NEP III & VIII Semester Scheme & Syllabus

(2021-22)
Department of
Aeronautical Engineering

SCHEME AND SYLLABUS

Department of Aeronautical Engineering

GLOBAL ACADEMY OF TECHNOLOGY
(Autonomous institution affiliated to VTU, Belagavi.
Accredited by NAAC with 'A' grade,
NBA Accredited CS, E&C, E&E, MECH and IS branches)
Ideal Homes Township,
Raja Rajeshwari Nagar, Bengaluru-560098.

H.P. Rajashekhar Hegde
Dean Academic
Global Academy of Technology,
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Head of the Department
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PREAMBLE

There has been a lot of discussion on the current mode of engineering education in our country and its impact on employability of fresh engineering graduates. Employability rating of fresh graduates is far from being satisfactory and industries are running short of trained and skilled manpower.

The demands of society are dynamic, complex and keep changing at a rapid pace. Technological advancement is providing several innovations and breakthroughs exponentially in IT related domains like Artificial intelligence, Internet of Things, Machine learning, Automation and Robotics. These interventions are changing further the expectations of the society on products and services. In view of this, it becomes imperative to equip students to learn the art of linking science and engineering to the needs of the industry and society. The students must relate their learning to provide solutions to complex and real-life problems faced by the society. Engineering education needs to focus on how to apply knowledge to complex, unstructured problems in a global platform. The herculean task ahead of the engineering institutions is to produce graduates who are employable. Employability does not mean that a student should be placed in an industry before he/she leaves the portals of an institution. Employability means equipping engineering graduates with necessary technical skills, communication skills, leadership qualities, soft skills, professional ethics, and a social responsibility.

The onus of providing graduates with the attributes mentioned above lies with the institutions. Institutes should create conducive atmosphere where students learn to stimulate their creativity and develop their talents. The graduates must be trained to work in teams and must be exposed to interdisciplinary areas to establish better links with present generation industries. The domain boundaries have collapsed and most of the engineering streams are getting integrated and blended. It is therefore crucial that the graduates must be made to understand the nuances of engineering education and the importance of creative thinking, innovation and being sensitive to societal changes.

Global Academy of Technology (GAT) has understood the importance of broad-based education and has created a conductive environment for the students to blossom into complete individuals. A true broad-based education prepares students for life, without losing their areas of specialization and competence. Our aim is to become a premier institution imparting quality education in engineering and management to meet the changing needs of the industry and society. The entire team at GAT is committed to realize the dream of making GAT an institution of eminence and creating an indelible impression in the area of engineering education.

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The present focus of the institute is to improve the laboratory infrastructure by bringing new industry relevant technology to enable higher level of learning in students, foster integrated learning by providing multiple industry relevant interfaces, enable students to take up industry relevant projects and encourage faculty to take up research by providing ability to add customer logic.

With changing times and emergence of disruptive technologies, GAT stands strong in adapting and encompassing these into the mainstream in shaping students' career, thus contributing directly to society and nation building.

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1. Global Academy of Technology – An Overview

(Autonomous Institution under Visvesvaraya Technological University, Belagavi)

1.1 Vision of the Institute:

Become a premier institution imparting quality education in engineering and management to meet the changing needs of society.

1 .2 Mission of the Institute:

- **Create environment conducive for continuous learning through quality teaching and learning processes supported by modern infrastructure.**
- **Promote Research and Innovation through collaboration with industries.**
- **Inculcate ethical values and environmental consciousness through holistic education programs.**

1.3 Objectives:

- **With a very firm resolve, Global Academy of Technology is continuously investing untiring efforts to enable students to:**
- **Develop careers in Government and Private engineering organizations and other**
- **professionally related domains.**
- **Pursue higher studies and research to develop innovative solutions and technologies in engineering and other multi-disciplinary areas.**
- **Improve professional and personal traits oriented towards professional ethics and environmental compulsions.**
- **Inculcate professional leadership and successful entrepreneurship qualities.**
- **Help society in raising the quality of life.**

1.4 Quality Policies:

- **Providing Excellent Education Through High Quality, Experienced and Committed Faculty.**
- **Evolving creative processes for optimal Knowledge and Skill Transfer.**
- **Building up state-of-the-art infrastructure at par with international standards.**
- **Creating an environment for holistic personality development and develop research temperament.**

1.5 Hallmarks of Global Academy of Technology:

- **Proactive management determined to build the institute as a Centre of Excellence in engineering education.**
- **Qualified and dedicated faculty in all the departments.**
- **State of the art Infrastructure and up to date laboratory and Library facilities.**
- **Lush green campus with an environment of tranquility and harmony.**
- **Student centric teaching-learning processes banking on Outcome Based Education;**
- **students' friendly learning atmosphere.**

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- **Emphasis on Project based learning throughout the course.**
- **Strong Industry-Institute interface with more than twenty Memorandum of Understanding**
- **(MOUs) signed with leading industries and institutions of repute.**
- **Indian Institute of Information Technology (IIIT), Allahabad, has signed a MOU for providing internships to students of GAT, research assistance to faculty, and conducting Faculty Development Programs in key areas of IT - Big Data, Cloud Computing, Artificial Intelligence, and Machine Learning.**
- **Mahatma Gandhi University, Kottayam, has signed a MOU to facilitate research in Nano Technology and provide research assistance to faculty of GAT.**
- **Industrial consultancy undertaken in many departments.**
- **Excellent Placement with more than 80% of the eligible students placed in leading IT**
- **companies, core industries and Start-up companies.**
- **Holistic and integrated training modules covering communication skills, leadership skills, soft skills and technical skills through professional trainers.**
- **On campus and off campus internship facilities.**
- **Robust parent connects and Student counselling system.**
- **In-house technical skill training programs/add on courses to enhance the employability of the students.**
- **Strong and growing alumni connect in place**
- **Exclusive Research and Development, Industry–Institute Interaction Cell and Teaching and Learning Centre in place.**
- **Rainwater harvesting facility in the campus.**

The following academic processes are implemented on a regular basis to sustain a meaningful and proactive teaching-learning environment:

- **Emphasis on continuous revision of the curriculum, based on feedback from the students and input from industry, alumni, and other stakeholders.**
- **Conduction of regular training programme for faculty, technical & supporting staff.**
- **Conduction of Academic Audit of each department on an annual basis.**
- **Under open electives students have the options to study subjects offered by other departments to augment their interdisciplinary knowledge.**
- **Students have to do value added courses, mandatory courses, certificate courses, and become members of professional bodies, etc.**
- **Advanced and enrichment courses are offered as Electives during the final year UG and PG Degree Programmes.**
- **Self-Learning is encouraged in students through MOOCs, NPTEL/SWAYAM, Coursera, Edex etc. Credit shall be awarded to students for completion of such courses.**

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2.0 Department of Aeronautical Engineering

2.1 Vision of the Department:

To emerge as an excellent center for imparting quality education and research to produce competent Aeronautical Engineers to meet the global challenges.

2.2 Mission of the Department:

M1: Empower the students with the fundamental knowledge and skill for a successful career in the field of Aeronautical Engineering, and facilitating them to continue their education through higher studies and Research & Development activities.

M2: Providing state of the art laboratories and infrastructure for academics and research in the areas of Aerodynamics, Structures, Propulsion and control systems.

M3: Enhancing industry-institute interaction leading to interdisciplinary research with social concern to become leaders in industries and/or become entrepreneurs with good ethics.

2.3 About the Department:

The Department of Aeronautical Engineering was established in the year 2020, affiliated to VTU, Belagavi, Karnataka, approved by AICTE. The department offers 4-year undergraduate programme, B.E. in Aeronautical Engineering. The department has a team of highly qualified, dedicated and motivated young and experienced faculties. The Department of Aeronautical Engineering has laboratories catering to students, scholars and faculty members for their academic and research activities. The curriculum is designed to impart engineering knowledge in topics such as Aerodynamics, Aircraft structures, Propulsion, Flight dynamics & Controls and UAVs. Further provision exists to acquire additional engineering knowledge through electives. The department prepares the graduates to undertake design, analysis, experimental and research activities as their careers in aeronautical engineering. The institution is located very closer to many leading aeronautical industries (ISRO, NAL, HAL, ADA, ADE etc.) and IT industries which will benefit the students in terms of collaboration.

The department activities are being monitored by the Department Advisory Board (DAB) and Program advisory committee (PAC) whose members are eminent personalities from industries, government organizations and R&D Sectors. The new initiative of establishing Research Centre in Aeronautical Engineering, GAT would provide researchers a good opportunity for enhancing their Research knowledge and Problem-solving skills.

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3 Salient Featuresof Autonomy

Autonomous institutions occupy pivotal positions and are the key interfaces between the industry and academia. Autonomous institutions can create the key channels required for scientific and industrial research and innovation, inclusive teaching and training, and initiatives to develop the eco system for creating more employment.

Autonomy means freedom and authority in academic matters. Autonomy bestows the teacher with the right to decide what to teach, how to teach, how much to teach and whom to teach.

Autonomy gives the privilege to:

- **Run courses relevant to requirements of industries and society at large.**
- **Design Teaching-Learning methodologies, Assessment Tools and Methods, and Admission policies.**
- **Create an eco- system for holistic development of the individuals.**
- **Build strong academia and industry interface.**
- **Build the reputation of the institution through quality education.**
- **Industry relevant value-added courses during vacations.**
- **Internships in Industry/ R&D establishments in summer holidays.**
- **Building leadership qualities including spirit of tolerance and teamwork.**
- **There will be a lot of scope for industry- oriented skill development built-in into the system.**
- **Deliver engineering graduates who can effectively shoulder the responsibility of building a strong and vibrant INDIA.**

GAT has Board of Governance, Academic Council, Boards of Studies, Boards of Examination, Finance Committee, and Institute Steering Committee. Stakeholders in these bodies comprise of Academicians, Researchers, Industry Experts, Faculty and Alumni. Governing Body of the autonomous college lays down policies and procedures for Governance of the college carried out through the Principal of the college. Academic Council is the apex academic body of the college responsible for approval of schemes of study, syllabi, examinations and evaluation methods, declaration of results, recommendation of candidates to the University for Award of degrees etc. The college constitutes different Boards of Studies for different branches of engineering. The BOS's are responsible for framing of schemes of study and detailed curricula, academic rules etc. Other bodies like Finance Committee, Recruitment Committee help in administration of the college.

3.1 Outcome Based Education (OBE):

Outcome based education (OBE) is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitude. Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behavior a graduate is expected to attain upon completion of a program and after 4 to 5 years of graduation.

The induction of India in the Washington Accord in 2014 with the permanent signatory status of The National Board of Accreditation (NBA) is considered a big leap forward for the higher-education system in India. It means that an Engineering graduate from India can be employed

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in any one of the other countries who have signed the accord. For Indian Engineering Institutions to get accredited by NBA according to the pacts of the accord, it is compulsory that engineering institutions follow the Outcome Based Education (OBE) model. So, for an Engineering Institution to be accredited by NBA it should compulsorily follow the OBE model.

The OBE model measures the progress of the graduate in three parameters, which are:

- **Program Educational Objectives (PEO)**
- **Program Outcomes (PO)**
- **Course Outcomes (CO)**

Outcome Based Education assesses students' performance, knowledge and skills through quiz, solving puzzles, giving an online presentation, modelling something, taking up a multiple - choice assessment. Assessments are criterion-focused which the students achieve during the learning period. Students are expected to go with the flow, think out of the box in order to implement outcome based education.

Students studying in an accredited program of an institution in India can be confident of getting an education which is of assured quality comparable to global standards. They can compete with their global counterparts for securing jobs in Multi-National Companies and other enterprises across the world. Students can also have global mobility- can work anywhere -in any corner of the globe. In addition, students will have access to the state-of-the-art facility, infrastructure, and access to highly qualified teaching faculty in an accredited program. Students would have acquired "graduate attributes" at the end of the course and will be industry ready. A student can also get into post- graduation and research.

3.2 Advantages of Outcome Based Education:

- **Student-centered - It is an approach by which the learner's mastery over a particular skill is demonstrated and measured.**
- **Clarity in focus - A learning outcome must be made obvious to the learner even at the outset of learning. This outcomes-based model works on bringing out the specific outcomes from the learners.**
- **The curriculum is designed with a clear definition, outlining the expected outcomes. This will pave a way to achieve the expanded opportunities in the student's performance.**
- **Exceeding expectations - All students can deliver the highest level of performance. The only kick start needed is to make them believe and encourage, the only way to attain high expectation.**
- **Expanded opportunities - It means giving countless chances and ways to show the students that they have met with their objective. Not all learners learn the same thing, the same way, and at the same time. However, extended opportunities can help achieve high standards. They help students to learn what is mostly needed for the time and hour.**

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3.3 Program Outcomes (POs) as prescribed by National Board of Accreditation (NBA):

PO1- Engineering knowledge: **Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**

PO2- Problem analysis: **Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**

PO3- Design/development of solutions: **Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**

PO4- Conduct investigations of complex problems: **Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

PO5- Modern tool usage: **Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**

PO6- The engineer and society: **Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.**

PO7- Environment and sustainability: **Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**

PO8- Ethics: **Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**

PO9- Individual and teamwork: **Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**

PO10- Communication: **Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**

PO11- Project management and finance: **Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**

PO12- Life-long learning: **Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.**

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3.4 Program Specific Outcomes

PSO1: Apply the fundamental knowledge of Aerodynamics, Propulsion, Structures and Flight controls to solve core contemporary problems.

PSO2: Develop and use modern engineering tools to design and analyze the simple and complex problems in Aeronautical Engineering.

