 1	Develop the rigid body equations of motion of aero vehicles.
CLO 2	Understand the longitudinal and lateral-directional stability as well as control of aircraft.
CLO 3	Develop the rigid body equations of motion of aero vehicles.
CLO 4	Understand the longitudinal and lateral-directional stability as well as control of aircraft.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					**TOTAL**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	
3	1	-	4	60	0	20	0	20	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching Hrs.
1	**Basic concepts of stability and control** Definition of Static Stability and dynamic Stability **Longitudinal Stick-fixed static stability and control:** Criteria for longitudinal static stability and control; contributions of wing, contribution of horizontal tail, contribution of fuselage and contribution of power to longitudinal stability, stick-fixed Neutral point. Effect of C.G position on stability.	**10%**	**4**
2	**Longitudinal stick-free static stability and control** Longitudinal Control, Factors affecting control surface design, Elevator effectiveness, Flight Measurement of XN.P., Hinge moments, Relationship between stick force and hinge moment, trim tabs; floating angle of elevator; stick-free static stability and stick-free neutral point; stick forces vs velocity,	**20%**	**10**
3	**Lateral - Directional static stability and control** Sideslip and yaw; 6 effects caused by rolling, yawing and sideslip; criteria for equilibrium and static stability about z- axis; contributions of wings, contribution of fuselage, contribution of power and contribution of vertical tail to Cnþ; desirable level of Cnþ; critical conditions for design of rudder, Dihedral effect; criterion for stabilizing dihedral effect, contributions of Wing, contribution of fuselage, contribution of vertical tail.	**25%**	**12**
4	**Dynamic stability analysis: - Equations of motions and estimation of stability derivatives** Equations of motion for a rigid body in vector and scalar form; forces and moments acting on an airplane; various axes systems in flight dynamics and relationships between them; Euler angles;	**20%**	**8**
5	**Longitudinal motion** Second order differential equation, characteristic equation for longitudinal motion and its solution; roots of characteristic equation and types of motions indicated by them; short period oscillation (SPO) and long period oscillation (LPO) or Phugoid; Lateral motion; Lateral-directional equation and its roots; roll approximation, spiral approximation, Dutch roll approximation.	**10%**	**5**

i. Text Book and
Reference Book:

1. Flight Stability and Automatic Control by Robert C Nelson | McGraw Hill Education

a. **Course Name:** Computational Fluid Dynamics
b. **Course Code:** 303101353
c. **Prerequisite**: Fundamentals of Fluid Mechanics and Basics of Aerodynamics.
d. **Rationale:** This is an introductory course in CFD. In this course, students will be exposed to basics of CFD, formulation of the problem and solution techniques.

e. Course Learning Objective:

CLOBJ 1	Understand fundamentals: Governing equations, models, and mathematical behavior of fluid flow.
CLOBJ 2	Master boundary conditions: Implementing various conditions for accurate computational simulations.
CLOBJ 3	Apply discretization methods: Utilize finite differences, explicit/implicit approaches, and analyze stability.
CLOBJ 4	Develop numerical skills: Learn Lax-Wendorff, McCormack, relaxation, and ADI techniques.
CLOBJ 5	Gain practical knowledge: Use pre-processor, solver, post-processor, and graphic techniques effectively.

f. Course Learning Outcomes:

CLO 1	Apply CFD methods for fluid flow analysis using numerical techniques.
CLO 2	Implement appropriate boundary conditions for accurate simulation in CFD.
CLO 3	Apply CFD methods for fluid flow analysis using numerical techniques.
CLO 4	Implement appropriate boundary conditions for accurate simulation in CFD.
CLO5	Understand and solve governing equations for viscous and inviscid flows.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					**TOTAL**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	
3	0	0	3	60	0	20	0	20	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	**Topics**	**Weightage %**	**Teaching Hrs.**
1	**Introduction** Introduction to Computational Fluid Dynamics, Experimental, Numerical and Analytical approach, Applications and Advantages of CFD, Limitations of CFD, Pre-processor, Solver, Post-processor, Some Computer Graphic Techniques used in CFD: xy Plots, Contour Plots,	**10%**	**5**

	Vector & Streamline Plots, Scatter Plots, Mesh Plots, Composite Plots.		
2	**The Governing Equations of Fluid Dynamics** Introduction, Models of the flow, The Substantial Derivative, The Continuity Equation, The Momentum Equation, The Energy Equation, Equations for Viscous Flow (The Navier-Stokes Equation), Equations for Inviscid Flow (The Euler Equation), Shock Fitting and Shock Capturing Method.	**25%**	**10**
3	**Implementation of Boundary Conditions** Introduction, Inlet Boundary Conditions, Outlet Boundary Conditions, Wall Boundary Conditions, The Constant Pressure Boundary Conditions, Symmetry Boundary Conditions, Periodic or Cyclic Boundary Conditions.	**20%**	**8**
4	**Mathematical Behavior of PDEs** Introduction, Classification of Quasi-Linear Partial Differential Equations, Crammer's Rule, The Eigen Value Method, General Behavior of the Different Classes of PDEs: Hyperbolic Equations, Parabolic Equations, Elliptic Equations	**15%**	**8**
5	**Basic Aspects of Discretization** Introduction to the Finite Differences, Forward Difference, Rearward Di ferrous, Central Difference, One Dimensional Heat Conduction Equatio N, Explicit and Implicit Approach, Errors and an Analysis of Stability.	**20%**	**8**
6	**Basic Numerical Techniques** Introduction, The Lax-Wendroff Technique, MacCormack's Technique, The Relaxation Technique, and The Alternating-Direction-Implicit Technique.	**10%**	**4**

i. Text Book and Reference Book:

1. Computational Fluid Dynamics: The Basics with Applications, John D. Anderson, McGraw-Hill Education
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg and W. Malalasekera

a. **Course Name:** Computational Fluid Dynamics Lab
b. **Course Code:** 303101354
c. **Prerequisite**: Fundamentals of Fluid Mechanics and Basics of Aerodynamics.
d. **Rationale:** This is an introductory course in CFD. In this course, students will be exposed to basics of CFD, formulation of the problem and solution techniques.
e. **Course Learning Objective:**

CLOBJ 1	Understand fundamentals of CFD for fluid flow simulations.
CLOBJ 2	Simulate flow characteristics over a flat plate using CFD.
CLOBJ 3	Model and analyze turbulent flow in a pipe with CFD.
CLOBJ 4	Investigate laminar flow patterns over a backward-facing step.
CLOBJ 5	Apply CFD to study steady flow around square and circular cylinders.

f. Course Learning Outcomes:

CLO 1	Master fundamentals of Computational Fluid Dynamics (CFD) principles and applications.
CLO 2	Simulate laminar flow over flat plate with confidence and accuracy.
CLO 3	Master fundamentals of Computational Fluid Dynamics (CFD) principles and applications.
CLO 4	Simulate laminar flow over flat plate with confidence and accuracy.
CLO5	Model turbulent flow through pipes, understanding its complex characteristics.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	**TOTAL**
0	0	4	2	0	60	0	40	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

List Of practical
1. Introduction to CFD. 2. To simulate flow over flat plate. 3. To simulate turbulent flow through pipe.

4. To simulate laminar flow over a backward facing step.
5. To simulate steady flow over a square cylinder.
6. To simulate steady flow over a circular cylinder.
7. To simulate unsteady flow over a circular cylinder.
8. To simulate flow through C-D Nozzle
9. To simulate flow over an airfoil.
10. To simulate supersonic flow over a wedge.
11. To simulate flow over a wing.

i. Text Book and Reference Book:

1. Computational Fluid Dynamics: The Basics with Applications, John D. Anderson, McGraw-Hill Education
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg and W. Malalasekera

a. **Course Name:** Minor Project
b. **Course Code:** 303101356
c. **Prerequisite:** Fundamental Knowledge of Basic Aeronautical Engineering Subjects
d. **Rationale:** This is an advance level course designed for those who have undergone the fundamentals of design thinking process and understand the importance and process completely.
e. **Course Learning Objective:**

CLOBJ 1	To define and articulate a clear problem statement for the minor project, establishing the scope and objectives.
CLOBJ 2	To conduct a comprehensive literature review, analyzing existing solutions and gaining insights to inform the project's approach.
CLOBJ 3	To develop a robust methodology for addressing the defined problem and successfully implement the proposed solution within the given constraints.
CLOBJ 4	To collect relevant data, apply appropriate analysis methods, and draw meaningful conclusions to support the project's objectives.
CLOBJ 5	To produce a well-organized and comprehensive documentation of the minor project, and effectively present the findings through a presentation or report.

f. **Course Learning Outcomes:**

CLO 1	Students will gone through the process of Observation, Empathy, Ideation and Product Development.
CLO 2	Students will prepare detailed design of prototype/model.
CLO 3	Students will gone through the process of Observation, Empathy, Ideation and Product Development.
CLO 4	Students will prepare detailed design of prototype/model.

g. **Teaching & Examination Scheme:**

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					**TOTAL**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	
0	0	2	1	0	50	0	50	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

a. Course Name: Finite Element Method
b. Course Code: 303101381

c. Prerequisite: Fundamental Knowledge of Strength of Materials and Aircraft Structures.

d. Rationale: The main objective of this course Finite Element Method (FEM) is a numerical technique for solving differential equations that describe many engineering problems. Main reason for its popularity is that the method results in computer codes which are versatile in nature that can solve many practical problems.

e. Course Learning Objective:

CLOBJ 1	Understanding essential principles of Finite Element Analysis (FEA) including basic concepts, elasticity, and analysis steps.
CLOBJ 2	Proficiently apply FEA formulation techniques such as Virtual Work, Variational Principle, and the Displacement Approach, understanding the Stiffness Matrix and its role in problem-solving.
CLOBJ 3	Investigate element properties through natural coordinates, various element types, isoperimetric formulation, and numerical integration in different dimensions.
CLOBJ 4	Apply FEA to analyze structural components, determining stiffness for truss and beam members, analyzing continuous beams, and considering thermal effects in 1-D elements with quadratic shape functions.
CLOBJ 5	Expand FEA proficiency into two and three-dimensional scenarios, exploring solid elements, strain triangles, rectangular elements, and numerical evaluation of element stiffness.

f. Course Learning Outcomes:

CLO 1	Grasp the mathematical foundations of the finite element method and its application to fundamental (linear) ordinary and partial differential equations.
CLO 2	Proficiently implement the finite element method to tackle specific equations for straightforward scenarios.
CLO 3	Resolve both elementary and intricate 3D structural issues in stress analysis when subject to general engineering-related impact loads.
CLO 4	Develop an awareness of the ethical considerations involved in the responsible use of Finite Element Analysis (FEA) within the field of Aeronautical Engineering.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					**TOTAL**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	
3	0	0	3	60	0	20	0	20	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching Hrs.
1	**Introduction to Finite Element Analysis** Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis.	**10%**	**6**
2	**Finite Element Formulation Techniques** Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions.	**25%**	**10**
3	**Element Properties** Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoperimetric Formulation, Stiffness Matrix of Isoperimetric Elements, Numerical Integration: One-dimensional, Numerical Integration: Two and Three Dimensional.	**25%**	**10**
4	**Analysis of Structures** Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Thermal effect in 1-D element, Quadratic shape function, displacement, stress-strain For quadratic element. Include Case Studies, Research Findings	**25%**	**10**
5	**FEM for Two and Three Dimensional** Solids Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Thermal effect in the trusses member. Integration of Practical Applications	**15%**	**8**

i. Text Book and Reference Book:

1. **An Introduction to the Finite Element Method** | By J Reddy | McGraw Hill Education | 3rd edition.
2. The Finite Element Method in Engineering | By Singiresu S. Rao | Butterworth-Heinemann | 5th edition.
3. Textbook of Finite Element Analysis | By Seshu P., | Prentice Hall India Learning Private Limited
4. The Finite Element Method: Its Basis and Fundamentals | By Oleo C Sienkiewicz and R. L. Taylor | Butterworth-Heinemann Ltd | 7th edition (2 October 2013).
5. Finite element Method in Engineering | By S S Rao | Elsevier

a. **Course Name:** Heat and Mass Transfer
b. **Course Code:** 303101383
c. **Prerequisite**: Fundamentals of Engineering Thermodynamics.
d. **Rationale:** The main objective of this course is to understand the principles of heat and mass transfer. This subject addresses the underlying concepts, methods and application of Heat and Mass transfer.
e. **Course Learning Objective:**

CLOBJ 1	Understand fundamental heat transfer principles, differentiating between thermodynamics and heat transfer, and grasp the laws governing heat transfer modes.
CLOBJ 2	Master one-dimensional steady-state conduction, analyze thermal conductivity in various materials, and explore transient heat conduction in different geometries.
CLOBJ 3	Review fluid flow equations, engage in dimensional analysis for forced convection, and analyze laminar and turbulent flows. Explore free convection, heat transfer from vertical plates, and comprehend heat exchanger types. Understand overall heat transfer coefficients and apply methods like LMTD and NTU for analysis.
CLOBJ 4	Comprehend surface emission properties, laws governing radiation, and their application to radiation exchange between bodies and non-black surfaces.
CLOBJ 5	Gain an understanding of mass transfer modes, Fick's Law, and general mass diffusion equations, applying these concepts to steady-state and transient diffusion in various media.

f. **Course Learning Outcomes:**

CLO 1	Understand the fundamentals of heat and mass transfer.
CLO 2	Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
CLO 3	Understand the fundamentals of heat and mass transfer.
CLO 4	Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
CLO 5	Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.

g. **Teaching & Examination Scheme:**

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
3	0	0	3	60	0	20	0	20	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching Hrs.
1.	**Basic Concepts** Heat, Importance of Heat Transfer, Review of Thermodynamic Principles, Difference Between Thermodynamics and Heat Transfer, Basic Laws of Governing Heat Transfer, Modes of Heat Transfer, Heat Transfer by Conduction, Heat Transfer by Convection, Heat Transfer by Radiation.	**10%**	**4**
2.	**Conduction** Introduction, Derivation of Generalized Equation in The Cartesian, Cylindrical and Spherical Co-Ordinates, One Dimensional Steady State Conduction. Thermal Conductivity of Metals, Refractory and Building Materials, Liquids & Gases. Temperature Distribution and Heat Flow In Steady State Through Plane, Cylindrical And Spherical Walls With Constant And Variable Thermal Conductivity, Composite Walls, Electrical Analogy, Transient Heat Conduction, Critical Thickness Of Insulation for cylinder and sphere, overall heat transfer coefficient.	**20%**	**8**
3.	**Convection** Review of Basic Equations of Fluid Flow, Dimensional Analysis- Forced Convection, Laminar Flow Over Flat Plate and Flow Through Pipes, Turbulent Flow Over Flat Plate and Flow Through Pipes, Free Convection – Heat Transfer From Vertical Plate Using Integral Method – Empirical Relations - Types Of Heat Exchangers – Overall Heat Transfer Coefficient – LMTD And NTU Methods of Analysis.	**20%**	**8**
4.	**Radiation** Surface Emission Properties, Absorptivity, Reflectivity and Transmission vity, Concept of a Black body, The Stefan-Boltzmann Law, Kirchhoff's La w, Planck's Law, Wien Displacement Law, Intensity of radiation, Lamb ert's Cosine Law, Radiation Exchange Between Black Bodies Separated by an a Non-absorbing Medium, Shape Factor Algebra and Salient Fea tures of the Shape Factor, Heat Exchange Between Non-black Bodies, E electrical Network Analogy for Thermal Radiation Systems, radiation h eat exchange between gray bodies, radiosity, irradiation, radiation shields.	**25%**	**10**
5.	**Mass Transfer** Introduction, Modes of Mass Transfer, Concentrations, Velocities and Fluxes, Fick's Law, General Mass Diffusion Equation in Stationary Med ia, Steady-State Diffusion in Common Geometries, Steady state diffusio n through a plain membrane, Steady state diffusion through a cylindri cal shell, Steady state diffusion through a spherical shell, Steady-State Equimolar Counter Diffusion, Steady State Unidirectional Diffusion, St eady State Diffusion in Liquids, Transient Mass Diffusion in Semi-finit e Stationary Medium, Mass Transfer Co-efficient, Convective Mass Tra nsfer, Correlations for Connective Mass Transfer, Reynolds and Colburn Analogies for Mass Transfer-Combined Heat and Mass Transfer	**25%**	**12**

i. Text Book and Reference Book:

1. "Heat & Mass Transfer" by R. K. Rajput, S.Chand & Co.
2. "Heat & Mass Transfer" by D. S. Kumar, S.K.Kataria & Sons

3. “Heat & Mass Transfer” by Arora & Domkundwar, Dhanpatrai & co
4. “Engineering Heat & Mass Transfer” by M.M.Rathore, Laxmi Prakashan
5. “Heat Transfer” by Holman, Tata Mc Graw Hill

a. **Course Name:** Control Theory and Systems
b. **Course Code:** 303101385
c. **Prerequisite**: Laplace Equations, Basic Electronics, Physics.
d. **Rationale:** The main objective of this course is to understand the working of the control system. This subject brief the elements of control system required to design controllers. Control system techniques to check the stability of the system is also addressed.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of Concept, Natural & Man-made control systems, Open Loop & Closed Loop systems.
CLOBJ 2	Grasp the fundamentals of Modeling of mechanical systems and Modeling of electrical systems.
CLOBJ 3	Apply reduction methods to reduce the block diagrams, Construction of SFG, Mason's Gain Formula
CLOBJ 4	Analyze signals in the time domain especially in Excitation functions, First, Second and Higher Order Systems Transient response, Steady State Error, s- plane root location and transient response.
CLOBJ 5	Understand the characteristics of Root Locus plots, Rules for construction of root loci Feedback systems and demonstration of various Stability Conditions.
CLOBJ 6	Learn to construct various controllers such as Proportional – Integral (PI) control, Proportional – Derivative (PD) control, Proportional – Integral – Derivative (PID) control with desired features of a feedback control algorithms.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic concepts of control systems.
CLO 2	Understand the procedure about how to analyze the problem.
CLO 3	Understand the basic concepts of control systems.
CLO 4	Understand the procedure about how to analyze the problem.

g. **Teaching & Examination Scheme:**

Teaching Scheme (Hrs./Week)			**Credit**	**Examination Scheme**					**TOTAL**
				External		**Internal**			
L	**T**	**P**		**T**	**P**	**T**	**P**	**CE**	
3	0	3	3	60	0	20	0	20	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Unit No.	Topic	Weightage %	Teaching Hrs.
1	**Introduction:** Concept, Natural & Man-made control systems, Open Loop & Closed Loop systems	10%	4
2	**Mathematical models of systems:** Modeling of mechanical systems, Modeling of electrical systems, Examples	20%	10
3	**Block Diagrams & Signal Flow:** Properties of block diagrams, Block diagram reductions, Construction of SFG, Mason's Gain Formula	25%	12
4	**Time Domain Performance Analysis:** Excitation functions, First Order, Second Order and Higher Order System Transient response, Steady State Error, Error constants, s- plane root location and transient response, Time response of second order sys tem	20%	10
5	**Root Locus Method:** Introduction, Root Locus plots, Rules for construction of root loci Feedback systems, Stability Conditions	10%	4
6	**Composite Controllers:** Introduction, Proportional – Integral (PI) control, Proportional – Derivative (PD) control, Proportional – Integral – Derivative (PID) control Special terminology, (proportional band, repeats per minute, rate gain direct action, reverse, action), desired features of a feedback control algorithms, Proportional mode, integral mode, derivative Mode.	15%	5

i. Text Book and Reference Book:

1. Control Systems by A. Anand Kumar
2. Control Theory by U. A. Bakshi & V. U. Bakshi
3. Control Systems by Rao V Dukkapati
4. Automatic Control System by B.S.Manke

a. **Course Name:** Aircraft Systems and Instruments
b. **Course Code:** 303101387
c. **Prerequisite**: Fundamental knowledge of Aircraft components.
d. **Rationale:** The main objective of this course is to understand the workings of Aircraft Systems and Instruments. This subject addresses the understanding and functioning of the different aircraft systems, instruments and associated components.
e. **Course Learning Objective:**

CLOBJ 1	Analyze aircraft systems for safe and efficient operation in diverse conditions.
CLOBJ 2	Evaluate engine systems' components and functions to ensure optimal performance.
CLOBJ 3	Examine auxiliary systems for aircraft safety and passenger comfort in various situations.
CLOBJ 4	Interpret aircraft instruments and their readings for effective flight navigation and control.
CLOBJ 5	Apply knowledge of aircraft systems to troubleshoot and resolve operational challenges.

f. Course Learning Outcomes:

CLO 1	Identify the key components and their roles in ensuring the proper functioning of various aircraft systems.
CLO 2	Proficiently optimize diverse aircraft engine systems for safe, efficient operation.
CLO 3	Identify the key components and their roles in ensuring the proper functioning of various aircraft systems.
CLO 4	Proficiently optimize diverse aircraft engine systems for safe, efficient operation.

g. Teaching & Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					
				External		Internal			
L	T	P		T	P	T	P	CE	TOTAL
3	0	0	3	60	0	20	0	20	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-
Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage %	Teaching Hrs.

1	**Aircraft Systems** Introduction, Classification, Hydraulic System, Pneumatic System, Brake System, Landing Gear System.	**20%**	**10**
2	**Engine Systems** Lubrication System, Fuel System, Engine Cooling Systems, Ignition and Starting System, Induction and Exhaust Systems, Typical Aircraft Bleed Air System, Turbocharger System, and Propeller System.	**30%**	**12**
3	**Auxiliary Systems** Ice and Rain Protection Systems, Fire Protection System, Cabin Environmental Control System, Electrical System & APU.	**20%**	**10**
4	**Aircraft Instruments** Introduction, Types of instrument panels, Electronic Flight Display, Flight Instruments, Engine Instruments, Navigation Instruments, Air Data Computer (ADC), Trim tab indicator, Flap position indicator, Angle of Attack Indicator, Magnetic Compass, Outside Air Temperature (OAT) Gauge, EGT, CHT & Mach meter.	**30%**	**13**

i. Text Book and Reference Book:

1. Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration Ian Moir and Allan Seabridge Wiley India Pvt. Ltd 3rd edition, 2012
2. General Hand Books of Airframe and Power plant Mechanics, U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi1995.
3. Aircraft Maintenance & Repair, McKinley, J.L., and Bent, R.D., McGraw-Hill, 1993.
4. Aircraft Hydraulic Systems William A Neese Himalayan Books 2007
5. Aircraft Instruments and Integrated Systems Pallet, E.H.J Longman Scientific and Technical 1996

a. Course Name: Employability Skills

b. Course Code: 303193353

c. Prerequisite: Basic knowledge of ethics, corporate etiquettes and understanding of the fundamentals of communication are essential.

d. **Rationale:** Interpersonal skills and employability skills are essential for better career.

e. Course Learning Objective:

CLOBJ 1	Students will be able to understand the importance of resume customization for different job applications.
CLOBJ 2	Students will develop strategies for identifying job opportunities through various channels.
CLOBJ 3	Students will demonstrate proficiency in preparing for job interviews.
CLOBJ 4	Students will build and expand a professional network using both online and offline channels.
CLOBJ 5	Students will be able to understand workplace communication dynamics, including formal and informal channels.
CLOBJ 6	Students will be able to apply time management techniques to prioritize tasks and meet deadlines.

f. Course Learning Outcomes:

CLO 1	Get ready for IELTS tests.
CLO 2	Develop a professional resume.
CLO 3	Get an understanding of the interview process.
CLO 4	Improve employability skills through mock tests.
CLO 5	Use soft skills during job interviews.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	1	0	1	-	100	-	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. no.	Topic	Weightage %	Teaching Hrs.
1	**IELTS Mock Test**: • To develop students English Learning and improve their employment prospects. • To create opportunity for students to study around the globe & give them Practice on : Listening Speaking Reading Writing	**25%**	**5**
2	**Resume Building**: • Cover letter & Resume Writing • Students will create a functional resume along with cover letter that they will be able to use when applying for a job, college or a scholarship.	**25%**	**2**
3	**Advanced Group Discussion: Mock Round**: • To provide students with an avenue to train themselves in various interpersonal skills. • To prepare students for the Group Discussion after the written test for employment or for admission to educational institutes. • To generate new ideas or new approaches for solving a problem. • To reach a solution on an issue of concern.	**25%**	**4**
4	**Personal Interview: Mock Round**: • Preparing For The Interview • Review Question • Employer's Expectation • Case Interview	**25%**	**4**

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills and Soft Skills Suresh Kumar; Pearson Publication, 2010
3. Technical Communication : Principles And Practice
   Sangeetha Sharma, Meenakshi Raman; Oxford University Press

Semester 7

a. **Course Name:** Aircraft Design
b. **Course Code:** 303101401
c. **Prerequisite:** Fundamental knowledge of Aircraft components and aerodynamics.
d. **Rationale:** Aircraft design is one of the core area in the field of aviation. To enter in the world of an aircraft modeling, one has to start with the conceptual design and all the fundamentals related to aircraft system
e. **Course Learning Objective:**

CLOBJ 1	Define an appropriate set of mission requirements and sketch the mission profile of an airplane.
CLOBJ 2	Identify the critical mission requirements of an airplane
CLOBJ 3	Estimate the takeoff weight of an airplane based on the mission requirements using the weight fraction method.
CLOBJ 4	Design the empennage and the directional controls of an airplane.
CLOBJ 5	Design the landing gear of an airplane using tip-over and ground clearance criteria

f. **Course Learning Outcomes:**

CLO 1	Demonstrate an understanding of the top level aircraft design to put the detailed design of one aircraft component into context.
CLO 2	Assess the performance interface between the engine and the airframe.
CLO 3	Identify the fuselage layout according to requirement.
CLO 4	Evaluate the various landing gear layout schemes and assess which is best for any particular aircraft layout.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	0	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Overview of the design process** Introduction, Aircraft Classification and Design Constraints, Mission Profile, Phases of Aircraft Design: Conceptual Design, Preliminary Design, Detail Design	10	04

2.	**Preliminary Design** Introduction, Maximum Take-Off Weight Estimation: The General Technique, Weight Build-up, Payload Weight, Crew Weight, Fuel Weight, Empty Weight.	15	05
3.	**Wing Design** Introduction, Number of Wings, Wing Configuration, Wing Vertical Location, Airfoil Section, Wing Incidence, Aspect Ratio, The Significance of Lift and Load Distributions, Sweep Angle, Twist Angle, Dihedral Angle, High-Lift Device, Accessories: Strake, Fence, Vortex Generator, Winglet.	15	10
4.	**Tail Design** Introduction, Aft Tail Configuration, Optimum Tail Arm, Horizontal Tail Parameters, Vertical Tail Parameters.	15	06
5.	**Fuselage Design** Introduction, Functional Analysis and Design Flowchart, Fuselage Configuration Design and Internal Arrangement, Cockpit Design, Passenger Cabin Design, Cargo Section Design, Other Fuselage Internal Segments. Introduction, Functional Analysis and Design Requirements, Landing Gear Configuration, Fixed, Retractable, or Separable Landing Gear, Take-off and Landing Distance	30	13
6.	**Propulsion System Design** Introduction, Functional Analysis and Design Requirements, Engine Type Selection, Number of Engines, Engine Location	15	06

i. Text Book and Reference Book:

1. Aircraft Design: A Conceptual Approach, Daniel P Raymer, AIAA Education Series
2. Aircraft Design: A Systems Engineering Approach, Mohammad H. Sadraey, Wiley Publication

a. **Course Name:** Aircraft Design Lab
b. **Course Code:** 303101402
c. **Prerequisite:** Fundamental knowledge of Aircraft components and aerodynamics.
d. **Rationale:** Aircraft design is one of the core area in the field of aviation. To enter in the world of an aircraft modeling, one has to start with the conceptual design and all the fundamentals related to aircraft system
e. **Course Learning Objective:**

CLOBJ 1	Define an appropriate set of mission requirements and sketch the mission profile of an airplane.
CLOBJ 2	Identify the critical mission requirements of an airplane
CLOBJ 3	Estimate the takeoff weight of an airplane based on the mission requirements using the weight fraction method.
CLOBJ 4	Design the empennage and the directional controls of an airplane.
CLOBJ 5	Design the landing gear of an airplane using tip-over and ground clearance criteria

f. **Course Learning Outcomes:**

CLO 1	Demonstrate an understanding of the top level aircraft design to put the detailed design of one aircraft component into context.
CLO 2	Assess the performance interface between the engine and the airframe.
CLO 3	Identify the fuselage layout according to requirement.
CLO 4	Evaluate the various landing gear layout schemes and assess which is best for any particular aircraft layout.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	2	1	0	0	20	0	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

List Of Practical	
1.	To prepare the configuration of the aircraft as per the given data and mission profile.
2.	To determine maximum takeoff weight, basic empty weight, fuel weight, fuel volume, maximum zero fuel weight, maximum ramp weight
3.	To determine the thrust/weight ratio of power loading and wind loading.