3.5 Some Definitions:

"Course" is a unit of teaching, which encompasses various topics, that typically lasts one semester, is led by one or more faculty and has a fixed registered student. Course means a subject either theory or practical identified by its title and code number.

"Program" – cohesive arrangements of courses, co- curricular extra-curricular activities to accomplish predetermined objectives leading to award of a Degree.

"Degree"- Academic award conferred upon a student on successful completion of a program designed to achieve the defined attributes.

3.6 Choice Based Credit System (CBCS):

Major Benefits: Major benefits accruing by adopting the Credit System are listed below:

- **Quantification and uniformity in the listing of courses for all programmes at a college, like core (hard/soft), electives and project work.**
- **Ease of allocation of courses under different heads by using their credits to meet national/international practices in technical education.**
- **Convenience to specify the minimum/ maximum limits of course load and its average per semester in the form of credits to be earned by a student.**
- **Flexibility in programme duration for students by enabling them to pace their course load within minimum/maximum limits based on their preparation and capabilities.**
- **Wider choice of courses available from any department of the same College or even from other similar Colleges, either for credit or for audit.**
- **Improved facility for students to optimize their learning by availing of transfer of credits earned by them from one College to another.**

As the Credit System has many advantages over the conventional system of organizing academic programs, GAT has introduced an appropriate Choice Based Credit System (CBCS) for the various programs. This will be of great benefit to the students in their preparations to meet the challenging opportunities ahead. In the Credit System, the course work of students is unitized, and each unit is assigned one credit after a student completes the teaching-learning process as prescribed for that unit and is successful in its assessment. However, there are different definitions followed in academic circles for the size of a unit and in turn, for a credit.

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3.7 Credit Definition:

As it is desirable to have uniformity in the definition of credit across all Autonomous Colleges under the University, the following widely accepted definition for credit shall be followed at GAT. This can provide the good flexibility to the students and also strengthens CBCS under the University. Here, one unit of course work and its corresponding one credit (while referring to a Main Semester) shall be equal to:

I. **Theory course conducted for 1 hour/week/ semester;**
II. **Laboratory course or Tutorial conducted for 2 hours/week/semester. The following additional factors may also be noted in this connection:**
III. **The above figures shall be multiplied by a factor of 2 in the case of the Supplementary Semester,**
IV. **Other student activities which are not demanding intellectually, or which do not lend to effective assessment, like practical training, study tours, attending guest lectures shall not carry any credit.**

Audit Courses: In Addition, a student can register for courses for audit only with a view to supplement his/her knowledge and/or skills. Here also, the student's grades will have to be reflected in the Grade Card. These courses shall not be considered in determining the student's academic performance in the semester. In view of this, it may not be necessary for the college to issue any separate transcript covering the audit courses to the registrants at these courses.

For more details on the academic regulations, students are advised to refer Academic Rules and regulations document available on the college website www.gat.ac.in.

3.5 Credit Distribution among Curricular components:

Sl. No.	Curricular Component	Credits allocated	Percentage of allocation
1	Humanities and Basic Sciences	4	3.3
2	Engineering Sciences	6	5.0
3	Professional courses core	64	53.3
4	Professional courses Electives	22	18.3
5	Laboratory Courses	3	2.5
6	Project work+ Mini project+ Technical Seminar	21	17.5
	Total	**120**	**100**

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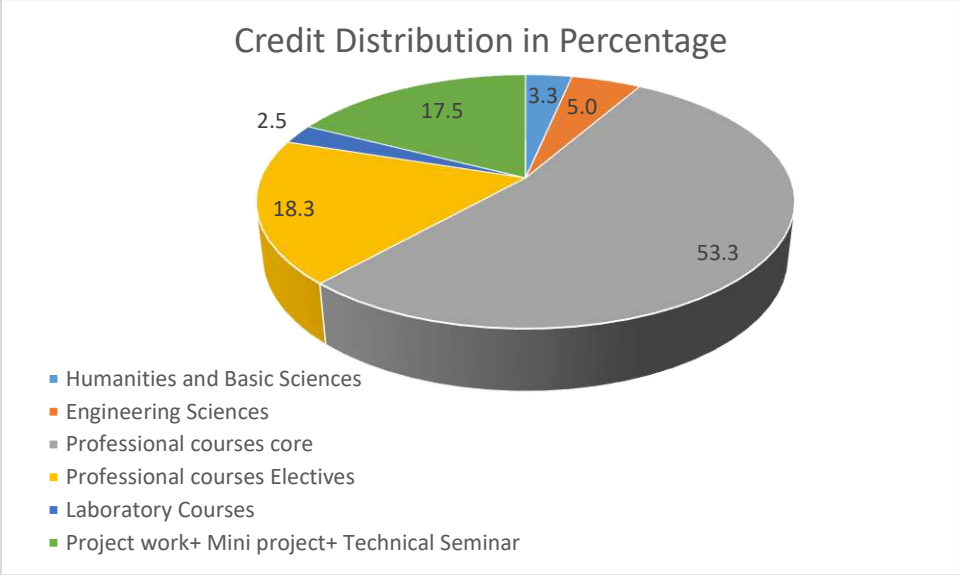

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III – VIII Semester

SCHEME AND SYLLABUS

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Scheme of UG Autonomous Program – 2021batch
(3rd to 8th Semester)

III SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	21MAT31C	Complex Variables and Probability	BS	MAT	2	2	0	50	50	100	3
2	21ANE32	Fluid Mechanics	IPC	Respective Department	3	0	2	50	50	100	4
3	21ANE33	Solid Mechanics	IPC		3	0	2	50	50	100	4
4	21ANE34	Aero Thermodynamics	PC		2	2	0	50	50	100	3
5	21ANE35	Basics of Aeronautical Engineering	PC		3	0	0	50	50	100	3
6	21KSK36	Samskrutika Kannada	HSM	Any Department	1	0	0	50	50	100	1
	21KBK36	Balake Kannada									
	OR										
	21CIP36	Constitution of India and Professional Ethics									
7	21ANE37X	Ability Enhancement Course–I Digital Manufacturing in Aerospace Industries	PC	Respective Department	1	0	0	50	50	100	1
							Total	**350**	**350**	**700**	**19**
9	21MATDIP31	Additional Mathematics (For Lateral Entry Students)	BS	MAT	2	2	0	100	--	100	0

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IV SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	21MAT41X	Transforms Calculus and Numerical Techniques	BS	MAT	2	2	0	50	50	100	3
2	21ANE42	Aerodynamics – I	IPC	Respective Department	3	0	2	50	50	100	4
3	21ANE43	Computer Aided Aircraft Drawing	IPC		3	0	2	50	50	100	4
4	21ANE44	Aero Propulsion – I	PC		2	2	0	50	50	100	3
5	21ANE45	Aircraft structures - I	PC		2	2	0	50	50	100	3
7	21KSK46	Samskrutika Kannada	HSM	Any Department	1	0	0	50	50	100	1
	21KBK46	Balake Kannada									
	OR										
	21CIP46	Constitution of India and Professional Ethics									
8	21ANE47X	Ability Enhancement Course - II	PC	Respective Department	1	0	0	50	50	100	1
9	21INT48	Inter/Intra Institutional Internship	INT	Respective Department	0	0	3	100	-	100	2
							Total	**450**	**350**	**800**	**21**

Ability Enhancement Course – I

Course Code	Course Title
21ANE371	Digital Manufacturing in Aerospace Industries

Ability Enhancement Course – II

Course Code	Course Title
21ANE471	Introduction to artificial intelligence and machine learning

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V SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	21ANE51	Control Engineering and Microprocessor	PC	Respective Department	2	2	0	50	50	100	3
2	21ANE52	Aircraft structures-II	PC		3	0	0	50	50	100	3
3	21ANE53	Aero Propulsion -II	IPC		3	0	2	50	50	100	4
4	21ANE54	Program Elective 1	PEC		3	0	0	50	50	100	3
5	21ANE55	Research Methodology	AEC		3	0	0	50	50	100	3
6	21ANE561	Ability Enhancement Course – IV Drone Technology	AEC		1	0	0	50	50	100	1
7	21CIV57/67	Environmental Science	HSM	Civil	1	0	0	50	50	100	1
	OR										
	21UHV57/67	Universal Human Values	HSM	Any Department							
8	21ANEL58	Aircraft Structures Laboratory	PC	Respective Department	0	0	2	50	50	100	1
							TOTAL	**400**	**400**	**800**	**19**

VI SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	21ANE61	Aircraft Performance	PC	Respective Department	2	2	0	50	50	100	3
2	21ANE62	Aerodynamics-II (Integrated)	IPC		3	0	2	50	50	100	4
3	21ANE63	Finite Element Method	PC		3	0	0	50	50	100	3
4	21ANE64X	Program Elective 2	PEC		2	2	0	50	50	100	3
5	21ANE65X	Open Elective 1	OEC	Respective Offering Department	3	0	0	50	50	100	3
6	21ANE661	Ability Enhancement Course – V Urban Air Mobility	AEC	Respective Department	1	0	0	50	50	100	1
7	21CIV57/67	Environmental Science	HSM	Civil	1	0	0	50	50	100	1
	OR										
	21UHV57/67	Universal Human Values	HSM	Any Department							
8	21MPT68	Mini Project	MP	Respective Department	Two Contact hours per week			50	50	100	2
9	21ANEL69	Modelling and Simulation Laboratory	PC	Respective Department	0	0	2	50	50	100	1
							TOTAL	**450**	**450**	**900**	**21**

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VII SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	21ANE71	Computational Fluid Dynamics	PC	Respective Department	2	2	0	50	50	100	3
2	21ANE72	Aircraft Stability and Control	PC		3	0	0	50	50	100	3
3	21ANE73	Avionics (Integrated)	IPC		3	0	2	50	50	100	4
4	21ANE74X	Program Elective 3	PEC		2	2	0	50	50	100	3
5	21ANE75X	Open Elective 2	OEC	Respective Offering Department	3	0	0	50	50	100	3
6	21ANE76	Project Phase 1	MP	Two Contact hours per week				100	-	100	2
7	21ANEL77	Flight Simulation Laboratory	PC	Respective Department	0	0	2	50	50	100	1
							TOTAL	**400**	**300**	**700**	**19**

VIII SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	21ANE81X	Program Elective 4	PEC	Respective Department	3	0	0	50	50	100	3
2	21ANE82X	Program Elective 5	PEC		3	0	0	50	50	100	3
3	21ANE83	Project work phase – II	MP	Two Contact hours per week				100	100	200	12
4	21ANE84	Technical Seminar	MP	One Contact hours per week				100	--	100	1
5	21ANE85	Internship	INT	Completed during the intervening period of VI and VII Semester				100	--	100	2
							TOTAL	**400**	**200**	**600**	**21**

Program Elective & Open Elective

Program Elective 1		
Sl. No.	**Course Code**	**Course Title**
1	21ANE541	Aircraft materials and manufacturing
2	21ANE542	Aircraft Systems and Instruments
3	21ANE543	Composite materials and structures
4	21ANE544	Wind Tunnel Techniques
Program Elective 2		
Sl. No.	**Course Code**	**Course Title**
1	21ANE641	Theory of Vibration
2	21ANE642	Rocket and Missile
3	21ANE643	Theory of Elasticity
4	21ANE644	Fuels and combustion

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Program Elective 3		
Sl. No.	**Course Code**	**Course Title**
1	21ANE741	Helicopter Engineering
2	21ANE742	Space Mechanics
3	21ANE743	Experimental Aerodynamics
4	21ANE744	Aircraft Maintenance Repair and Overhaul
Program Elective 4		
Sl. No.	**Course Code**	**Course Title**
1	21ANE811	Satellite Technology
2	21ANE812	UAV Artificial Intelligence Systems
3	21ANE813	Guidance and control
4	21ANE814	Flight Vehicle design
Program Elective 5		
Sl. No.	**Course Code**	**Course Title**
1	21ANE821	Civil Aviation Requirement
2	21ANE822	Flight Testing
3	21ANE823	Total Quality Management
4	21ANE824	NDT in Aerospace
Open Elective 1		
1	21ANE651	Introduction to Aeronautical Engineering
2	21ANE652	Aircraft Systems and Instrumentation
3	21ANE653	Aircraft Maintenance and Practice
Open Elective 2		
1	21ANE751	Drone Technology
2	21ANE752	Airport Planning and Management
3	21ANE753	Aviation Safety Management and accident Investigations

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III Semester Syllabus

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SEMESTER – III

COURSE: COMPLEX VARIABLES AND PROBABILITY (COMMON FOR ME/AE)

Course Code	**21MAT31C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of mathematics in the field of engineering by making them to learn:

CLO1	Analytic functions and complex line integrals
CLO2	Probability distributions
CLO3	Joint probability distributions
CLO4	Sampling distributions and testing of hypothesis

Content	No. of Hours/ RBT levels
Module 1 Function of a complex variable, Analytic functions, Cauchy-Riemann equations, construction of analytic functions using Milne Thomson method, Properties of analytic functions.	**08 Hours L2, L3**
Module 2 Conformal mapping, Bilinear transformations. Complex line integrals, Cauchy's theorem, Cauchy's integral formula, Singularities, poles, residues, Cauchy's residue theorem.	**08 Hours L2, L3**
Module 3 Probability, Axioms of probability, Conditional probability, Bayes theorem, Discrete and continuous random variables, Moments, Moment generating functions, Binomial, Uniform, Exponential, Poisson, Normal distributions.	**08 Hours L2, L3**
Module 4 Joint distributions, Marginal and conditional distributions, Expectation and Covariance. Transformation of random variables, Central limit theorem and law of large numbers.	**08 Hours L2, L3**
Module 5 Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, student's t-distribution, chi-square distribution as a test of goodness of fit.	**08 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Apply Cauchy Riemann equations to study different properties of analytic functions
CO2	Evaluate complex line integrals
CO3	Solve problems associated with random variables using probability distributions

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CO4	Solve problems related to testing of hypothesis

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017
2. T Veerarajan, Probability, Statistics and Random Processes for Engineers, Tata McGraw Hill, 3rd Edition, 2008

Reference books:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006
2. N.P.Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications 6 th Edition, 2014
3. Richard H Williams, Probability, Statistics and Random Processes for Engineers, Cengage Learning, 1st Edition, 2003.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO31.1	3	2	1									3				
CO31.2	3	2	1									3				
CO31.3	3	2	1									3				
CO31.4	3	2	1									3				
Average	3	2	1									3				

Low-1: Medium-2: High-3

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SEMESTER – III

COURSE: FLUID MECHANICS

Course Code	**21ANE32**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Fluid Mechanics in broad domain of Aeronautical Engineering by making them to learn:

CLO1	The properties of fluids and its Characteristic are studied
CLO2	To understand the importance of dimensional analysis
CLO3	The applications of the conservation laws to flow through pipes are studied
CLO4	To understand the importance of Flow Measuring devices.
CLO5	To understand the importance of Viscous effect.