4.	To select the type and number of engines.
5.	Determine wing dimensions and plot on the drawing sheet using the proper scale.
6.	Prepare fuselage geometry as per payload shape, weight and volume.
7.	To prepare tail plane geometry after determining tail size.
8.	Prepare the landing gear/undercarriage geometry of your design.
9.	Prepare all primary and secondary control surfaces possible for your aircraft configuration.

i. Text Book and Reference Book:

1. Aircraft Design: A Conceptual Approach, Daniel P Raymer, AIAA Education Series
2. Aircraft Design: A Systems Engineering Approach, Mohammad H. Sadraey, Wiley Publication

a. **Course Name:** Avionics
b. **Course Code:** 303101403
c. **Prerequisite:** Basics of Electrical and Electronics, Aircraft Science
d. **Rationale:** Avionics is one of the core areas in the field of aviation. The concepts of avionics are vitally important to the aeronautical engineer.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of various concepts of avionics, cockpit systems. Studying the various control and display technologies.
CLOBJ 2	Analyze various types of Radars used and the technology behind it.
CLOBJ 3	Develop a comprehensive understanding of various Navigation system used in Aircrafts and the technology behind it.
CLOBJ 4	Study about various components of Autopilot System and fundamental concept behind the control systems of each function.
CLOBJ 5	Understand the characteristics of various types of Missiles and Missile systems.

f. **Course Learning Outcomes:**

CLO 1	Gain knowledge of avionics architecture, subsystem design, and control/display
CLO 2	Understand the ground and airborne radar systems, GPWS, TCAS, and data processing.
CLO 3	Familiarize with navigation methods and aids for precise aircraft positioning.
CLO 4	Understand autopilot structures, integration with navigation systems, and automatic landing capabilities.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Introduction to Avionics** Basics of Avionics, Basics of Cockpits, Need for Avionics in civil and military aircraft and space systems, Integrated Avionics Architecture, Military and Civil system, Typical avionics System and Subsystems – Design and Technologies. Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS,	30%	13

	HUD, MFK, HOTAS.		
2.	**Radar Engineering** Primary ground radar Secondary surveillance radar (SSR) Radar display & data processing systems Radar altimeter, Radar Ground Proximity Warning System (GPWS) Doppler radar Airborne Weather Radar (AWR) Traffic Collision Avoidance System (TCAS).	20%	10
3.	**Aircraft Navigation** Maps and Charts, classification of various navigation systems, celestial and radio navigation, Radio direction finding at medium, high and very high frequencies. The radio compass and Automatic Direction finders. Hyperbolic navigation systems, Loran and Decca. TACAN. Aids to approach and landing, the standard ILS, various categories of ILS accuracy, MLS, Ground Control Approach Systems. Dead reckoning navigation systems, Doppler navigational and inertial navigation, Global Positioning System (GPS).	30%	12
4.	**Aircraft Autopilot System** Components of Autopilot, Autopilot Structure- Successive Loop Closure, Longitudinal Autopilot; Airspeed Hold, Attitude Hold, Altitude Hold. Lateral Autopilot; Bank Angle Hold, Heading Hold, Yaw Damper, Principle and applications, Integration with Flight Management and Flight Direction system, Automatic approach and landing, height and throttle control system, ILS/MLS coupled autopilot system.	20%	10

i. Text Book and Reference Book:

1. Avionics Systems by D H Middleton
2. Principles of Avionics by Albert Helfrick
3. Avionics Handbook (Text Book) by CARYR.SPITZER; Avionic Con, Inc

a. **Course Name:** Major Project - I
b. **Course Code:** 303101406
c. **Prerequisite:** Fundamental Knowledge of Basic Aeronautical Engineering Subjects
d. **Rationale:** Major projects in aeronautical engineering offer hands-on experience, innovation opportunities, interdisciplinary collaboration, career development, personal interest alignment, and potential for long-term industry impact.
e. **Course Learning Objective:**

CLOBJ 1	Conduct extensive literature review on cutting-edge advancements in aeronautical engineering.
CLOBJ 2	Design and develop a prototype aircraft component or system using CAD software.
CLOBJ 3	Perform comprehensive aerodynamic analysis and simulation using computational tools.
CLOBJ 4	Conduct experimental testing and validation to assess the performance and reliability of the designed component or system.
CLOBJ 5	Document and present the project findings effectively through reports and presentations.

f. **Course Learning Outcomes:**

CLO 1	Innovative drone design with enhanced flight capabilities and autonomous navigation systems.
CLO 2	Aerodynamic analysis of supersonic wing configurations for increased efficiency and stability.
CLO 3	Development of advanced composite materials for lighter and stronger aircraft structures.
CLO 4	Optimization of jet engine performance through computational fluid dynamics simulations.
CLO 5	Design and testing of a novel airfoil shape for improved lift and drag characteristics.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	12	6	0	0	100	0	100	200

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

a. **Course Name:** Summer Internship - II
b. **Course Code:** 303101408
c. **Prerequisite:** Completion of three years.
d. **Rationale:** Summer internships for engineering students provide real-world experience, fostering practical skills and industry exposure. This hands-on learning enhances academic knowledge, prepares for future careers, and builds professional networks.
e. **Course Learning Objective:**

CLOBJ 1	Gain practical skills through hands-on engineering projects and applications.
CLOBJ 2	Develop industry-specific knowledge for future career readiness.
CLOBJ 3	Build a professional network through mentorship and collaboration opportunities.
CLOBJ 4	Enhance problem-solving abilities by addressing real-world engineering challenges.
CLOBJ 5	Apply theoretical concepts to practical scenarios for comprehensive understanding.

f. **Course Learning Outcomes:**

CLO 1	Increased employability with practical experience and industry connections.
CLO 2	Improved problem-solving skills through hands-on engineering applications.
CLO 3	Enhanced understanding of theoretical concepts in real-world contexts.
CLO 4	Strengthened professional confidence and readiness for future engineering roles.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	4	2	0	0	100	0	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

a. **Course Name:** Airport Operations and Management
b. **Course Code:** 303101431
c. **Prerequisite:** Fundamental knowledge of Airport operations and Air Traffic Control
d. **Rationale:** The main objective of this course is to understand the of Airport operations and Air Traffic Control. This subject addresses the understanding along with functioning of the various task involved in managing Airport operations and Air Traffic Control.
e. **Course Learning Objective:**

CLOBJ 1	Explain the aviation challenges and its environment.
CLOBJ 2	Explain the airport planning and organizational structure design.
CLOBJ 3	Examine the economics in aviation.
CLOBJ 4	Analyze the maintenance management in Airport hangar.
CLOBJ 5	Comprehend and apply safety protocols and procedures related to Air traffic control.

f. **Course Learning Outcomes:**

CLO 1	Explain the aviation challenges and its environment.
CLO 2	Explain the airport planning and organizational structure design.
CLO 3	Examine the economics in aviation.
CLO 4	Analyze the maintenance management in Airport hangar.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Airport Operation - Introduction** Evolution of Management of Aviation-Organization, Global, Social, and Ethical Environment-History of Indian Airline Industry - Major Players in the Airline Industry -SWOT analysis of Airline Industry- Market potential on Indian Airline Industry-Current	25%	12

	Challenges in Airline Industry- Completion in Airline Industry.		
2.	**Airport Management** Airport Planning-Terminal Planning, design and operation-Airport Operation Airport Functions- Organization Structure of Airline sectors- Airport Authorities Global and Indian Scenario of Airport Management	25%	12
3.	**Air Transport Services** International Trends-Emerging Indian Scenario-Private Participation: International Developments- Private Participation in Indian Airports-Environmental regulation Regulatory Issues-Meteorological Services in Aviation-Airport fees, rates charges	25%	11
4.	**Air Traffic Management** Safety Regulation - Economic Regulation - Management of Bilateral - Aviation Security. Traffic Control-Airspace and Navigational aids-TCAS-Controlling Process- Coordination Response to emergencies and airport Securities-Case Studies in Airline Industry.	25%	10

i. Text Book and Reference Book:

1. Graham A. "Managing Airports: An International Perspective"-Butterworth-Heinemann, Oxford2001
2. Wells. A,"Airport Planning and Management",4thEditionMcGraw-Hill,London 2000
3. Richard de Neufille, "Airport Systems: Planning, Design and Management", McGraw-Hill London 2007.
4. P S Senguttavan "Fundamentals of Air Transport Management",ExcelBooks2007

a. **Course Name:** Industrial Engineering
b. **Course Code:** 303101433
c. **Prerequisite:** Zeal to learn the subject
d. **Rationale:** The primary objective of this subject is to cultivate an understanding of the industrial sector. The overall well-being of a nation hinges on the productivity and production quality of its industries. Technical managers, engineers, plant operators, machine operators, supervisors, and workers within industries must adhere to established standards in terms of quality, quantity, and productivity to effectively compete in both domestic and international markets.
e. **Course Learning Objective:**

CLOBJ 1	Analyze plant location factors, compare layout types, and apply analytical tools for effective plant layout planning.
CLOBJ 2	Understand production systems, functions of Production Planning and Control (PPC), and apply sales forecasting techniques.
CLOBJ 3	Define productivity, evaluate improvement tools, and apply work study techniques, including method study and work measurement.
CLOBJ 4	Comprehend method study principles, recording techniques, and work measurement methods for efficient workplace design.
CLOBJ 5	Explore inspection types, quality control principles, and concepts like Total Quality Management (TQM) and Six Sigma.
CLOBJ 6	Understand entrepreneurship concepts, from product identification to project report preparation, and grasp the essentials of industrial finance and government incentives.