Content	**No. of Hours/ RBT levels**
Module 1 **Fluids**: Introduction, Properties of fluids, Viscosity, Types of fluids, Compressibility and Bulk Modulus. **Fluid Statics**: Fluid Pressure at a Point, Pascal's law, Pressure variation in a Static fluid, Absolute, Gauge, Atmospheric and Vacuum Pressures. Simple Manometer and Differential Manometer. Total Pressure and center of Pressure on Submerged Plane Surfaces.	**10HoursL3**
Module 2 **Buoyancy:** Buoyancy, Center of Buoyancy, Meta-Centre and Meta-Centric Height, Conditions of Equilibrium of Floating and Submerged Bodies, Determination of Meta-Centric Height. **Dimensional Analysis:** Introduction, Derived Quantities, Dimensions Of Physical Quantities, Dimensional Homogeneity, Rayleigh's Method, Buckingham's Π Theorem, Types Of Similarities And Dimensionless Numbers.	**10HoursL3**
Module 3 **Fluid Kinematics:** Types of Fluid Flow, Continuity Equation in 2D and 3D Velocity and Acceleration. Velocity Potential Function and Stream Function, Flow net, Fundamentals of flow visualization stream lines, stream tube, timeline, path lines, streak lines, flow visualization techniques. Vortex Flow - Free and Forced Vortex	**10HoursL3**
Module 4 **Fluid Dynamics**: Introduction, Equation of motion, Euler's equation of Motion, Bernoulli's equation from first principles, limitations of Bernoulli's equation. **Fluid Flow Measurements:** Venturimeter, Orifice meter, pitot-tube, vertical orifice, V-Notch and Rectangular notches.	**10HoursL3**

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Module 5	
Flow through pipes: Minor Energy losses through pipes. Darcy's and Chezy's equation for loss of head due to Friction in pipes. **Viscous Flow**: Reynolds's number, Critical Reynold's number, Laminar flow, Turbulent flow, Viscous flow through Circular Pipe-Hagen Poiseille's formula, Viscous flow between two parallel plates and, Boundary layer concept.	**10Hours** **L3**

Laboratory Exercises

S.N	LIST OF EXPERIMENTS	RBT levels
1	Determination of the Coefficient of discharge of given Orifice meter.	L4
2	Determination of the Coefficient of discharge of given Venturimeter.	L4
3	Calibration of Venturimeter	L4
4	Determination of Vane Coefficient for Flat Vane and Semi-circular Vane.	L4
5	Determination of Minor Losses in Flow through pipes	L4
6	Determination of Coefficient of Friction of flow in a pipe	L4
7	Performance Characteristics of single stage Centrifugal Pump	L4
8	To determine the coefficient of discharge of Notch (V and Rectangular types)	L4

COURSE OUTCOMES: Upon completion of this course, student will be able to:

CO1	Apply Fundamental knowledge to Predict the Properties and Characteristics of fluid.
CO2	Apply principle of dimensional analysis & similitude to simple engineering problems and describe buoyancy force.
CO3	Understand the Kinematics of fluid flow and Continuity Equation.
CO4	Analyze the Forces and energy for the fluid flow in a conduit and compare the different flow Measuring devices.
CO5	Analyse the losses and viscous effects in the flow through pipes.

Textbooks:

1. R K Bansal, "Fluid Mechanics and Hydraulic machines", Lakshmi Publications, revised 9th Edition 2015.
2. Frank M. White "Fluid Mechanics", Seventh Edition, McGraw-Hill Companies,Inc. Publications, New York 2011.

Reference books:

1. Graebel W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016

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Web references/ links

Mod-01 Lec-01 Introduction and Fundamental Concepts - I

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE-on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2		
	CIE Test-3		
	Laboratory	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – III

COURSE: SOLID MECHANICS

Course Code	**21ANE33**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Solid Mechanics in broad domain of Aeronautical Engineering by making them to learn:

CLO1	To understand the concepts of stress, strain.
CLO2	To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
CLO3	To determine stresses and deformation under bending and shear load.
CLO4	To determine stresses and deformation in circular shafts due to torsion , also to determine deflection in beams.
CLO5	To study the stresses and deformations induced in thin and thick shells.

Content	**No. of Hours/RBT levels**
Module 1 **Stresses and Strains:** Introduction to Stress, Types of stress, Strain, Types of Strain, Modulus of Elasticity, True Stress, True Strain, Simple problems, Stress Strain Diagram of Ductile, Brittle, Visco- Elastic, Linear & Non-linear Elastic materials, Bars with varying sections, Bars of composite sections, Simple problems, Thermal stresses, Simple problems, Elastic constants and its relation, volumetric stains, Simple problems.	**10 Hours L3**
Module 2 **Compound Stresses:** Methods of Determining stresses in oblique sections, Principal planes and stresses, Simple problems, Construction of Mohr's circle, simple problems. **Shear Force and Bending Moment Diagram:** Introduction to shear force, bending moment, Types of Beams and loads, sign convention for shear force and bending moment, Shear force and bending moment diagram for various beams. Relation between shear force and bending moment.	**10 Hours L3**
Module 3 **Bending Stresses and shear stress in Beams:** Introduction, Pure Bending and Simple Bending, Expression of Bending stress, Neutral axis and Moment of resistance, bending stress in symmetrical sections, Section modulus, Section modulus for various shapes of the beam section. Introduction to shear stress, shear stress distribution for different section	**08 Hours L3**

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Module 4 **Torsion of Shafts:** Introduction to torsion, Derivation of shear stress produced in a circular shaft subjected to Torsion, Expression of Torque in terms of polar moment of Inertia, Power transmitted by shaft, simple problem.	**09 Hours L3**
Module 5 **Column and struts:** Introduction to columns and struts, Failure of a column, Expression of crippling load when (a) both ends are hinged (b) One end of the column is fixed and the other end is free (c) both ends are fixed (d) One end is fixed and the other end is hinged. Simple problems to be solved used Euler's formula and Rankine formula. **Thick and Thin cylinders:** Thin cylinders subjected to internal pressure. Stresses in a thin cylinder subjected to internal pressure, Expression of circumferential stress and hoop stress, Simple problems Thick Cylinder: Lame's theorem, Stresses in a thick cylinder, Simple problems to be solved.	**08 Hours L3**

Laboratory Exercises

S.N	LIST OF EXPERIMENTS	RBT levels
1	Brinell, Rockwell and Vicker's hardness test on various specimens.	L4
2	Izod and Charpy test on various specimens using impact-testing machine.	L4
3	Preparation of specimen for metallographic examination of different engineering materials. Study of microstructures of plain carbon steel, tool steel, gray CI, SG iron, brass, bronze & composite.	L4
4	1) To study the defects of cast and welded components using non-destructive tests: a) Ultrasonic flaw detection. b) Magnetic crack detection.	L4
5	Tensile, Shear, Bending and Compression tests of metallic and non-metallic specimen using Universal Testing Machine.	L4
6	Torsion test on metallic specimen using torsion testing machine.	L4
7	To study the wear characteristics of metals and non-metal materials under different parameters.	L4
8	Fatigue Test (demonstration only).	L4

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Evaluate mechanical properties of engineering materials
CO2	Assess the Bending moment and shear Force for engineering materials
CO3	Examine the Bending stresses and shear stresses for engineering materials
CO4	Evaluate torsional behavior of shaft material and the hardness of the ferrous and non-ferrous materials.
CO5	Analyze the stress distribution in Thick and Thin cylinder and also identify the defects in the material and in-service components using non-destructive testing methods.

Textbooks:

1. R K Bansal, Strength of Materials , Laxmi Publication Pvt Ltd., New Delhi, 2004.
2. Ramamrutham, Strength of Materials, Vikas Publication, New Delhi, Eighth edition (2014).
3. Gere and Timoshenko, Mechanics of materials, CBS Publishers & Distributors, 2nd edition, 2006.

Reference books:

1. Egor P. Popov, Engineering Mechanics of Solids, PHI publications 2nd edition.
2. R.c Hibbeler , Mechanics of materials, Pearson publications, 9th edition.
3. B.C. Punmia, Ashok Kumar Jain & Arun Kumar Jain, Mechanics of Materials, Laxmi publications, New Delhi , 2006

Web references/ links

https://freevideolectures.com/course/96/strength-ofmaterials

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE-on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive flaboratory internal assessment test to be conducted at the end of the semester

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2		
	CIE Test-3		
	Laboratory	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – III

COURSE: AERO THERMODYNAMICS

Course Code	**21ANE34**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Learning Objectives: To enable students to apply the knowledge of Aero Thermodynamics in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Basic knowledge on the fundamental concepts of thermodynamics
CLO2	The First law of thermodynamics and its application in Various flow systems
CLO3	The second law of thermodynamics applying to systems and the concept of entropy.
CLO4	Basic knowledge on standard air cycles
CLO5	To get exposure on the basic concepts of Heat and Mass transfer.

Content	No. of Hrs /RBT Levels
Module-1 **FUNDAMENTAL CONCEPTS** Continuum and macroscopic approach; Thermodynamic Systems: open, closed and isolated; Thermodynamic properties and equilibrium; State of a system, state postulate for simple compressible substances, state diagrams, paths and processes on state diagrams; zeroth law of thermodynamics; concept of temperature.	**08Hours L1, L2**
Module-2 **FIRST LAW OF THERMODYNAMICS** Concept of energy and various forms of energy; concepts of heat and work, different modes of work; internal energy, enthalpy; specific heats; first law applied to elementary processes, closed systems and control volumes, steady flow analysis of nozzles, diffusers, throttling devices, mixing, turbines and compressors; unsteady flow analysis.	**10 Hours L2,L3**
Module-3 **SECOND LAW OF THERMODYNAMICS AND ENTROPY** Limitations of the first law of thermodynamics, concepts of heat engines and heat pumps/refrigerators, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes. Carnot cycle and Carnot theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; the principle of increase of entropy, T-s diagrams; availability and irreversibility	**8 Hours L2,L3**
Module-4 **AIR STANDARD CYCLES** Otto, Diesel, Dual, Ericsson, Atkinson, Stirling and Brayton cycles - air standard efficiency - Mean effective Pressure.	**8 Hours L2,L3**
Module-5 **BASICS OF HEAT AND MASS TRANSFER** Modes of heat transfer, Basic laws governing Heat transfer, combined heat transfer mechanism. Boundary conditions of 1st, 2nd and 3rd kind. Introduction to mass transfer, definition and terms used in mass transfer, Fick's law of	**8 Hours L2,L3**

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diffusion, Numerical.	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Relate laws of thermodynamics in various engineering problems.
CO2	Differentiate thermodynamic work and heat and apply I law of thermodynamics to different process
CO3	Analyze and decide the feasibility of design variables using thermodynamics principles.
CO4	Analyze the different types of air standard cycles
CO5	Recognize and Calculate heat transfer involving several heat transfer mechanisms.

Textbooks:

1. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach" 9th ed., McGraw Hill Publishing Company Limited.
2. Yunus A Cengel, Heat and Mass Transfer - A Practical Approach, 5th ed., McGraw Hill Publishing Company Limited.
3. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2013.
4. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2005.

Reference books:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 2007.
3. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series,Tata McGraw-Hill, New Delhi, 2004.
4. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
5. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987.
6. Incropera, DeWitt, "Fundamentals of Heat and mass transfer", John Wiley and Sons, 6 th Edition, 2005.
7. Hegde, R.K., Heat and Mass Transfer - Basic Approach, Sapna book House, Bangalore

Web references/ Additional online information (related to module if any):

1. https://nptel.ac.in/courses/101/104/101104067/
2. https://nptel.ac.in/courses/101/104/101104067/
3. https://nptel.ac.in/courses/101/104/101104067/
4. https://nptel.ac.in/courses/101/104/101104067/
5. https://nptel.ac.in/courses/101/104/101104067/
6. https://nptel.ac.in/courses/112101097/

Practical knowledge references

1. https://www.youtube.com/watch?v=suuTC9uGLrI
2. https://www.youtube.com/watch?v=suuTC9uGLrIhttps://www.youtube.com/watch?v=7bJywbP7ZIU
3. https://www.youtube.com/watch?v=7OJGZHrbD8
4. https://www.youtube.com/watch?v=7OJG-ZHrbD8https://www.youtube.com/watch?v=7bJywbP7ZIU
5. https://www.youtube.com/watch?v=7bJywbP7ZIUhttps://www.youtube.com/watch?v=2vHLJjlinjw
6. https://www.youtube.com/watch?v=Juz9pVVsmQQhttps://www.youtube.com/watch?v=Juz9pVVsmQQ
7. https://www.youtube.com/watch?v=L1AHGHRvv9s

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes/ Alternate Assessment Tools (AATs) for 10 marks. Typical Evaluation pattern for regular courses is shown in Table 1.

Table1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER – III

COURSE: BASICS OF AERONAUTICAL ENGINEERING

Course Code	**21ANE35**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Introduction to Aeronautical Engineering in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Understand the Historical evaluation of Airplanes & different structures & construction
CLO2	Understand the basic properties and principles behind the flight
CLO3	Study the various types of power plants used in aircrafts
CLO4	Study of the aircraft Stability
CLO5	Study the different component systems and functions

Content	**No. of Hours/ RBT levels**
Module 1 **Introduction to Aircrafts** History of aviation; Atmosphere and its properties; Classification of aircrafts; Basic components of an aircraft; structural members; aircraft axis system; aircraft motions; control surfaces and high lift devices; conventional design configurations; Helicopters, their parts and functions. **Aircraft Structures and Materials:** Introduction; general types of construction; monocoque, semimonocoque and geodesic structures; typical wing and fuselage structure; metallic and non-metallic materials for aircraft application.	**08 Hours L3**
Module 2 **Aerodynamics:** Basic principles of flight – significance of speed of sound; airspeed and groundspeed; Bernoulli's theorem; forces over wing section, aerofoil nomenclature, pressure distribution over a wing section. Lift and drag components, lift curve, drag curve, types of drag, factors affecting lift and drag; centre of pressure and its significance; aerodynamic centre, aspect ratio, Mach number and supersonic flight.	**08 Hours L3**
Module 3 **Aircraft Propulsion:** Aircraft power plants, classification based on power plant and principle of operation. Turboprop, turbojet and turbofan engines; ramjets and scramjets; performance characteristics. Aircraft power plants – basic principles of piston, turboprop and jet engines; Brayton cycle and its application to gas turbine engines; use of propellers and jets for production of thrust; comparative merits and limitations of different types of propulsion engines; principle of thrust augmentation.	**08 Hours L3**

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Module 4 **Aircraft Stability:** Forces on an aircraft in flight; static and dynamic stability; longitudinal, lateral and roll stability; necessary conditions for longitudinal stability; basics of aircraft control systems. Performance of aircraft – power curves, maximum and minimum speeds for horizontal flight at a given altitude; effect of changes in engine power and altitude on performance; correct and incorrect angles of bank; aerobatics.	**08 Hours** **L3**
Module 5 **Aircraft Systems:** Mechanical systems and their components; hydraulic and pneumatic systems; oxygen System; environmental Control System; fuel system. Electrical systems, flight deck and cockpit systems; navigation system, communication system. Flight control system, cockpit instrumentation and displays; communication systems; navigation systems; power generation systems – engine driven alternators, auxiliary power Module, ram air turbine; power conversion, distribution and management.	**10 Hours** **L3**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

CO1	Learn the history of aircraft & developments over the years, Acquire knowledge on Aircraft differentiate types and constructions
CO2	Understand the basic concepts of flight & Physical properties of Atmosphere
CO3	Understand the Different types of Engines and principles of Rocket
CO4	Understand the Basics of aircraft Stability
CO5	Ability to identify the types & classifications of components and control systems

Textbooks:

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition, 2015
2. Handbooks of Airframe and Power Plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, the English Book Store, New Delhi, 1995.
3. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
4. Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co 1993.
5. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

Reference books:

1. Kermode, A.C. Flight without Formulae, Pearson Education; Eleven edition, 2011
2. McKinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 1993.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

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Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – III

COURSE: Balake Kannada (for Non-Kannadiga Students)

Subject Code	21KBK36	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
Credits	0	Examination Hours	-

Course Learning Objectives:

The course will enable the students to understand Kannada and communicate (converse) in Kannada language.

Table of Contents

- Abbreviations
- Key to Transcription
- Easy learning of a Kannada Language: A few tips
- Necessity of learning a local langauge:
- Tips to learn the language with easy methods.
- Hints for correct and polite conservation
- About Kannada Language (Kannada Bhashe)
- Eight Kannada authors who have won 'Jnanpith Award'
- Information about Karnataka State

Part : I

Instructions to Teachers

1. How to Teach the BaLake Kannada Book
2. Methods to be followed in Teaching of all the chapters/ concepts

Chapter – 1 Listening and Speaking - KelisikoLLuvudu mattu Maatanaduvudu

1. Pronouns – SarvanaamagaLu
2. Adjectives – Naama VisheshaNagaLu
3. Verbs – KriyapadagaLu
4. Adverbs – KriyavisheshaNagaLu

Necessity of learning a local langauge:

The learning of local language,

- Encourages the respect for other people: it fosters an understanding of the interrelation of language and human nature.
- Expands one's view of the world, liberalizes one's experiences, and makes one more flexible and tolerant.
- Limits the barriers between people: barriers cause distrust and fear.
- Opens the door to art, music, dance, fashion, cuisine, film, philosophy, science...etc.
- Leads to an appreciation of cultural diversity.
- Helps fluent communication.

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Language learning helps to develop strong cognitive skills, such as a better concept formation, mental flexibility, multitasking, listening skills and problem-solving, in addition to improve social interaction and also encourages the connection between peers.

Use of local language help to mingle with the local society and ensures security, pleasant welcoming from auto/cab drivers, shop owners, employees of local government etc., and make the living easier and more comfortable.

Tips to learn the language with easy methods.

Apart from the conventional method of learning from teachers, the learning of language can be accelerated by adopting the following methods.

1. Love the learning without boredom.
2. Talk to classmates and others in Kannada without hesitation and with no concern to grammatical mistakes during the initial stages of learning the language.
3. Use English words to continue the conversation when you find difficulty in finding suitable Kannada word/s. Vocabulary improves with the use of language.
4. While reading, read aloud (not silently or in a whisper manner, but audibly so that others are not being disturbed or others can hear what is being read). Reading aloud not only helps proper/ correct pronunciation of words with variation in pitch, pace, volume, pauses etc., but also produces a fluent and enjoyable delivery during conversation/debate/presentation.
5. Listen to Kannada news and watch Kannada movies.
6. Listen to Kannada FM radios for news, live conversations and songs.
7. Use online applications (apps) for fast learning.

Easy learning of a Kannada Language: A few tips

1. Watching Kannada movies (preferably with subtitles), can be of great help. This is an important and entertaining way to improve your language skills.
2. Do not hesitate. Speak the language at every possible opportunity.
3. Never mind if you are using less Kannada and more English words. Kanglish is anyway popular in Bangalore. However constantly try to improve your Kannada vocabulary.
4. Watch Kannada news. This is not only helpful in learning the language, but will help you to know your city better.
5. If you are a user of public transport, carefully listen to co-passengers' conversations.
6. Enjoy the local tang of the language by listening to Kannada FM stations.
7. Do not completely rely on 'Learn Kannada in 30 days' type of books. Many Bangaloreans will fail to comprehend your textbook language and you are sure to face some embarrassment, if you go strictly by books.

Hints for correct and polite conservation

1. Be vigilant about the verbs, the pronouns, the genders and tense required for day to day Conversation.
2. Pronounce the words properly.
3. Use plural form to address others.
4. Use simple sentences for conversation.

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About Kannada Language (Kannada Bhashe)

- Kannada is one of the classical (Shastreeya) languages of India since November 01, 2008, and is the official language of the Karnataka state.
- This language is not just confined within the borders of Karnataka, for you will find it spoken by people in parts of the neighboring states of Andhra Pradesh, Tamil Nadu and Maharashtra. Kannada is spoken in its various dialects by Six to Seven million people across the globe. It is one among the top 40 most spoken languages of the world.
- Spoken Kannada is in use since 2500 years, and has its own script since 1900 years. Spoken Kannada varies according to the regions of Karnataka, while the written form of Kannada remains almost the same. Kannada is the third oldest language of India (after Sanskrit and Tamil).
- The written form of Kannada is phonetic and it is written as it is spoken.
- The first Kannada-English Dictionary (ShabdaKosha) was compiled in 1894 by a German priest, Rev. Ferdinand Kittel. He also wrote a book on Kannada Grammar entitled, "A Grammar of the Kannada Language: Comprising the Three Dialects of the Language".
- Several noted centuries old literary works of Kannada have been translated into Sanskrit, and other languages.
- November 1st of every year is celebrated as Kannada Rajyotsava Day throughout Karnataka state and is declared as a state holiday. This was the day that the name Karnataka was given to the Mysore state in the year 1973.

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SEMESTER – III

COURSE: Samskruthika Kannada

Subject Code	21KSK36	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
Credits	0	Examination Hours	-

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
- ಕನ್ನಡ ಭಾಷಾ ಬರಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗೂ ಅವುಗಳ ನಿವಾರಣೆ.
- ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆ ಸರ್ಕಾರಿ ಪತ್ರವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
- ಭಾಷಾಂತರ ಮತ್ತು ಪ್ರಬಂಧ ರಚನೆ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡಿಸುವುದು.
- ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ

ಪರಿವಿಡಿ

ಭಾಗ – ಒಂದು ಲೇಖನಗಳು (ಕನ್ನಡ ನಾಡು, ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು)

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿಗೆ : ಪಂಪ ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ವಿಶಾವಿಯ ಆಡಳಿತ ಕನ್ನಡದ ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನ•

ಭಾಗ – ಎರಡು ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ)

೪. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರ ದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೫. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸ

ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯಶಾಳು ಮನವೆ – ಕನಕದಾಸ

೬. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಷರೀಫ

ಶಿವಯೋಗಿ – ಬಾಲಲೀಲಾ ಮಹಾಂತ ಶಿವಯೋಗಿ

೭. ಜನಪದ ಗೀತೆ : ಬೀಸುವ ಪದ, ಬಡವರಿಗೆ ಸಾವ ಕೊಡಬೇಡ

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ಭಾಗ – ಮೂರು ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ)

೮. ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ : ಡಿ.ವಿ.ಜಿ.

೯. ಕುರುಡು ಕಾಂಚಾಣ : ದ.ರಾ. ಬೇಂದ್ರೆ

೧೦. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು

೧೧. ಹೆಂಡತಿಯ ಕಾಗದ : ಕೆ.ಎಸ್. ನರಸಿಂಹಸ್ವಾಮಿ

೧೨. ಮಜ್ಜಿನಿಂದ ಮಜ್ಜಿಗೆ : ಜಿ.ಎಸ್. ಶಿವರುದ್ರಪ್ಪ

೧೩. ಆ ಮರ ಈ ಮರ : ಚಂದ್ರಶೇಖರ ಕಂಬಾರ

೧೪. ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು : ಸಿದ್ಧಲಿಂಗಯ್ಯ

ಭಾಗ – ನಾಲ್ಕು ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

೧೫. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ – ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ : ಎ ಎನ್ ಮೂರ್ತಿರಾವ್

೧೬. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

೧೭. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ

ಭಾಗ – ಐದು ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ

೧೮. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

೧೯. 'ಕ' ಮತ್ತು 'ಬ' ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು ಕನ್ನಡದ ಟೈಪಿಂಗ್'

೨೦. ಕನ್ನಡ – ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ'

೨೧. ತಾಂತ್ರಿಕ ಪದಕೋಶ : ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು'

'(ಏತಾವ ಯ ಆಡಳಿತ ಕನ್ನಡ ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನಗಳು – ಡಾ. ಎಲ್. ಶಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೋ.ವಿ.ಕೇಶವಮೂರ್ತಿ)

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SEMESTER – III

COURSE: Constitution of India and Professional Ethics (CIP)

Course Code	**21CIP36**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0 : 2 : 0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**02 Hours/Week**	**Total Marks**	**100**
No. of Credits	**01**	**Examination Hours**	**01 Hours**

Course Objectives:

CLO1	To know about the basic structure of Indian Constitution.
CLO2	To know the Fundamental Rights (FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
CLO3	To know about our Union Government, political structure & codes, procedures.
CLO4	To know the State Executive & Elections system of India.
CLO5	To learn the Amendments and Emergency Provisions, other important provisions given by the constitution

Content	**No. of Hours**
Module 1 **Introduction to Indian Constitution:** The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly. The Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.	**03 Hours**
Module 2 **FR's, FD's and DPSP's:** Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building	**03 Hours**
Module 3 **Union Executive :** Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.	**03 Hours**
Module 4 **State Executive & Elections, Amendments and Emergency Provisions:** State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (How and Why) and Important Constitutional Amendments till today. Emergency Provisions	**03 Hours**

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Module 5	
Professional Ethics: Ethics & Values. Types of Ethics. Scope & Aims of Professional & Engineering Ethics. Positive and Negative Faces of Engineering Ethics. Clash of Ethics, Conflicts of Interest. The impediments to Responsibility. Trust & Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.	**03 Hours**

COURSE OUTCOMES: Upon completion of this course, student will be able to

CO1	Analyse the basic structure of Indian Constitution
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution.
CO3	know about our Union Government, political structure & codes, procedures.
CO4	Understand our State Executive & Elections system of India.
CO5	Remember the Amendments and Emergency Provisions, other important provisions given by the constitution.