f. **Course Learning Outcomes:**

CLO 1	Enhanced productivity, workflow, and resource utilization through strategic planning.
CLO 2	Improved scheduling, resource allocation, and coordination for enhanced productivity.
CLO 3	Increased productivity, optimized resource utilization, and improved work conditions.
CLO 4	Consistent quality, reduced defects, and customer satisfaction through quality assurance measures.
CLO 5	Successful establishment, sustainable growth, and utilization of available resources.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage %	Teaching hours
1.	**Location Selection and Plant Layout:** Selection of Plant Location, Comparison of location, Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors and process plant.	18%	7
2.	**Production Planning and Control:** Types of Production systems and their Characteristics, functions and objectives of Production Planning and Control, Sales forecasting: Techniques and Applications, Steps of Production Planning and Control: Process planning, Leading, Scheduling, Dispatching and Expediting with illustrative examples,	22%	8
3.	**Productivity and Work Study:** Definition of productivity, application and advantages of productivity Improvement tools, reasons for increases and decreases in productivity. Areas of application of work study in the industry. The reaction of management and labor to work-study. **Method Study:** Objectives and procedure for methods analysis, Recording techniques, Operations Process Chart, Flow Process Chart, Man-Machine, Multiple Activity Chart, Travel Chart, and Two-Handed process chart, String Diagram, Therbligs, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design. **Work Measurement:** Objectives, Work measurement techniques – time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, and standard time. Introduction to ergonomics.	25%	13
4.	**Inspection and Quality Control:** Inspection – functions, types, objectives and benefits, quality control principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, Basic Concept ISO 9000, ISO 14000 and QS 9000, Six sigma: Concept, Principle, Methodology, Scope, Advantage and limitations.	25%	12
5.	**Entrepreneurship:** Concept, product identification, infrastructure facilities, preparation of projec t report, sources of industrial finance, Resources allocation, Government incentives to entrepreneurs.	10%	5

i. Text Book and Reference Book:

1. Manufacturing Organization and Management, Harold Amrine, John Ritchey, Moodie, Kmec, 6ht Ed., Pearson
2. Production System, Planning, Analysis and Control – By J.L. Riggs 3rd ed. Wiley
3. Production and Operations Management – By R. Panneerselvam, PHI Private Ltd.,
4. Industrial Engineering and Production Management Martand Telsang S Chand & company.
5. Industrial Engineering and Production Management by Banga and Sharma, Khanna Publishers.
6. Industrial Engineering and Management by Dr. B. Kumar Khanna Publishers

a. **Course Name:** Geometric Dimensioning and Tolerance [303101435]
b. **Course Code:** 303101435
c. **Prerequisite:** Fundamental knowledge of Mechanical Measurement & Instruments
d. **Rationale:** GD&T ensures precise communication of design specifications, promoting part interchangeability and enhancing manufacturing efficiency. By standardizing tolerances and geometric requirements, it improves quality control, supports globalization, and facilitates efficient inspection processes. Its adoption streamlines engineering practices, ensuring consistent, reliable, and high-quality manufacturing outcomes globally.
e. **Course Learning Objective:**

CLOBJ 1	Understand the principles of geometric product definition, including geometric characteristic symbols and the verification of position with open setup.
CLOBJ 2	Explain the concepts of geometric dimensioning and tolerance, including tolerance zone conversion, surfaces, and features of size, datum features, and tolerances.
CLOBJ 3	Analyze the concepts of Maximum Material Condition (MMC), Least Material Condition (LMC), and Regardless of Feature Size (RFS), and their practical applications.
CLOBJ 4	Interpret Feature Control Frames and understand how to read them to determine size control forms, including the Taylors principle and gauging size limits.
CLOBJ 5	Describe the various form controls, orientation controls, and location controls in geometric dimensioning and tolerancing, including flatness, circularity, angularity, concentricity, and position.

f. **Course Learning Outcomes:**

CLO 1	Contrast between conventional and GD&T tolerance zones
CLO 2	Explain MMC, LMC and RFS concepts
CLO 3	Explain Taylor's principle of gauging
CLO 4	Assess the significance of selection of datum & datum features
CLO 5	Point out form, orientation, profile, runout and orientation controls

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**

1.	**INTRODUCTION:** Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerance: an explanation of tolerance zone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances; components common to geometrically dimensioned & toleranced drawing; fits & allowances, advantages of GD&T.	22%	10
2.	**MMC, LMC & RFS:** Maximum Material Condition (meaning & use); Least Material Condition (meaning & use); Regardless of Feature Size How to read a Feature Control Frame.	15%	7
3.	**SIZE CONTROL FORM:** The Taylors principle; Gauging size limits. Rules, concepts, Characteristics, and Untoleranced Dimensions: individual or related Datum's, Material Conditions; Intolerance dimensions.	15%	6
4.	**DATUMS:** Datum features; oddly configured & curved surfaces as datum features; equalizing datum's; datum feature symbols; flexible parts; direct vs indirect tolerancing. MMC and its ramifications. Relations between individual features. Virtual Condition and Resultant condition Boundaries: Virtual condition (MMC concept & a functional boundary). Effect of LMC; wall thickness calculation.	22%	10
5.	**DATUM FEATURE OF SIZE REPRESENTATION:** Modes of datum feature representation; angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile; line element controls Run out: circular & total Location: concentricity; the return of symmetry; position.	26%	12

i. Text Book and Reference Book:

1. James D Meadows, "Geometric Dimensioning and Tolerancing", Marcel Dekker, Inc
2. James D Meadows, "Measurement of Geometric Tolerances in Manufacturing" Marcel Dekker, Inc
3. P S Gill, "Geometric Dimensioning and Tolerancing", S K Kataria & sons, 2005-6

a. **Course Name:** Hypersonic Aerodynamics
b. **Course Code:** 303101437
c. **Prerequisite:** Fundamental knowledge of Aerodynamics and Thermodynamics.
d. **Rationale:** The main objective of this course is to understand the fundamentals of hypersonic aerodynamics. This subject addresses the understanding thin shock layers, entropy effects, and inviscid and viscous flows.
e. **Course Learning Objective:**

CLOBJ 1	Identify and explore key concepts like thin shock layers, entropy, and hypersonic flows. Examine their dynamics in inviscid hypersonic conditions.
CLOBJ 2	Analyze local surface inclination techniques, explore modified Newtonian Law, and examine shock expansion methods for precise flow property calculations.
CLOBJ 3	Identify and explore the application of hypersonic small disturbance equation, thin shock layer theory, and blast wave theory for inviscid hypersonic flow analysis.
CLOBJ 4	Examine Navier-Stokes equations, explore hypersonic boundary layer theory, and analyze the effects of aerodynamic heating and entropy layers in viscous hypersonic flows.
CLOBJ 5	Identify and analyze strong and weak viscous interactions. Explore the estimation of hypersonic boundary layer transitions and examine laminar viscous interactions.

f. **Course Learning Outcomes:**

CLO 1	Explain the characteristics of thin shock layers and entropy layers in hypersonic aerodynamics.
CLO 2	Apply local surface inclination methods, explore shock expansion, calculate surface flow properties, and develop proficiency in shock expansion methods.
CLO 3	Apply approximate methods, explore blast wave theory, analyze rotational method, and examine correlations between hypersonic shock wave shapes and parameters.
CLO 4	Understand Navier-Stokes equations, evaluate boundary layer equations, scrutinize non-similar boundary layers, and estimate heat flux in hypersonic flows.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Fundamentals of Hypersonic Aerodynamics** Thin shock layers – entropy layers – low density and high-density flows – hypersonic flight paths – hypersonic flight similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.	30%	12

2.	**Surface Inclination Methods For Hypersonic Inviscid Flows** Local surface inclination methods – modified Newtonian Law – Newtonian theory – tangent wedge or tangent cone and shock expansion methods – Calculation of surface flow properties.	20%	10
3.	**Approximate Methods For Inviscid Hypersonic Flows** Approximate methods – hypersonic small disturbance equation and theory – Shock Tunnel Theory, thin shock layer theory – blast wave theory – entropy effects – rotational method of characteristics – hypersonic shock wave, shapes and correlations.	20%	10
4.	**Viscous Hypersonic Flow Theory** Navier-Stokes equations – boundary layer equations for hypersonic flow – hypersonic boundary layer – hypersonic boundary layer theory and non-similar hypersonic boundary layers – hypersonic aerodynamic heating and entropy layers effects on aerodynamic heating – heat flux estimation.	30%	13

i. Text Book and Reference Book:

1. Anderson J. D., "Hypersonic and High Temperature Gas Dynamics", AIAA Education Series, 2nd Ed., 2006.
2. Anderson J. D., "Modern Compressible Flow with Historical Perspective", TMH, 3rd Ed., 2012.
3. Heiser, W. H. and Pratt, D. T., "Hypersonic Air Breathing Propulsion", AIAA, 1994.
4. John T. Bertin, "Hypersonic Aerothermodynamics", AIAA Inc., Washington DC, 1994

a. **Course Name:** Industrial Aerodynamics
b. **Course Code:** 303101439
c. **Prerequisite:** Fundamental knowledge of Aerodynamics.
d. **Rationale:** The main objective of this course is to understand the non-aeronautical application of aerodynamics. This subject addresses atmospheric dynamics, wind energy, vehicle aerodynamics, and building aerodynamics and provides practical insights into environmental interactions and structural considerations.
e. **Course Learning Objective:**

CLOBJ 1	Gain insights into the diverse applications of aerodynamics beyond aviation.
CLOBJ 2	Analyze wind energy collectors, power coefficients, and momentum theory.
CLOBJ 3	Evaluate vehicle aerodynamics, drag coefficients, and transportation effects.
CLOBJ 4	Examine building aerodynamics, wind forces, environmental winds, and architectural considerations.
CLOBJ 5	Study flow-induced vibrations, Reynolds number effects, and structural stability assessments.

f. **Course Learning Outcomes:**

CLO 1	Analyze winds, boundary layer, terrain effects, and turbulent flows comprehensively.
CLO 2	Evaluate horizontal and vertical axis machines, power coefficients, and Betz coefficient.
CLO 3	Evaluate power needs, drag coefficients, cut back angle effects, and transportation aerodynamics.
CLO 4	Understand pressure distribution, wind forces, environmental winds, tall building challenges, ventilation, and architectural considerations.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Atmosphere** Earth atmosphere, Types of winds- Primary, Secondary, Tertiary winds,	20%	10