Textbooks:

1. "Constitution of India" (for Competitive Exams) - Published by Naidhruva Edutech Learning Solutions, Bengaluru. – 2022
2. Engineering Ethics", M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Prentice –Hall, 2004

Reference Books:

1. "Samvidhana Odu" - for Students & Youths by Justice HN Nagamohan Dhas, Sahayana, kerekon.
2. "Constitution of India, Professional Ethics and Human Rights" by Shubham Singles, Charles E. Haries, and et al: published by Cengage Learning India, Latest Edition – 2019.
3. "Introduction to the Constitution of India", (Students Edition.) by Durga Das Basu (DD Basu): Prentice –Hall, 2008.
4. "The Constitution of India" by Merunandan K B: published by Merugu Publication, Second Edition, Bengaluru

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

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Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

Total CIE : IA 20*3=60, Assignment 10+10=20, Quiz 20 = 100 /2 = 50

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject

(duration 02 hours)

1. The question paper will have 50 questions. Each question is set for 01 mark.
2. Semester End Exam (SEE) Pattern will be in MCQ Model (Multiple Choice Questions) for 50 marks (60 minutes duration).

Table 2: Distribution of weightage for CIE

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**40**	**100**
	CIE Test-2	**40**	
	Quiz 1/AAT	**10**	
	Quiz 2/AAT	**10**	
Grand Total			**100**

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SEMESTER – III

COURSE: ABILITY ENHANCEMENT COURSE – I

DIGITAL MANUFACTURING IN AEROSPACE INDUSTRIES

Course Code	**21ANE371**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Objectives:

CLO1	To impart the importance of additive manufacturing and its applications.
CLO2	To acquire knowledge about the various techniques involved in additive manufacturing.
CLO3	To be aware of the additive manufacturing techniques in Aerospace industries

Content	No. of Hours/ RBT levels
Module 1 **INTRODUCTION:** Additive manufacturing principle, Advantages of additive manufacturing, General limitation of additive manufacturing.	**02 Hours L3**
Module 2 **Development of Additive Manufacturing Technology:** Lasers, Printing Technologies, Programmable Logic Controllers, Materials, Computer Numerically Controlled Machining.	**02 Hours L3**
Module 3 **Solid Based Additive Manufacturing Systems:** Fused deposition Modeling (FDM): Principle, details of processes.	**02 Hours L3**
Module 4 **Liquid Based Additive Manufacturing Systems:** Stereolithographic Apparatus (SLA): Principle.	**02 Hours L3**
Module 5 **Powder Based Additive Manufacturing Systems:** SLS process description, Powder fusion mechanisms.	**02 Hours L3**

Course Learning Outcome:

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

CO1	Understand the principles, merits and demerits of additive manufacturing
CO2	Understand the convergence of different technologies and integrated into additive manufacturing
CO3	Understand the diverse range of additive manufacturing techniques
CO4	Understand the application of additive manufacturing in Aerospace industries
CO5	Select suitable process and materials used in additive manufacturing

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Textbooks:

1. Gibson l D. W. Rosen l B. Stucker, Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid Prototyping; Principles and Applications", Third Edition, World Scientific Publishers, 2010.

References:

1. Andreas Gebhardt, Understanding Additive Manufacturing Rapid Prototyping · Rapid Tooling, Rapid Manufacturing, Hanser Publishers, 2011.
2. Frank W. Liou, Rapid Prototyping and Engineering Applications "A Toolbox for Prototype Development, CRC Press, 2008.
3. Peter D. Hilton, Paul F. Jacobs, Rapid Tooling Technologies and Industrial Applications, Marcel Dekker, Inc., 2000.
4. Kamrani, Ali K, Nasr, Emad Abouel, Rapid Prototyping: Theory and Practice, Springer, 2006.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – III

COURSE: ADDITIONAL MATHEMATICS (FOR LATERAL ENTRY STUDENTS)

Course Code	**21MATDIP31**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**00**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Mathematics in various fields of engineering by making them to learn:

CLO1	Derivatives, Polar curves and Radius of curvature
CLO2	Partial Derivatives and Jacobians
CLO3	Multiple integrals, beta & gamma functions
CLO4	Ordinary and Partial differential equations

Content	**No. of Hours/ RBT levels**
Module 1 Successive differentiation - simple problems. Polar Curves - angle between radius vector and tangent, angle between two curves, Pedal equation. Taylor's and Maclaurin's series for function of one variable.	**8 Hours L2, L3**
Module 2 Evaluation of Indeterminate forms. Partial derivatives, Differentiation of implicit and composite functions. Jacobians. Taylor's series for functions of two variables.	**8 Hours L2, L3**
Module 3 Multiple Integrals-Double integrals- direct evaluation, change of order of integration, change of variables. Triple integrals-direct evaluation. Beta and Gamma functions, relation between beta and gamma function.	**8 Hours L2, L3**
Module 4 Solution of first order and first degree differential equations – Variable Separable, Exact and Bernoulli's differential equations. Second order linear differential equation with constant Coefficients-Inverse differential operators. Cauchy's and Legendre's Linear differential equations.	**8 Hours L2, L3**
Module 5 Formation of partial differential equations by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration, homogeneous PDEs involving derivative with respect to one independent variable only.	**8 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Apply the knowledge of differential calculus to solve problems related to curvature, maxima & minima of a function and Jacobians
CO2	Evaluate double and triple integrals
CO3	Evaluate definite integrals using beta and gamma functions
CO4	Solve linear differential equations of first and second order with constant/variable coefficients
CO5	Solve partial differential equations.

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Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006

Reference books:

1. E. Kreyszig , Advanced Engineering Mathematics, John Wiley & Sons 10th Edition, 2016
2. N.P.Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications 6th Edition, 2014.

Semester End Examination (SEE):
There will be no SEE examination for this course.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
Grand Total (Final CIE x 2)			**100**

CO/PO Mapping																
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1									2				
CO2	3	2	1									2				
CO3	3	2	1									2				
CO4	3	2	1									2				
CO5	3	2	1									2				
Average	3	2	1									2				

Low-1: Medium-2: High-3

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SEMESTER IV

COURSE: TRANSFORMS CALCULUS AND NUMERICAL TECHNIQUES

Course Code	**21MAT41C**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Mathematics in various fields of engineering by making them to learn:

CLO1	Laplace Transforms
CLO2	Fourier series and Fourier Transforms
CLO3	Numerical Methods

Content	No. of Hours/ RBT levels
Module 1 plase transforms of elementary functions, Unit-step and Dirac delta functions. Inverse Laplace Transforms, Solution of second order linear differential equations using Laplace transforms.	**08 Hours L2, L3**
Module 2 urier series of periodic functions, half range Fourier sine and cosine series. Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms.	**08 Hours L2, L3**
Module 3 lution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson method. Finite differences: Newton's forward and backward difference formulae. Newton's divided difference formula and Lagrange's interpolation formula. Numerical integration: Simpson's 1/3rd, 3/8th, Weddle's rule.	**08 Hours L2, L3**
Module 4 merical solution of ordinary differential equations of first order and first degree using Modified Euler method, Runge-Kutta method of fourth order, Milne's and Adam-Bashforth predictor and corrector methods. Numerical solution of second order ordinary differential equations: Runge-Kutta method and Milne's method.	**08 Hours L2, L3**
Module 5 One dimensional wave and heat equation. Solution of heat and wave equation by method of separation of variables. Two-dimensional heat flow, Solution of Laplace's equation, Laplace's equation in polar coordinates. Two dimensional wave equation. Numerical solution of heat and wave equations.	**08 Hours L2, L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Determine Laplace and inverse Laplace transforms of given functions and solve linear differential equations
CO2	Determine Fourier series and Fourier Transform of given function.
CO3	Apply numerical techniques to solve algebraic and transcendental equations.
CO4	Apply numerical techniques for interpolation and to evaluate definite integrals.
CO5	Solve ordinary differential equations of first and second order using single step and multistep numerical methods
CO6	Solve problems related to heat and wave equations

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006

Reference books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons 10th Edition, 2016
2. N.P.Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications 6th Edition, 2014

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER IV

COURSE: AERODYNAMICS – I

Course Code	**21ANE42**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Pre requisite: Fluid Mechanics

Course Objectives: To enable students to apply the knowledge of aero dynamics in broad domain of aeronautical engineering by making them to learn:

CO1	The governing equations of fluid flow for incompressible inviscid flow
CO2	Understand the concept of superposition of elementary flows for inviscid, incompressible flow
CO3	Methods for describing airflow around airfoils and wings and calculating lift, drag and moments
CO4	Viscous Flow: boundary layer, velocity profile, thickness and friction coefficient.

Content	No. of Hours/ RBT levels
Module 1 **REVIEW OF BASIC DEFINITIONS & EQUATIONS** Importance of Aerodynamics, Fundamental aerodynamics, variables and dimensional analysis leading to Force & Moment coefficient and dimensionless similarity parameters such as Reynolds number, Mach number, Incompressible flow, Compressible flow and Mach number, Models of the Fluid: Control volume, and Fluid Elements. Continuity, Momentum and Energy Equations.	**10 Hours** **L3**
Module 2 **INVISID, INCOMPRESSIBLE FLOW** Basic flows – Uniform parallel flow, Source and Sink, Doublet, Vortex Flow. Path lines, Streamlines, Streak lines, and Circulation. Combinations of basic flows, Non lifting flow and Lifting flow over circular cylinder. Kutta Joukowski's theorem and generation of lift. D' Alembert Paradox and Magnus effects.	**10 Hours** **L3**
Module 3 **INCOMPRESSIBLE FLOW OVER AIRFOILS:** Blasius theorem, Kutta condition, Airfoils Nomenclature and NACA series, Airfoil Characteristics, Stall condition and Flow separation. Vortex sheet, Kelvin Circulation theorem and the Starting Vortex. Classical Thin airfoil theory: The Symmetrical airfoil and its Applications.	**10 Hours** **L3**
Module 4 **INCOMPRESSIBLE FLOW OVER FINITE WING:** Introduction to Finite wing, Downwash and Induced Drag, Vortex Filament, the Biot -Savart law and Helmholtz's theorems, Horse shoe vortex, Prandtl's Classical Lifting line theory and its limitations, Elliptical lift distribution.	**10 Hours** **L3**

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Module 5	
VISCOUS FLOW: Boundary layer, Laminar & Turbulent layer, Boundary layer Thickness, Displacement Thickness, Momentum Thickness, Energy Thickness, Boundary layer equation for a steady, two-dimensional incompressible flow, Boundary layer growth over a Flat Plate, Blasius Solution.	**10 Hours** **L3**

Laboratory Exercises

LIST OF EXPERIMENTS

1. Calibration of subsonic Wind tunnel.
2. Determination of lift for the given aerofoil section.
3. Pressure distribution over a smooth circular cylinder.
4. Pressure distribution over a rough circular cylinder.
5. Pressure distribution over a symmetric aerofoil.
6. Pressure distribution over a cambered aerofoil.
7. Force measurement using wind tunnel balancing set up.
8. Determination of Aerodynamic forces of Finite wing.
9. Flow visualization studies in low speed flows over cylinders.
10. Flow visualization studies in low speed flows over airfoil with different angle of incidence.
11. Calculation of total drag of a two-dimensional circular cylinder at low speeds using pitot-static probe wake survey.
12. Calculation of total drag of a two-dimensional cambered aerofoil at low speeds at incidence using pitot-static probe wake survey.
13. Calculation of aerodynamic coefficients and forces acting on a model aircraft at various Angle of Attack and speeds using wind tunnel balance (With and Without Yaw).
14. Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and momentum thickness.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Apply the Fundamental Conservative Principles of Nature to Obtain the Governing Equations in Fluid Flows.
CO2	Calculate the Basic Flow Properties of 2 - D geometries by using Potential flow theory and Superposition Principles.
CO3	Determine the Aerodynamic forces of Lift and Drag using Thin airfoil theory and Finite wing Theory.
CO4	Understand the Transport Properties of fluid due to Viscosity, Thermal Conductivity and Mass Diffusivity.

Textbooks:

1. **J. D. Anderson**, "Fundamentals of Aerodynamics", 5th Edition, McGraw HillEducation India Private Limited, 2010.
2. **L J Clancy**,"Aerodynamics" Paperback 2006

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Reference books:

1. **E. L. Houghton**, "Aerodynamics for Engineering students", 6th edition, Elsevier, 2012.
2. **Ethirajan Radhakrishnan**, "Theoretical Aerodynamics", 1st Edition, Wiley Publications, 2013.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.

CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 Marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**20**	**50**
	CIE Test-2	**20**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – IV

COURSE: COMPUTER AIDED AIRCRAFT DRAWING

Course Code	**21ANE43**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Prerequisites: Computer Aided Engineering Drawing.

Course Objectives: To enable students to apply the knowledge of Computer Aided Aircraft Drawing in broad domain of Aeronautical engineering by making them to learn:

CLO1	To familiarize the students with Indian Standards on drawing practices and standard components.
CLO2	To make the students to understand and interpret riveted joints.
CLO3	To produce different views using orthographic projections using standard CAD packages.
CLO4	To gain practical experience in modelling in 3D and to assemble parts using standard CAD packages.
CLO5	Convert 3D Assembly into 2D drafting and generate Bill of materials for assembled drawing. Create exploded views using standard CAD packages.