	Coriolis effect, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.		
2.	**Wind Energy Collectors** Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.	30%	12
3.	**Vehicle Aerodynamics** Introduction to Ground vehicle Aerodynamics, Power requirements and drag coefficients of automobiles, Aerodynamics of Cars, Air dams, Splitter, Reduction of fore body drag in cars, Effects of cut back angle, Aerodynamics of race cars, Aerodynamics of trains and Hovercraft.	30%	13
4.	**Building Aerodynamics** Pressure distribution on low-rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, building codes, Building ventilation and architectural aerodynamics.	20%	10

i. Text Book and Reference Book:

1. M.Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and Road vehicles", Plenum press, New York, 1978.
2. Sachs. P., "Winds forces in Engineering", Pergamon Press, 1978.
3. Calvent. N.G., "Wind Power Principles", Charles Griffin & Co., London, 1979.

a. **Course Name:** Introduction to Helicopters
b. **Course Code:** 303101441
c. **Prerequisite:** Fundamental knowledge of Helicopter components.
d. **Rationale:** The aerodynamics of a rotary-wing aircraft differs significantly from that of a fixed-wing aircraft and it is important to study this variation to understand the working of a helicopter. The physics and underlying theories required to be studied before actually embarking upon the design of a helicopter are included within this content.
e. **Course Learning Objective:**

CLOBJ 1	Understand chronological development and types of helicopters for application.
CLOBJ 2	Analyze advantages, limitations, and main rotor configurations in helicopter engineering.
CLOBJ 3	Master basic helicopter controls, blade flapping, and feathering mechanisms.
CLOBJ 4	Explore rotor aerodynamics, including forces, Coriolis effect, and momentum analysis.
CLOBJ 5	Apply blade element analysis and assess helicopter performance and aerodynamic design.

f. **Course Learning Outcomes:**

CLO 1	Analyze helicopter types, controls, and rotor aerodynamics for engineering applications.
CLO 2	Evaluate helicopter performance factors and limitations in various flight conditions.
CLO 3	Apply momentum and blade element analyses to understand rotor dynamics.
CLO 4	Design aerodynamic features for optimal helicopter performance and efficiency.
CLO 5	Demonstrate proficiency in fundamental principles of helicopter engineering and aerodynamics.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**

5.	**Fundamentals of Hypersonic Aerodynamics** Thin shock layers – entropy layers – low density and high-density flows – hypersonic flight paths – hypersonic flight similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.	30%	12
6.	**Surface Inclination Methods For Hypersonic Inviscid Flows** Local surface inclination methods – modified Newtonian Law – Newtonian theory – tangent wedge or tangent cone and shock expansion methods – Calculation of surface flow properties.	20%	10
7.	**Approximate Methods For Inviscid Hypersonic Flows** Approximate methods – hypersonic small disturbance equation and theory – Shock Tunnel Theory, thin shock layer theory – blast wave theory – entropy effects – rotational method of characteristics – hypersonic shock wave, shapes and correlations.	20%	10
8.	**Viscous Hypersonic Flow Theory** Navier-Stokes equations – boundary layer equations for hypersonic flow – hypersonic boundary layer – hypersonic boundary layer theory and non-similar hypersonic boundary layers – hypersonic aerodynamic heating and entropy layers effects on aerodynamic heating – heat flux estimation.	30%	13

i. Text Book and Reference Book:

1. Basic Helicopter Aerodynamics, John M. Seddon and Simon Newman, 3rd edition, Wiley, 2011
2. Principles of Helicopter Aerodynamics, Gordon J. Leishman, Cambridge University Press, 2006

a. **Course Name:** Lighter than Air Systems [303101443]
b. **Course Code:** 303101443
c. **Prerequisite:** Introduction to Aeronautics
d. **Rationale:** This course is designed to provide students an overview of Lighter-than-Air (LTA) systems, a subject of Aerospace Engineering that was once at the forefront of technological developments. The subject involves the study of systems for long-endurance applications with low fuel consumption. An increased focus on green aerial vehicles, especially for large-volume cargo transportation to remote areas has led to a revival of sorts of Lighter-than-Air (LTA) systems. Several research and development projects in this area have been launched all over the world for various applications, and it has become a hot topic of research.
e. **Course Learning Objective:**

CLOBJ 1	Understand historical evolution, components, and applications of Lighter-than-Air systems.
CLOBJ 2	Grasp principles of aerostatics, buoyancy, and factors influencing static lift in LTA systems.
CLOBJ 3	Explore materials, design, and operational considerations in constructing and handling aerostats.
CLOBJ 4	Examine challenges and advancements in designing hybrid and stratospheric airships.
CLOBJ 5	Analyze current trends, developments, and applications, including solar-powered and biomimetic airships.

f. **Course Learning Outcomes:**

CLO 1	Apply historical perspectives to analyze and innovate Lighter-than-Air systems.
CLO 2	Calculate and predict static lift, considering various parameters and environmental factors.
CLO 3	Evaluate envelope materials, structural design, and operational challenges for aerostats and airships.
CLO 4	Design hybrid and stratospheric airships, integrating current trends and technological advancements.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage %	Teaching hours
1.	**Introduction and Historical Perspectives** Background and Introduction to Lighter-than-Air systems, Differences between LTA and HTA systems, The three conventional LTA systems, LTA gases, Types of Airships and their components, Introduction of Skyship 600 and USP of Airships, Applications of Airships, Tethered Aerostat systems, Why use Aerostats. Historical developments of LTA systems, Overview of PADD, Remote Controlled Airships, Autonomous Airships, Indoor Blimp Projects by students, Biomimetic Airships.	25%	10
2.	**Principles of Aerostatics** Introduction to Buoyancy, Basic Concepts of Aerostatics, Ballasting, Weigh off and Fuel weight recovery, In flight Ballast Collection methods, Static Lift Prediction, :Effect of Humidity & Vapour Pressure, Calculation of Ambient Air Density, Effect of Lifting Gas Purity, Super-pressure and Superheat, Ballonet Air Weight Estimation, Net Static Lift of non-rigid airships, Net Static Lift for other LTA systems, Parameters affecting Static Lift, Effect of change in Atmospheric Pressure, Effect of Super-pressure, Effect of Slow change in Atmospheric Temperature and Superheat, Effect of Rapid change in Atmospheric Temperature, Effect of change in Relative Humidity, Effect of change in Lifting Gas Purity, Effect of change in Lifting Gas Volume, Determination of Inflation Fraction, Flight To Lower Ground Elevation, Outdoor Hot Air Balloon. Pressure Height, Level Inflation Fraction, Flight above Pressure Height, Effect of Change in Operating Altitude, Descent Following Exceedance, Pressure Height for other LTA Vehicles.	50%	24
3.	**Miscellaneous** Envelope materials and structural design, Operational issues and ground handling, aerodynamics and flight mechanics, Aerostat sizing and conceptual design, Airship sizing and conceptual design, High altitude airships, Challenges in design of LTA systems, Hybrid LTA systems, Stratospheric airships, Current trends and recent developments, features of hybrid airships, Solar powered airships, Hybrid LTA systems. Reviews of Few Successful Airships.	25%	10

i. Text Book and Reference Book:

1. Airship Technology by Gabriel Alexander Khoury (Editor), Cambridge Aerospace Series.
2. Fundamentals of Aircraft and Airship Design: Airship Design and Case Studies v. 2 (AIAA Education) by Leland M. Nicolai and Grant Carichner.
3. Advanced Airship Technologies and Design Approaches by Philip V. Hunt
4. Principles of Aerostatics, The Theory of Lighter-Than-Air Aircraft by John A. Taylor

SEMESTER 8

a. **Course Name:** Unmanned Aerial Systems
b. **Course Code:** 303101451
c. **Prerequisite:** Fundamentals of Avionics and Aircraft Design, Performance and Stability
d. **Rationale:** The study of Unmanned Aerial Systems (UAS) is vital due to their diverse applications in agriculture, surveillance, and defense sectors. Understanding UAV technology, regulations, environmental impact, and societal implications is crucial for innovation, safety, and ethical deployment in modern society.
e. **Course Learning Objective:**

CLOBJ 1	To understand UAV fundamentals, types, regulations, design, and applications.
CLOBJ 2	Learn UAV components, including propulsion, sensors, and payloads, and their roles.
CLOBJ 3	Understand mission planning, control, and UAV testing procedures.
CLOBJ 4	Apply the UAV design process from concept to evaluation for quadcopters and fixed-wing types.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate understanding of UAV history, regulations, and types.
CLO 2	Identify and explain key UAV components and navigation systems.
CLO 3	Apply mission planning, control, and testing techniques for UAV operations.
CLO 4	Develop a complete design process for UAVs, including quadcopters and fixed-wing models.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Introduction** UAV: Definition, History, Difference between aircraft and UAV, DGCA Air Law/ The Drone Rules 2021, Broad Classification of UAVs, Anatomy & characteristics of Fixed Wing, Multi-rotors, Hybrid and Lighter-Than-Air	35%	14

	Systems, Applications of UAVs, Future Prospects and Challenges, Aerodynamics of UAVs.		
2.	**UAV Elements, Navigation and Guidance** Components: Arms, Motors or Propulsion, Propellers, ESC, Flight Controllers, Landing Gear, Battery, Receiver, Transmitter, Telemetry, Servo Motors and their applications, Pumps and controller for spray mechanisms, Sensors, Navigation System and Payloads**:** Classification of payload based on applications, GPS, IMU, Light Detection and Ranging (LiDAR), Imaging cameras, Hyperspectral sensors, Synthetic Aperture Radar (SAR), Thermal cameras, Ultra-sonic detectors, Mission Planning and Control, Communications System, Guidance and control, Control Stations, UAV Ground testing and in-flight testing. Launch Recovery and Retrieval Equipment's.	40%	16
3.	**Design Fundamentals** Introduction, Review of a Few Successful UAVs, Decision Making, Design Criteria, Objectives and Priorities, Design Groups, Design Process, Systems Engineering Approach, Conceptual Design, Preliminary Design, Detail Design, Design, Review, Evaluation, Feedback, UAV Design Steps, Design of Quadcopter and Fixed Wing UAV.	25%	12

i. Text Book and Reference Book:

1. Design of Unmanned Aerial Systems by Mohammad H. Sadraey, Wiley
2. Drone Technology: Future Trends and Practical Applications by Sachi Nandan Mohanty, Wiley-Scrivener
3. Unmanned Aircraft Systems by Reg Austin, Wiley
4. Theory, Design, and Applications of Unmanned Aerial Vehicles By A. R. Jha, CRC Press
5. Handbook of Unmanned Aerial Vehicles, by George J. Vachtsevanos, Kimon P. Valavanis Springer Netherlands

a. **Course Name:** Major Project – II
b. **Course Code:** 303101454
c. **Prerequisite:** Core aero courses, software proficiency and basic project management understanding.
d. **Rationale:** Engagement in practical aero projects cultivates applied learning, teamwork, and problem-solving skills, effectively preparing students for successful careers in aeronautical engineering.
e. **Course Learning Objective:**

CLOBJ 1	To develop the ability to identify, analyze, and solve specific problems through comprehensive literature review and research.
CLOBJ 2	Equip students with the proficiency to skillfully craft project reports, enhancing their ability to communicate findings effectively.
CLOBJ 3	Equip students to face project reviews and viva voce examinations with confidence and competence.
CLOBJ 4	Enhance collaborative skills by having students work in groups of 3 to 4, fostering teamwork and shared responsibility.
CLOBJ 5	Develop oral presentation skills and the ability to articulate project outcomes, evaluated through joint assessments by external and internal examiners.

f. **Course Learning Outcomes:**

CLO 1	Students will apply theoretical aeronautical knowledge to practical aerospace problem-solving.
CLO 2	They will develop effective teamwork and communication skills.
CLO 3	Students will gain proficiency in industry-standard engineering software.
CLO 4	They will learn project management skills to prepare for real-world aerospace projects.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	12	6	0	0	100	0	100	200

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

a. **Course Name:** Aircraft Maintenance
b. **Course Code:** 303101481
c. **Prerequisite:** Fundamental knowledge of Aircraft systems.
d. **Rationale:** The main objective of this course is to understand the maintenance of an aircraft to keep it in airworthiness conditions. This subject addresses the understanding and functioning of the various task and tools used to maintain the aircraft.
e. **Course Learning Objective:**

CLOBJ 1	Attain proficiency in executing tie-down procedures for a variety of aircraft types.
CLOBJ 2	Develop skills in safely towing and taxiing aircraft, including interpreting taxi signals and utilizing appropriate ground support equipment
CLOBJ 3	Acquire knowledge and practical experience in servicing aircraft air, oil, and fluid systems.
CLOBJ 4	Identify and utilize specialized tools required for specific aircraft ground handling tasks.
CLOBJ 5	Comprehend and apply safety protocols and procedures related to ground movement activities.

f. **Course Learning Outcomes:**

CLO 1	Explain the different safety and ground handling Procedure of aircraft
CLO 2	Explain the different safety and ground handling Procedure of aircraft
CLO 3	Calculate the weight and balance of different Aircraft.
CLO 4	Select the appropriate inspection methods for different aircraft based on DGCA standards

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Aircraft Ground Handling and Support Equipment** Tie Down Procedure, Securing Light Aircraft, Securing Heavy Aircraft, Tie down Procedure for sea planes, Tie down procedure for ski planes, Tie down procedure for Helicopter, Procedure for securing weight shift control aircraft, Towing of Aircraft, Taxiing Aircraft, Taxi Signal, Servicing Aircraft	30%	12

	Air Oil and Fluid. General Purpose Tools, Metal Cutting Tools, Taps and Dies, Layout and Measuring Tools, special tools		
2.	**Ground Movement of Aircraft** Engine Starting and operations, Reciprocating Engines, Hand cranking Engines, Extinguishing Engine Fire, Turboprop Starting Procedure, Turbo fan starting Procedures, Auxiliary Power Units, Unsatisfactory turbine engine Starts, Hot start, Hung Start, Engine Will not Start, Ground Support Equipment's, Fuel Servicing Aircraft. Shop Safety, Flight Line Safety, Fire Protection	25%	11
3.	**Aircraft Weight and Balance** Need and requirements for Aircraft weighing, Weight and Balance Terminology, Procedure for weighing Aircraft, loading an Aircraft For weight, Weight and Balance extreme conditions, Equipment Change and Aircraft Alteration, use of Ballast, Helicopter weight and Balance, Weight and Balance for large airplanes	25%	11
4.	**Inspection fundamentals** Basic Inspection techniques, preparation, Aircraft Logs, Checklists, Publications, Routine/Required Maintenance, ATA iSpec 2200, Special Inspection, Special Flight Permits, Non Destructive Testing, inspection of Composites. Software used for Manual preparations.	20%	10

i. Text Book and Reference Book:

1. FAA, Aviation Maintenance Technician Hand Book,FAA-H-8083-30
2. A&P Mechanic, Aircraft Hand Book, FAA Himalayan Book House Delhi 1996
3. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993.
4. A&P Mechanics," General Hand Book", F A A Himalayan Bok House, New Delhi, 1996

a. **Course Name:** Airworthiness and Regulations
b. **Course Code:** 303101483
c. **Prerequisite:** Fundamental knowledge of Aircraft Maintenance and Aircraft Design.
d. **Rationale:** The main objective of this course is to understand the Flight testing of aircraft for which C or A had been previously issued, Registration Markings of aircraft; weight and balance control of an aircraft; provision of first aid kits & physicians' kit in an aircraft; use furnishing materials in an aircraft; concessions. Aircraft log books; document to be carried on board on Indian registered aircraft; procedure for issue of taxy permit.
e. **Course Learning Objective:**

CLOBJ 1	Understand the requirement of airworthiness certification in civil aircraft
CLOBJ 2	Understand how to record the various data for future investigation in civil aircraft.
CLOBJ 3	To know the basic requirements and knowledge for institution certification.
CLOBJ 4	To provide basic knowledge of eligibility and requirements for maintenance licensing
CLOBJ 5	Explore the various flight testing and basic requirements for safe flying.

f. **Course Learning Outcomes:**

CLO 1	Explain the maintenance requirement for airworthiness of aircraft and systems.
CLO 2	Describe the procedure followed for airworthiness certificate.
CLO 3	Describe the Airworthiness procedures based on Regulation Authorities.
CLO 4	Explain the issuance, renewal and experience requirements of AMEs.
CLO 5	Classify about the Flight Testing of aircraft.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**

1.	**C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIRWORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS VIS-À-VIS AIRWORTHINESS RECTORATE.** To introduce the civil aviation regulations followed by the directorate general of civil aviation. module I c.a.r series 'a' - procedure for civil airworthiness requirements and responsibility operators Airworthiness directorate.	20%	9
2.	**C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING** Defect recording, reporting, investigation, rectification, and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-fight readings & and recordings; maintenance control by reliability method. C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES: reliability program (engines); aircraft maintenance program & their approval; on condition maintenance of reciprocating engines; TBO - revision program; maintenance of fuel and oil uplift and consumption records - light aircraft engines; fixing routine maintenance, Total Hours and component tbos initial & revisions.	20%	9
3.	**C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS:** Approval of organizations in categories A, B, C, D, E, F, & G; requirements of infrastructure at stations other than parent base. C.A.R. SERIES 'F' - AIRWORTHINESS AND CONTINUED AIRWORTHINESS: Procedure relating to registration of aircraft; procedure for issue/revalidation of type certificate of aircraft and its engines/propeller; issue/revalidation of certificate of airworthiness; Requirements for renewal of certificate of airworthiness.	20%	9
4.	**C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER LICENSING** Issue of AME license, its classification and experience requirements, Complete Series 'L'. C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND IN SPECTIONS: mandatory modifications /inspections. Procedure For issue of type approval of aircraft components and equipment including instruments.	20%	9
5.	**C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT** Flight testing of (series) aircraft for issue of C of A; fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; weight and balance cont rol of an aircraft; provision of first aid kits & Physicians' kit in an aircraft; use furnishing materials in an aircraft; concessions. Aircraft log books; document to be carried on board on Indian registered aircraft; procedure for issue of taxy permit.	20%	9

i. Text Book and Reference Book:

1. " Aircraft Manual (India) ", Volume - Latest Edition, the English Book Store, 171, Connaught Circus, New Delhi."
2. Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi. "
3. Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA."
4. Advisory Circulars ", form DGCA. As Managers – Consulting Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership Sample Code of Conduct.

a. **Course Name:** Tribology
b. **Course Code:** 303101485
c. **Prerequisite:** Fundamental knowledge of Analysis of Mechanism & Machine Elements.
d. **Rationale:** The main objective of this course is to understand Tribology, Tribology Design, Tribology in Industry, Tribological Parameters Like Friction, Wear and Lubrication, different types of lubrication techniques and applications, measurement of friction and wear -The Topography of Engineering Surface, Contact Between Surfaces, surface modification techniques- Adhesion properties, Adhesion in Magnetic Recording Systems, Types of Bearings, Comparison of Sliding and Rolling Contact Bearings.
e. **Course Learning Objective:**

CLOBJ 1	To understand the genesis of friction, the theories/laws of sliding and rolling friction, and the effect of viscosity
CLOBJ 2	To learn about the consequences of wear, wear mechanisms, wear theories, and analysis of wear problems
CLOBJ 3	To learn about the principles of lubrication, lubrication regimes, theories of hydrodynamic and advanced lubrication techniques, and the application of lubrication in metal working.
CLOBJ 4	To understand the importance of adhesion properties in different applications and to get knowledge about different bearing materials.
CLOBJ 5	To understand the nature of engineering surfaces, and their topography and learn about surface characterization techniques.