Content	**CO/ RBT Levels**
Module-1 **GEOMETRICAL DIMENSIONING & TOLERANCES, THREAD FORMS AND FASTENERS:** Types of GD&T, Datum, scope of GD&T standards, Machine tool tests to check for Straightness, Flatness, Parallelism, Squareness, Roundness, Cylindricity, Runout, Limits, Fits and Tolerances, Principle of interchangeability and selective assembly, Hole base system & shaft base system. **Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External), Square and Acme, Sellers thread, American Standard thread. **Fasteners**: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut.	**10 Hours L2**
Module-2 **RIVETED JOINTS:** Single and double riveted lap joints, butt joints with single /double cover straps (Chain and Zigzag, using snap head rivets).	**10 Hours L3**
Module-3 **ORTHOGRAPHIC VIEWS:** Introduction to orthographic projection, Conversion of pictorial views into orthographic projections of simple machine parts with or without section. Principle of visualization of objects, sectional views, full and half-sectional views.	**10 Hours L3**
Module-4 **3D SKETCHING & PART MODELLING:** Conversion of 2D Aeronautical components to 3D parts and sectional views of simple Aeronautical components and Assign material properties and textures to parts: (Detailed 2D part drawings will be given). 1. Propeller and hub parts. 2. Wing parts. 3. Fuselage parts. 4. Engine mount parts. 5. Helicopter rotor blade parts. 6. Landing gear parts.	**10 Hours L3**

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Module-5	
ASSEMBLY AND DRAFTING: Introduction to assembly drawing: 1. Propeller and hub assembly. 2. Wing assembly. 3. Fuselage assembly. 4. Engine mount assembly. 5. Helicopter rotor blade assembly. 6. Landing gear assembly. Exploding an assembly **Drafting:** Creating detailed drawings and conversion of different views of above mentioned assemblies to 2D drafting. Dimensions, Annotations and Parts Lists. Detailing a drawing, Bill of Materials.	**10 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Implement the drawing standards, Fits and Tolerances, knowledge of Thread forms and fasteners.
CO2	Interpret types of riveted joints using in Aviation component manufacturing.
CO3	Sketch the orthographic views of machine components from isometric view.
CO4	Develop 3D model of Aircraft parts of assembly by reading the blueprint of each part.
CO5	Re-create part drawings, sectional views and assembly drawings as per standards, Bill of Materials and of components using CAD software.

Textbooks:

1. K R Gopalakrishna, Machine Drawing in First angle of Projection, Subhas Publications, 23, 2017.
2. N. D. Bhatt, Machine Drawing, Charotar Publication, 50th Edition 2016.

Reference books:

1. KL Narayana, P Kannaiah, K V Reddy, Machine Drawing, New Age International Publishers, 6th Edition, 2019.
2. Sidheshwar, Machine Drawing, Tata McGraw-Hill Education, 33 reprint 2006.
3. R. K. Dhawan, Machine Drawing, S Chand Publishing reprint, 2006.

E-Books / Web References

1. Solid Edge 2022 Part Design Tutorial for Beginner [COMPLETE]. https://www.youtube.com/watch?v=pgSHJmObd00
2. Solid Edge fundamentals https://support.industrysoftware.automation.siemens.com/training/se/en/ST4/pdf/mt0141 3-s-1040_en.pdf.
3. Assembly : https://support.industrysoftware.automation.siemens.com/training/se/en/ST4/pdf/spse016 60-s-1040_en.pdf
4. Explode — Animate application : https://d2t1xqejof9utc.cloudfront.net/files/17325/SolidEdge_ERA_2.pdf?1357790407
5. Computer Mouse (Solid Edge Tutorial): https://www.youtube.com/watch?v=0SuN3pVSE_8

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	Sketch Book	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER – IV

COURSE: AERO PROPULSION-I

Course Code	**21ANE44**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Learning Objectives: To enable students to apply the knowledge of Aero Propulsion-I in broad domain of Aeronautical Engineering by making them to learn:

CLO1	To introduce basic concepts and salient features jet propelled engines and its components which are operated in atmosphere.
CLO2	To familiarize with Hypersonic propulsion

Content	**No. of Hrs/RBT Levels**
Module-1 **FUNDAMENTALS OF AIR BREATHING ENGINES** Operating principles of piston engines – thermal efficiency calculations – classification of piston engines - illustration of working of gas turbine engine – the thrust equation – factors affecting thrust –effect of pressure, velocity and temperature changes of air entering compressor – methods of thrust augmentation – characteristics of turboprop, turbofan and turbojet – performance characteristics.	**8 Hours L1, L2**
Module-2 **INLETS AND NOZZLES** Internal flow and Stall in subsonic inlets – relation between minimum area ratio and eternal deceleration ratio – diffuser performance – supersonic inlets – starting problem on supersonic inlets –shock swallowing by area variation – real flow in nozzles and nozzle efficiency – losses in nozzles –equilibrium flow and frozen flow in nozzles– ejector and variable area nozzles - thrust reversal.	**08 Hours L2, L3**
Module-3 **COMPRESSORS FOR JET ENGINES** Principle of operation of centrifugal compressor and axial flow compressor– Work done and pressure rise – velocity diagrams – degree of reaction – free vortex and constant reaction designs of axial flow compressor – performance characteristics of centrifugal and axial flow compressors– stage efficiency calculations - cascade testing.	**09 Hours L2, L3**
Module-4 **TURBINES FOR JET ENGINES** Principle of operation of axial flow turbines– limitations of radial flow turbines- Work done and pressure rise – Velocity diagrams – degree of reaction – free vortex and constant nozzle angle designs – performance characteristics of axial flow turbine– turbine blade cooling methods – stage efficiency calculations – basic blade profile design considerations – matching of compressor and turbine.	**09 Hours L2, L3**

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Module-5 **JET ENGINE COMBUSTORS AND RAMJET PROPULSION** Classification of combustion chambers – combustion chamber performance – effect of operating variables on performance – flame stabilization. Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets. Coding for jet engine problems.aircracr	**08 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	To understand the working of various air breathing engines
CO2	To understand the design features of inlets and perform necessary calculations
CO3	To understand the design features of compressors and perform necessary calculations
CO4	To understand the design features of turbines and perform necessary calculations
CO5	To understand the design features of combustors and perform necessary calculations

Textbooks:

1. P.G. Hill and C.R. Peterson, "Mechanics & Thermodynamics of Propulsion", Addison - Wesley Longman INC, 2015.
2. M. L. Mathur and R. P. Sharma, "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2010.

Reference books:

1. Cohen, H. Rogers, G.F.C. and Saravana muttoo, H.I.H. “Gas Turbine Theory”, Longman, 1989.
2. Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3. Rathakrishnan., E, "Gas Dynamics”, Fifth edition Published by PHI Learning, 2014.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes/ Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – IV

COURSE: AIRCRAFT STRUCTURES-I

Course Code	**21ANE45**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Aircraft Structures-I in broad domain of Aeronautical Engineering by making them to learn:

CO1	Understand the types of loads experienced by aircraft structure and materials used for aircraft structures
CO2	Acquire knowledge on different methodologies to analyze statically determinate and indeterminate structures under various loading conditions
CO3	Apply the energy method concept to determine the strain energy using various methods
CO4	Discuss about the theory of failure of aircraft structure
CO5	Solve aircraft structural problems by applying the concepts of theory of elasticity and failure theory

Content	**No. of Hours/ RBT levels**
Module 1 **Introduction to Aircraft Structures:** Structural layout of the Airplane and components, loads acting on major components such as wing, fuselage, tails, landing gear etc. V-n diagram, Concept of allowable stress and margin of safety. Types of loads – load factor – Aerodynamics loads –Symmetric manoeuvre loads –Aircraft Materials.	**08 Hours L3**
Module 2 **STATICALLY DETERMINATE & INDETERMINATE STRUCTURES :** Plane truss analysis – method of joints – method of sections – method of shear – 3-D trusses – principle of super position, Clapeyron's 3 moment equation and moment distribution method for indeterminate beams	**10 Hours L3**
Module 3 **ENERGY METHODS:** Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications. Energy theorems – dummy load & unit load methods – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.	**08 Hours L3**
Module 4 **FAILURE THEORIES:** Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory	**08 Hours L3**
Module 5 **THEORY OF ELASTICITY:** Concept of stress and strain, derivation of Equilibrium equations, strain displacement relation, compatibility conditions and boundary conditions. Plane stress and Plane strain problems in 2D elasticity.	**08 Hours L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Outline the types of loads experienced by aircraft structure and materials used for aircraft structures
CO2	Apply different methodologies to analyze statically determinate and indeterminate structures under various loading conditions
CO3	Apply the energy method concept to determine the strain energy
CO4	Discuss about the theory of failure of aircraft structure
CO5	Solve aircraft structural problems by applying the concepts of theory of elasticity and failure theory

Textbooks:

1. **'**Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing; 8th edition, 2012.
2. Megson T M G, `Aircraft Structures for Engineering students' Butterworth-Heinemann publisher, 5th edition, 2012.
3. N.C. Pandya, C.S. Shah, "Elements of Machine Design", Charotar Publishing House, 15th edition, 2009.

Reference books:

1. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985
2. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction' Cambridge University Press publishers, 2nd edition , 2008
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – IV

COURSE: Balake Kannada (for Non-Kannadiga Students)

Subject Code	21KBK46	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
Credits	0	Examination Hours	-

Course Learning Objectives:

The course will enable the students to understand Kannada and communicate (converse) in Kannada language.

Table of Contents

- Abbreviations
- Key to Transcription
- Easy learning of a Kannada Language: A few tips
- Necessity of learning a local langauge:
- Tips to learn the language with easy methods.
- Hints for correct and polite conservation
- About Kannada Language (Kannada Bhashe)
- Eight Kannada authors who have won 'Jnanpith Award'
- Information about Karnataka State

Part : I

Instructions to Teachers

1. How to Teach the BaLake Kannada Book
2. Methods to be followed in Teaching of all the chapters/ concepts

Chapter – 1 Listening and Speaking - KelisikoLLuvudu mattu Maatanaduvudu

1. Pronouns – SarvanaamagaLu
2. Adjectives – Naama VisheshaNagaLu
3. Verbs – KriyapadagaLu
4. Adverbs – KriyavisheshaNagaLu

Necessity of learning a local langauge:

The learning of local language,

- Encourages the respect for other people: it fosters an understanding of the interrelation of language and human nature.
- Expands one's view of the world, liberalizes one's experiences, and makes one more flexible and tolerant.
- Limits the barriers between people: barriers cause distrust and fear.
- Opens the door to art, music, dance, fashion, cuisine, film, philosophy, science...etc.
- Leads to an appreciation of cultural diversity.
- Helps fluent communication.

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Language learning helps to develop strong cognitive skills, such as a better concept formation, mental flexibility, multitasking, listening skills and problem-solving, in addition to improve social interaction and also encourages the connection between peers.

Use of local language help to mingle with the local society and ensures security, pleasant welcoming from auto/cab drivers, shop owners, employees of local government etc., and make the living easier and more comfortable.

Tips to learn the language with easy methods.

Apart from the conventional method of learning from teachers, the learning of language can be accelerated by adopting the following methods.

1. Love the learning without boredom.
2. Talk to classmates and others in Kannada without hesitation and with no concern to grammatical mistakes during the initial stages of learning the language.
3. Use English words to continue the conversation when you find difficulty in finding suitable Kannada word/s. Vocabulary improves with the use of language.
4. While reading, read aloud (not silently or in a whisper manner, but audibly so that others are not being disturbed or others can hear what is being read). Reading aloud not only helps proper/ correct pronunciation of words with variation in pitch, pace, volume, pauses etc., but also produces a fluent and enjoyable delivery during conversation/debate/presentation.
5. Listen to Kannada news and watch Kannada movies.
6. Listen to Kannada FM radios for news, live conversations and songs.
7. Use online applications (apps) for fast learning.

Easy learning of a Kannada Language: A few tips

1. Watching Kannada movies (preferably with subtitles), can be of great help. This is an important and entertaining way to improve your language skills.
2. Do not hesitate. Speak the language at every possible opportunity.
3. Never mind if you are using less Kannada and more English words. Kanglish is anyway popular in Bangalore. However constantly try to improve your Kannada vocabulary.
4. Watch Kannada news. This is not only helpful in learning the language, but will help you to know your city better.
5. If you are a user of public transport, carefully listen to co-passengers' conversations.
6. Enjoy the local tang of the language by listening to Kannada FM stations.
7. Do not completely rely on 'Learn Kannada in 30 days' type of books. Many Bangaloreans will fail to comprehend your textbook language and you are sure to face some embarrassment, if you go strictly by books.

Hints for correct and polite conservation

1. Be vigilant about the verbs, the pronouns, the genders and tense required for day to day Conversation.
2. Pronounce the words properly.
3. Use plural form to address others.
4. Use simple sentences for conversation.

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About Kannada Language (Kannada Bhashe)

- Kannada is one of the classical (Shastreeya) languages of India since November 01, 2008, and is the official language of the Karnataka state.
- This language is not just confined within the borders of Karnataka, for you will find it spoken by people in parts of the neighboring states of Andhra Pradesh, Tamil Nadu and Maharashtra. Kannada is spoken in its various dialects by Six to Seven million people across the globe. It is one among the top 40 most spoken languages of the world.
- Spoken Kannada is in use since 2500 years, and has its own script since 1900 years. Spoken Kannada varies according to the regions of Karnataka, while the written form of Kannada remains almost the same. Kannada is the third oldest language of India (after Sanskrit and Tamil).
- The written form of Kannada is phonetic and it is written as it is spoken.
- The first Kannada-English Dictionary (ShabdaKosha) was compiled in 1894 by a German priest, Rev. Ferdinand Kittel. He also wrote a book on Kannada Grammar entitled, "A Grammar of the Kannada Language: Comprising the Three Dialects of the Language".
- Several noted centuries old literary works of Kannada have been translated into Sanskrit, and other languages.
- November 1st of every year is celebrated as Kannada Rajyotsava Day throughout Karnataka state and is declared as a state holiday. This was the day that the name Karnataka was given to the Mysore state in the year 1973.

ಶುಭೋದಯ

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SEMESTER – IV

COURSE: Samskruthika Kannada

Subject Code	21KSK46	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
Credits	0	Examination Hours	-

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
- ಕನ್ನಡ ಭಾಷಾ ಬರಹದಲ್ಲಿ ಕಂಡುಬರುವ ದೋಷಗಳು ಹಾಗೂ ಅವುಗಳ ನಿವಾರಣೆ.
- ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆ ಸರ್ಕಾರಿ ಪತ್ರವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
- ಭಾಷಾಂತರ ಮತ್ತು ಪ್ರಬಂಧ ರಚನೆ ಬಗ್ಗೆ ಆಸಕ್ತಿ ಮೂಡಿಸುವುದು.
- ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕ

ಪರಿವಿಡಿ

ಭಾಗ – ಒಂದು ಲೇಖನಗಳು (ಕನ್ನಡ ನಾಡು, ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು)

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿಗೆ : ಪಂಪ ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ವಿಶಾವಿಯ ಆಡಳಿತ ಕನ್ನಡ ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನ

ಭಾಗ – ಎರಡು ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ)

೪. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರ ದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೫. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸ

ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯಶಾಳು ಮನವೆ – ಕನಕದಾಸ

೬. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಷರೀಫ

ಶಿವಯೋಗಿ – ಬಾಲಲೀಲಾ ಮಹಾಂತ ಶಿವಯೋಗಿ

೭. ಜನಪದ ಗೀತೆ : ಬೀಸುವ ಪದ, ಬಡವರಿಗೆ ಸಾವ ಕೊಡಬೇಡ

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ಭಾಗ – ಮೂರು ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ)

೮. ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ : ಡಿ.ವಿ.ಜಿ.

೯. ಕುರುಡು ಕಾಂಚಾಣ : ದ.ರಾ. ಬೇಂದ್ರೆ

೧೦. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು

೧೧. ಹೆಂಡತಿಯ ಕಾಗದ : ಕೆ.ಎಸ್. ನರಸಿಂಹಸ್ವಾಮಿ

೧೨. ಮಜ್ಜನಿಂದ ಮಜ್ಜಿಗೆ : ಜಿ.ಎಸ್. ಶಿವರುದ್ರಪ್ಪ

೧೩. ಆ ಮರ ಈ ಮರ : ಚಂದ್ರಶೇಖರ ಕಂಬಾರ

೧೪. ಜೋಮನ ಮಕ್ಕಳ ಹಾಡು : ಸಿದ್ಧಲಿಂಗಯ್ಯ

ಭಾಗ – ನಾಲ್ಕು ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

೧೫. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ – ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ : ಎ ಎನ್ ಮೂರ್ತಿರಾವ್

೧೬. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

೧೭. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ

ಭಾಗ – ಐದು ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ

೧೮. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರಿಗೌಡ ಬೀಚನಹಳ್ಳಿ

೧೯. 'ಕ' ಮತ್ತು 'ಬ' ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು ಕನ್ನಡದ ಟೈಪಿಂಗ್'

೨೦. ಕನ್ನಡ – ಕಂಪ್ಯೂಟರ್ ಶಬ್ದಕೋಶ'

೨೧. ತಾಂತ್ರಿಕ ಪದಕೋಶ : ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು'

'(ಎತಾವಿ ಯ ಆದಳಿತ ಕನ್ನಡ ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನಗಳು – ಡಾ. ಎಲ್. ಶಿಮ್ಲೇಶ ಮತ್ತು ಪ್ರೋ.ವಿ.ಕೇಶವಮೂರ್ತಿ)

ಸಂಪುಟ

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SEMESTER – IV

COURSE: Constitution of India and Professional Ethics (CIP)

Course Code	**21CIP46**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0 : 2 : 0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**02 Hours/Week**	**Total Marks**	**100**
No. of Credits	**01**	**Examination Hours**	**01 Hours**

Course Objectives:

CLO1	To know about the basic structure of Indian Constitution.
CLO2	To know the Fundamental Rights (FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
CLO3	To know about our Union Government, political structure & codes, procedures.
CLO4	To know the State Executive & Elections system of India.
CLO5	To learn the Amendments and Emergency Provisions, other important provisions given by the constitution

Content	**No. of Hours**
Module 1 **Introduction to Indian Constitution:** The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly. The Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.	**03 Hours**
Module 2 **FR's, FD's and DPSP's:** Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building	**03 Hours**
Module 3 **Union Executive :** Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.	**03 Hours**
Module 4 **State Executive & Elections, Amendments and Emergency Provisions:** State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (How and Why) and Important Constitutional Amendments till today. Emergency Provisions	**03 Hours**
Module 5 **Professional Ethics:** Ethics & Values. Types of Ethics. Scope & Aims of Professional & Engineering Ethics. Positive and Negative Faces of Engineering Ethics. Clash of Ethics, Conflicts of Interest. The impediments to Responsibility, Trust & Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.	**03 Hours**

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COURSE OUTCOMES: Upon completion of this course, student will be able to

CO1	Analyse the basic structure of Indian Constitution
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution.
CO3	know about our Union Government, political structure & codes, procedures.
CO4	Understand our State Executive & Elections system of India.
CO	Remember the Amendments and Emergency Provisions, other important provisions given by the constitution.

Textbooks:

1."Constitution of India" (for Competitive Exams) - Published by Naidhruva Edutech Learning Solutions, Bengaluru. – 2022
2. Engineering Ethics", M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Prentice –Hall, 2004

Reference Books:

1."Samvidhana Odu" - for Students & Youths by Justice HN Nagamohan Dhas, Sahayana, kerekon.
2. "Constitution of India, Professional Ethics and Human Rights" by Shubham Singles, Charles E. Haries, and et al: published by Cengage Learning India, Latest Edition – 2019.
3."Introduction to the Constitution of India", (Students Edition.) by Durga Das Basu (DD Basu): Prentice –Hall, 2008.
4. "The Constitution of India" by Merunandan K B: published by Merugu Publication, Second Edition, Bengaluru

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than
35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks **(duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

Total CIE : IA 20*3=60, Assignment 10+10=20, Quiz 20 = 100 /2 = 50

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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Semester End Examination:

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 02 hours)**

1. The question paper will have 50 questions. Each question is set for 01 mark.
2. Semester End Exam (SEE) Pattern will be in MCQ Model (Multiple Choice Questions) for 50 marks (60 minutes duration).

Suggested Learning Resources:

Textbook:

1. **"Constitution of India"** (for Competitive Exams) - Published by Naidhruva Edutech Learning Solutions, Bengaluru. – 2022.
2. **"Engineering Ethics",** M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Prentice –Hall, 2004.

Reference Books:

1. **"Samvidhana Odu"** - for Students & Youths by Justice HN Nagamohan Dhas, Sahayana, kerekon.
2. **"Constitution of India, Professional Ethics and Human Rights"** by Shubham Singles, Charles E. Haries, and et al: published by Cengage Learning India, Latest Edition – 2019. 3. **"Introduction to the Constitution of India"**, (Students Edition.) by Durga Das Basu (DD Basu): Prentice –Hall, 2008.
4. **"The Constitution of India"** by Merunandan K B: published by Merugu Publication, Second Edition, Bengaluru.

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SEMESTER – IV

COURSE: ABILITY ENHANCEMENT COURSE – II

Introduction to Artificial Intelligence and Machine Learning

Course Code	**21ANE471**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of AI and ML in broad domain of Aeronautical Engineering by making them to learn:

CO1	To understand about the basics of Data science, AL and ML.
CO2	Acquire knowledge methods and models in ML
CO3	Understand Programming and trends in ML
CO4	Know about basics of AI

Content	No. of Hours/ RBT levels
MODULE 1 **INRODUCTION:** Introduction to Data Science and AI & ML, Data Science, AI & ML	**02 Hours L2**
MODULE 2 **MACHINE LEARNING:** Linear Methods, Linear Regression, Forecasting models.	**02 Hours L2**
MODULE 3 **MODEL AND PROGRAMMING:** Probabilistic Models, Dynamic programming and Reinforcement Programming.	**02 Hours L2**
MODULE 4 **FOUNDATIONS FOR AI:** Foundations for AI, AI Basics , AI Classification, Supervised Learning.	**02 Hours L2**
MODULE 5 **USE OF PYTHON AND R:** Introduction to ML with R and using Python, Python and R for Artificial Intelligence	**02 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Outline the basics of data science, AI & ML
CO2	Understand the basics of different models of machine learning.
CO3	Discuss programming and use of different models.
CO4	Discuss AI classification and supervised learning.
CO5	Use of Python and R language for ML and AI.

Textbooks:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A modern Approach (3rd edition).
2. Deepak Khemani.A First Course in Artificial Intelligence, McGraw Hill Education (India),

2013.
3. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.

Reference books:

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.
3. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER – IV

COURSE: Inter/Intra Institutional Internship

Course Code	21INT48	CIE Marks	100
Hours/Week (L: T: P)	0:0:2	SEE Marks	-
No. of Credits	2	Examination Hours	-

Inter/Intra Institutional Internship

All the students admitted to III year of BE/B. Tech shall have to undergo mandatory Inter/Intra Institutional internship of 2 weeks during the vacation of the semesters.

Internship examination shall be conducted during semester end and the prescribed credit shall be included semester end . Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

Course Outcomes

CO1	Analyze and review various research papers to identify Aeronautical related topic
CO2	Understand new trends in Aeronautical field having cutting edge technologies in the selected topic
CO3	Impart skills in preparing detailed report describing the topic and results
CO4	Able to summarize the industrial Exposure and practices
CO5	Able to communicate technical information by means of ethical writing and presentation.

CIE procedure for Internship:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Internship shall be based on the evaluation of Internship report, presentation skill and question and answer session in the ratio 50:25:25.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
Grand Total			**100**

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

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V Semester Syllabus

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SEMESTER -V

COURSE: CONTROL ENGINEERING AND MICROPROCESSOR

Course Code	**21ANE51**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Nil

Course Objectives: To enable students to apply the knowledge of Control engineering in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Open And Closed Loop Systems, Feedback Control systems and Mathematical Models.
CLO2	Transfer Functions, Block Diagrams and Signal flow graphs
CLO3	System stability and types of controllers
CLO4	Basics about linear and digital IC's
CLO5	Architecture of Microprocessor and its application

Content	No. of Hours/RBT levels
Module 1 **INTRODUCTION TO CONTROL SYSTEMS AND MATHEMATICAL MODELS** Introduction: Concept of system and its types, control system- Open loop and closed loop systems with examples, Concepts of feedback and basic structure of feedback control system. Mathematical Models**:** DC and AC motors in control systems, Transfer functions definition and its properties - Transfer function models of mechanical systems, electrical circuits -Analogous systems: Force voltage and Force current analogy, Torque voltage and Torque current.	**08 Hours / L3**
Module 2 **BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS** Block representation of control systems and terminologies, block diagram algebra and reduction of block diagrams, Signal flow graph method, Mason's gain formula and its applications.	**08 Hours / L3**
Module 3 **STABILITY AND CONTROL** Introduction to Time response , frequency response - System stability analysis using Routh's – Hurwitz Criterion, Root locus, Bode plot .	**08 Hours / L4**
Module 4 **LINEAR AND DIGITAL IC'S:** Comparison Between Analog and Digital Systems ,Number representation, Full/Half adder,Multiplexers- Demultiplexers - Decoders – Encoders. Digital controllers and its types, application-Compensators	**08 Hours / L4**
Module 5 **MICROPROCESSORS:** Architecture of Intel 8085- Instruction Formats - Addressing Modes - Simple Assembly Language Programs - Architecture andFunctioning of Intel 8086 Processor - Instruction Formats – Addressing Modes. Microprocessor Applications in aerospace	**08 Hours / L4**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Comprehend the open loop & closed loop systems and Mathematical Models.
CO2	Solve the complex physical systems using Block diagrams and Signal Flow Graphs and obtain Transfer function
CO3	Apply the feedback control systems for stability and Controllers
CO4	Summarize the basic knowledge on Linear and Digital ICs.
CO5	Outline the architectures of Microprocessor and its application

Textbooks:

1. Control Engineering- U.A. Bakshi and V.U. Bakshi, Technical Publications Autar Kaw,
2. Control Systems Engineering, A. NagoorKani, RBA Publications 2014 edition,2006.