f. **Course Learning Outcomes:**

CLO 1	Understanding the theories/laws of sliding and rolling friction.
CLO 2	Apply a basic idea of the consequences of wear, wear mechanisms, wear theories, and analysis of wear problems.
CLO 3	Exposure to theories of hydrodynamics advanced lubrication techniques.
CLO 4	Gain an overview of adhesion properties in different applications.
CLO 5	Learn about surface characterization techniques.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage %	Teaching hours
1.	**Introduction to Tribology-:** Tribology in Design, Tribology in Industry, Economic Aspects of Tribology, Tribological Parameters Like Friction, Wear, and Lubrication The Topography of Engineering Surface, Contact Between Surfaces. Types of Bearings, Comparison of Sliding and Rolling Contact Bearings.	15%	7
2.	**Introduction to Friction:** Empirical Laws of Friction, Kinds of Friction, Causes of Friction, Theories of Friction, Measurement of Friction, Friction of Metals, Ceramic Materials, Polymers. Rolling Friction- Laws of Rolling Friction, Relation Between Temperature and Friction, Stick-Slip, Prevention of Stick-Slip, Consequences of Friction.	15%	7
3.	**Introduction to Wear:** Types of Wear, Various Factors Affecting Wear, Theories of Wear, Wear Mechanisms, and Measurement of Wear. Wear Regime Maps, Alternative Forms of Wear Equations, Lubricated and Unlubricated Wear of Metals, and Materials Used in Different Wear Situations.	15%	7
4.	**Fundamentals of Viscosity And Viscous Flow:** Principle and Application of; Hydrodynamic Lubrication, Elastohydrodynamic Lubrication, Boundary and Solid Lubrication, Types of Lubricants, Properties of Lubricants, Effect of Speed and Load on Lubrication, Frictional Polymers. Lubrication in Metal Working: Rolling, Forging, Drawing, and Extrusion.	15%	7
5.	**Adhesion:** Introduction, Adhesion Effect by Surface Tension, Purely Normal Contact and Compression Plus Shear Adhesion in Magnetic Recording Systems Dependence of Adhesion on Material and Geometric Properties. **Bearing Materials:** Introduction, Rolling Bearing, Fluid Film Lubricated Bearing, Dry Bearing, Bearing Constructions.	20%	8
6.	**Introduction To Surface Engineering, Concept and Scope of Surface Engineering.** Surface Modification – Transformation Hardening, Surface Melting, Thermochemical Processes. Surface Coating – Plating and Aboding Processes, Fusion Processes, Vapor Phase Processes. Selection of Coating For Wear And Corrosion Resistance, Potential Properties and Parameters of Coating.	20%	8

i. Text Book and Reference Book:

1. Ernest Rabinowicz, Friction and Wear of Materials, John Wiley & sons, 1995
2. I.M. Hutchings, Tribology: Friction and Wear of Engineering Materials, Butterworth-Heinemann, 1992
3. Prasanta Sahoo, Engineering Tribology, PHI Learning Private Ltd, New Delhi, 2011.
4. B. Bhushan, Introduction to Tribology, John Wiley & Sons, Inc, New York, 2002
5. B. Bhushan, B.K. Gupta, Handbook of tribology: materials, coatings and surface treatments", McGraw-Hill,1997
6. Halling J,"Principles of Tribology", McMillan Press Ltd.,1978

a. **Course Name:** Rocket and Missile Technology
b. **Course Code:** 303101487
c. **Prerequisite:** Basics of Flight Mechanics, Aerodynamics I, Aerodynamics II, Propulsion.
d. **Rationale:** Rocket Missile Technology is one of the core areas in the field of aviation as well as Space. The concepts of Rocket Missile Technology are vitally important to the aeronautical engineer
e. **Course Learning Objective:**

CLOBJ 1	Utilize aerodynamic principles to optimize stability and efficiency in the design of rockets and missiles.
CLOBJ 2	Optimize airframe component design in rockets and missiles by applying advanced aerodynamic principles for enhanced stability and efficiency.
CLOBJ 3	Enhance missile performance for diverse mission requirements by optimizing range, speed, and accuracy through key principles.
CLOBJ 4	Apply power plant design principles to create efficient and reliable propulsion systems for rockets and missiles, ensuring optimal aerospace performance.
CLOBJ 5	Select and apply rocket propellants for safe and efficient aerospace use, considering performance requirements.

f. **Course Learning Outcomes:**

CLO 1	Apply fundamental aerodynamic principles and terminology to design aerospace systems, ensuring optimal efficiency and stability in rocket and missile configurations.
CLO 2	Apply advanced aerodynamic principles to optimize airframe component designs for rockets and missiles, ensuring stability and efficiency in aerospace systems.
CLO 3	Demonstrate the ability to enhance missile performance by evaluating and applying essential principles, ensuring precision in meeting diverse mission requirements.
CLO 4	Design efficient and reliable rocket and missile propulsion systems by applying principles of power plant design for optimal aerospace performance.
CLO 5	Evaluate, select, and apply appropriate liquid and solid propellants for rocket systems, considering performance requirements and safety considerations in aerospace applications.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**General Aerodynamics Design Considerations** Introduction Missile, Missile Classifications, Types of Design and Control.	10%	05

	Rocket Design. RLV Design, Rocket Design, and Re-Entry Problems.		
2.	**Aerodynamics Characteristics of Airframe Components** Introduction, Bodies of Revolution, Forebode: Conical, Ogival, Hemispherical and other shapes, Mid-Section and Boattail, General Aerodynamics of Airfoil, Aspect ratio, wing planform, Airfoil sections, Wing area, Subsonic characteristics of Airfoil, Aerodynamics Controls & Jet Controls. RLV Design, Re-Entry Problems.	20%	10
3.	**Missile Performance** Introduction, Friction drag, Pressure drag, induced drag, Interference drag, Boost- Glide Trajectory, Boost – Sustain Trajectory, Long range Cruise Trajectory, Long range Ballistic Trajectory, Maneuvering Flight: Flat turns, Pull- ups & Relation between Maneuverability & Static stability margin.	20%	10
4.	**Power Plant Design Considerations** Introduction, Fundamentals of Rocket engines, Rocket motor design Considerations.	15%	06
5.	**Rocket Propellants:-** **Liquid Propellants** Introduction to propellant types, components, and basic principles. Fundamentals of liquid rocket combustion chamber, combustion processes and performance analysis. **Solid Propellants** Fundamentals of solid rocket combustion chamber. Introduction to different fuels and oxidizers, Properties of solid propellant and solid propellant Grain design Fundamentals of combustion of solid propellants.	35%	16

i. Text Book and Reference Book:

1. Missile Configuration Design by S. S. Chin, McGraw-Hill Book Company, Inc
2. Rocket Propulsion Elements", George P. Sutton and Oscar Biblarz, Wiley-Interscience
3. Propellants and Pressurization system by Elliot Ring

a. **Course Name:** Introduction to Space Technology
b. **Course Code:** 303101489
c. **Prerequisite:** Fundamental of Modern Physic and basic of flight mechanics.
d. **Rationale:** This study is based on Space mission, Rocket fundamentals and equation of trajectories with re-entry in orbital.
e. **Course Learning Objective:**

CLOBJ 1	Grasp fundamental principles of space technology, exploring satellites, launches, and orbital mechanics.
CLOBJ 2	2 Develop skills to analyze spacecraft systems, including power, communication, and control.
CLOBJ 3	Gain proficiency in orbital mechanics, celestial mechanics, and the dynamics of space objects.
CLOBJ 4	Acquire knowledge on launch vehicle technology, design, propulsion, and the essentials of space launches.
CLOBJ 5	Learn fundamentals of mission planning, encompassing trajectory analysis, design, and key considerations in space exploration.

f. **Course Learning Outcomes:**

CLO 1	Achieve proficiency in optimizing rocket propulsion and trajectories.
CLO 2	Expertise in spacecraft re-entry for designing and analyzing atmospheric descent.
CLO 3	Acquire precision in analyzing spacecraft trajectories through orbital mechanics principles.
CLO 4	Expertly plan and execute maneuvers to optimize spacecraft trajectories for diverse objectives.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage %**	**Teaching hours**
1.	**Fundamentals of Rocket Propulsion and Trajectories** Rocket propulsion fundamentals, rocket dynamics and ascent flight mechanics, chemical rockets, multi-staging and optimization, Electrical rockets. Fundamentals of orbital mechanics (two body motion, circular and escape velocity, motion in elliptic, hyperbolic and parabolic orbits), basic orbital maneuvers. Near earth missions (satellites to	40%	15

	GEO/MEO/Geosynchronous, human flight), deep space missions. Space environment (atmosphere, radiation and magnetic fields). Atmospheric entry flight mechanics, entry heating		
2.	**Atmospheric Re-entry** Introduction-Steep ballistic re-entry-Ballistic orbital re-entry-Skip reentry-"Double- Dip" re-entry – Aero-braking – Lifting body re-entry. Re-entry heat shields, aerothermodynamics, trajectory analysis, guidance systems, and recovery methods.	10%	06
3.	**Fundamentals of Orbital Mechanics, Orbital Manoeuvres** Kepler's laws and Newton's law of gravitation, Basic orbital dynamics principles. Two-body motion-circular, elliptic, hyperbolic, and parabolic Orbits-Basic Orbital Elements-Ground trace. In-Plane orbit changes-Hohmann Transfer-Bi-elliptical Transfer-Plane changes- Combined Manoeuvres Propulsion for manoeuvres.	20%	09
4.	**Spacecraft systems** Space environment, spherical (attitude) geometry, attitude determination and control, review of rotational dynamics, rigid body dynamics, disturbance torques, passive attitude control, active control, spacecraft subsystems, attitude sensors	30%	14

i. Text Book and Reference Book:

1. "Space Mission Analysis and Design" by James R. Wertz and Wiley J. Larson
2. "Introduction to Space Systems: Design and Synthesis" by Miguel R. Aguirre
3. "Fundamentals of Astrodynamics" by Roger R. Bate, Donald D. Mueller, and Jerry E. White
4. "Rocket Propulsion Elements" by George P. Sutton and Oscar Biblarz
5. "Introduction to Aerospace Engineering with a Flight Test Perspective" by Stephen Corda.