Reference books:

1. Modern Control Engineering, Katsuhiko Ogatta, Pearson Education 2004
2. Control Systems Engineering, I.J. Nagrath and M. Gopal, New Age Publishers 2017
3. Modern Control Systems, Richard. C. Dorf and Robert.H. Bishop Addison Wesley 1999

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER -V

COURSE: AIRCRAFT STRUCTURS-II

Course Code	**21ANE52**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aircraft structural mechanics

Course Learning Objectives: To enable students to apply the knowledge of Aircraft Structural Analysis in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Assess the Bending stresses in thin walled beams
CLO2	Analyze the Shear Flow in open and closed beams
CLO3	Evaluate the forces on Joints and fittings
CLO4	Apply the Structural Idealization to various structural components of an aircraft
CLO5	Analyze the stresses in wings and fuselage structures

Content	**No. of Hours/RBT levels**
Module 1 **BENDING OF OPEN AND CLOSED THIN WALLED BEAMS** Symmetrical bending, unsymmetrical bending, direct stress distribution due to bending, position of the neutral **axis**, load intensity, shear force, and bending moment relationships, deflection due to bending, calculation of section properties, approximation for thin-walled sections.	**08Hours/ L3**
Module 2 **SHEAR FLOW IN OPEN SECTIONS** Thin walled beams, Concept of shear flow, shear centre, Elastic axis. With one axis of symmetry, with wall effective and **ineffective** in bending, unsymmetrical beam sections. **SHEAR FLOW IN CLOSED SECTIONS** Bredt – Batho formula, Single and multi – cell structures, approximate methods. Shear flow in single and multi-cell under bending -with walls effective and ineffective.	**08 Hours/ L3**
Module 3 **JOINTS AND FITTINGS** Bolted or riveted joints, accuracy of fitting analysis, eccentrically loaded connections, welded joints, and concept of effective width.	**08 Hours/ L3**
Module 4 **STRUCTURAL IDEALIZATION:** Structural idealization Principle, Idealization of a panel, effect of idealization on the analysis of open and closed section beams. Bending of open and closed section idealized beams, shear of open section and closed section idealized beams.	**08 Hours / L3**

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Module 5 **STRESS ANALYSIS IN WING SPARS AND BOX BEAMS:** Tapered wing spar, open and closed section beams, beams having variable stringer areas, three- boom shell, tapered wings, cut-outs in wings. **STRESS ANALYSIS IN FUSELAGE FRAMES:** Bending, shear, torsion, cut-outs in fuselages, principles of stiffeners construction, fuselage frames, shear flow distribution.	**08 Hours / L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Analyze the Direct bending stresses in open and closed sections.
CO2	Analyze the shear flow in open and closed sections.
CO3	Evaluate the loads on riveted joints and welded joints
CO4	Applying idealization concepts to simplify complex structural sections to understand how they behave, under given loading conditions.
CO5	Analyze the stresses in wings and fuselage structures

Textbooks:

1. T.M.G Megson, Aircraft Structures for Engineering Students, Edward Arnold, 44th Edition, 1995.
2. Peery, D.J., and Azar, J.J, Aircraft Structures, McGraw– Hill, N.Y., 2nd edition, 1993

Reference books:

1. Bruhn. E.H, Analysis and Design of Flight Vehicles Structures, Tristate off set company, USA, 1985.
2. Rivello, R.M, Theory and Analysis of Flight Structures, McGraw- Hill, 1993.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks. Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER -V

COURSE: AERO PROPULSION -II

Course Code	**21ANE53**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

CLO1	The basic functions and challenges in design and development of ramjet and scramjet engines
CLO2	The classification and fundamentals of rocket propulsion and their systems
CLO3	The design and development of solid rocket propulsion and their applications
CLO4	The different types of liquid propellants, their merits and demerits. Development of hybrid rocket and their applications
CLO5	The elementary principles of electric rockets, their types, functions and future rocket engines

Course Learning Objectives: To enable students to apply the knowledge of Rocket Propulsion in broad domain of Aeronautical Engineering by making them to learn:

CONTENT	**No. of Hrs /RBT Levels**
MODULE-1 **RAMJET AND SCRAMJET** Operating Principles of ramjet engine, ramjet components and their functions, modes of inlet operations, combustion in ramjet, design of ramjet, performance characteristics. Introduction to scramjet, need for supersonic combustion, problems associated with supersonic combustion salient features of scramjet engine and its applications, Numerical problems	**10 Hours L1, L2**
MODULE-2 **FUNDAMENTALS OF ROCKET PROPULSION** History of rocket engines, basic principles of rocket propulsion, types of rocket engines, applications of rocket, ideal rocket engine, thrust equation, rocket nozzle classifications, performance parameters, staging in rockets, Numerical problems	**8 Hours L2,L3**
MODULE-3 **SOLID ROCKET PROPULSION** Solid propellant rocket, Selection criteria of solid propellants, burning rate of propellants, propellant grain design considerations, erosive burning, homogeneous propellants, heterogeneous propellants, igniters, types of igniters, Numerical problems	**8 Hours L2,L3**
MODULE-4 **LIQUID ROCKET PROPULSION** Liquid propellant rocket, monopropellants, bipropellants, selection of liquid propellants, liquid fuels and oxidizers, types of feed systems for liquid rockets, thrust control in liquid rockets, cooling in liquid rockets, hybrid propulsion, limitations of hybrid propulsion, Numerical Problems	**8 Hours L2,L3**

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MODULE-5 **NONCHEMICAL ROCKET ENGINE** Principles of electrical rocket engine, Classifications of electrical rockets, Electrothermal thrusters, Electrostatic thrusters, Electromagnetic thrusters, Nuclear rocket engines, Solar energy rockets, Numerical Problems	**8 Hours** **L2,L3**

Laboratory Exercises

S.N	LIST OF EXPERIMENTS	RBT levels
1.	Study of an aircraft piston engine.	L4
2.	Study of an aircraft jet engine	L4
3.	Study of free convective heat transfer over a flat plate	L4
4.	Study of forced convective heat transfer over a flat plate	L4
5.	Determination of Performance characteristics of a propeller	L4
6.	Flame Stabilization Studies using the conical flame holder	L4
7.	Measurement of the Burning velocity of a Premixed flame	L4
8.	Principle of Operation of Supersonic Jet Test rig	L4
9.	Wall pressure measurements in subsonic Nozzle	L4
10.	Wall pressure measurements in the supersonic Nozzle	L4
11.	Pressure decay of subsonic free jet	L4
12.	Pitot pressure study of an Over Expanded jet	L4
13.	Pitot pressure study of a correctly Expanded jet	L4
14.	Pitot pressure study of an under Expanded jet	L4
15.	Effect of Tabs on supersonic free jet	L4

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Outline the functions and challenges in design and development of ramjet and scramjet engines
CO2	Develop and demonstrate an rocket propulsion and their systems
CO3	Build an solid rocket and to examine their propellants and thrust performance.
CO4	Categorize the liquid propellants based on their merits and demerits for a selected mission profile
CO5	Model and exhibit an apposite electric rocket system based the mission requirements

Textbooks:

1. George P. Sutton and Oscar Biblarz, "Rocket propulsion elements", John Wiley & Sons Inc., Hoboken, New Jersey, 2017
2. D.P Mishra, "Fundamentals of Rocket Propulsion", CRC Press, Taylor & Francis Group, 2017

Reference books:

1. K Ramamurthi, “Rocket propulsion”, Macmillan publishers india ltd, 2010.
2. William J. Emrich Jr., “Principles of Nuclear Rocket Propulsion”, second edition, Butterworth Heinemann publications, 2023.
3. By Stephen D. Heister, William E. Anderson, Timothée L. Pourpoint, Joe Cassady, R. Joseph Cassady, "Rocket Propulsion”, Cambridge university press, 2019

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Web references/ Additional online information (related to module if any):
https://archive.nptel.ac.in/courses/101/106/101106082/
https://archive.nptel.ac.in/courses/112/106/112106073/
Practical knowledge references

https://study.com/academy/lesson/rocket-propulsion-definition-principles.html
https://spectra.mhi.com/rocket-engines-the-history-future-of-a-test-facility
https://www.grc.nasa.gov/www/k-12/rocket/TRCRocket/rocket_principles.html

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE-on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2		
	CIE Test-3		
	Laboratory	**20**	
SEE	Semester End Examinatio	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER -V

COURSE: RESEARCH METHODOLOGY

Course Code	**21ANE55**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: NIL

Course Objectives: To enable students to apply the knowledge of Research Methodology in broad domain of aeronautical engineering by making them to learn:

CLO1	To make the student understand the foundations of Research and problem solution
CLO2	Knowledge in Research design, Qualitative and Quantitative Research
CLO3	Knowledge to formulate and derive static and dynamic aero elastic equations of motion.

Content	No. of Hours/RBT levels
Module 1 **RESEARCH METHODOLOGY:** Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **DEFINING THE RESEARCH PROBLEM:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration	**10 Hours/ L3**
Module 2 **REVIEWING THE LITERATURE:** Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed. **RESEARCH DESIGN**: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs	**08 Hours/ L3**
Module 3 **DESIGN OF SAMPLE SURVEYS:** Design of Sampling: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **MEASUREMENT AND SCALING:** Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. **DATA COLLECTION:** Introduction, Experimental and	**08 Hours/ L3**

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Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	
Module 4 **TESTING OF HYPOTHESES:** Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. **CHI-SQUARE TEST:** Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests	**08 Hours/ L3**
Module 5 **INTERPRETATION AND REPORT WRITING:** Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. **INTELLECTUAL PROPERTY**: The Concept, Intellectual Property System in India, Different types of IPR	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the research problem
CO2	Define the research problem on the context of contemporary issues and progress in the field
CO3	Develop skills in qualitative and quantitative data analysis and presentation.
CO4	Develop advanced critical thinking skills.
CO5	Comprehend the report writing and awareness about IPR

Textbooks:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

Reference books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p,Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examinatio	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – V

COURSE: DRONE TECHNOLOGY

Course Code	**21ANE561**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Objectives: To enable students to understand the drone and its functioning

CLO1	To Identify & select different types of drones, drone rules and regulations
CLO2	Select different drone parts and to understand aerodynamics
CLO3	Understand BLDC motors and different type of batteries
CLO4	Understand different sensors ,Flight Control System and mission planning

Content	No. of Hours/ RBT levels
Module 1 **Introduction:** Different types of Drones, Nomenclatures, History of aerial drones, reputation, airframe, Configurations, basic components, current/future uses of drones. DGCA regulations	**08 Hours L1, L2**
Module 2 **Air vehicle and Propulsion system:** Basics of aerodynamics**,** Introduction to different electric motors like DC, BLDC, servo motors, working, understanding its functioning, speed torque characteristics, degree of freedom in drone. Introduction Electronic Speed Controller. Performing payload calculation, speed control techniques, thrust to weight ratio.	**08 Hours L1, L2**
Module 3 **Battery System:** Introduction of different types of batteries used in drone. Understand different specifications and their significance of batteries. Different charging circuits or batteries, battery management system (BMS) and Building Blocks of BMS.	**08 Hours L1, L2**
Module 4 **Sensors:** Introduction of different sensors used in drone like accelerometers, inertial measurement units, tilt and lidar sensor, gyro sensor. Principle of operation, their roles and characteristics. Selection of appropriate sensor as per requirement. Introduction to Flight controller system	**08 Hours L1, L2**

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Module 5	
Mission Planning and Control: Mission planning of Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Tradavionics e-offs, Current trends/ Technologies	**08 Hours L1, L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Identify different types of drones and drone rules and regulations
CO2	Explain the forces acting on Drone during flight
CO3	Comprehend the Drone propulsion and battery system
CO4	Describe different sensors and Flight Control System
CO5	Differentiate the various launch and recovery systems

Textbooks:

1. The Drone Rules, 2021. The Gazette of India: Extraordinary [Part II—Sec. 3(i)].
2. John Baichtal "Building Your Own Drones" A Beginner's Guide to Drones, UAVs, and ROVs Que Publishing, ISBN - 9780789755988
3. Julio Alberto Mendoza "Drones to Go" A Crash Course for Scientists and Makers, Apress ISBN-978-1-4842-6787-5

Reference books:

1. Paul Gerin Fahlstrom, Thomas James Gleason, Introduction to UAV Systems, Wiley Publication John Wiley & Sons, Ltd, 4th Edition 2012.
2. Landen Rosen, Unmanned Aerial Vehicle, Alpha Editions, N.Y., 2012
3. Valavanis, Kimon P, Unmanned Aerial Vehicles, Springer, 2011.
4. Valavanis, K., Vachtsevanos, George J, Unmanned Aerial Vehicles, Springer, 2015.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping														
CO/PO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	-	-	-	1	1	-	-	-	1	1	-
CO2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	1	-	-	-	-	-	1	-	-	-	-	1	1	-
CO4	1	-	-	-	-	-	1	-	-	-	-	1	1	-
Average	1						1	1				1	1	

Low-1: Medium-2: High-3

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SEMESTER-V

COURSE: ENVIRONMENTALSCIENCE

Course Code	**21CIV57/67**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**1 hour**

Pre requisite: NIL

Course Learning Objectives: To enable students to apply the knowledge of Environmental science in daily life:

CLO1	The fundamentals of environmental science
CLO2	The types of natural resources
CLO3	Various global environmental concerns
CLO4	The types of wastes generated and their handling at a basic level
CLO5	The environmental law and policies with a few important acts in the field

CONTENT	**No. of Hours/RBT levels**
Module 1 **Environment:** Definition, scope & importance components of environmental eco system: Structure and function of various types of eco systems. Human activities- Food, Shelter, Economic and Social security. Population- Growth, variation among nations- population explosion and impact on environment. **Biodiversity:** Types, value; Hot-spots; Threats and Conservation of Biodiversity, Forest Wealth and Deforestation.	**04Hours/ L2**
Module 2 **Natural Resources:** Forest, Water, Mineral, Food, Energy, Land **Environmental Pollution-**Definition-causes, effects and control measures of (a) Air pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear hazards	**04Hours/ L2**
Module 3 **Global Environmental Concerns:** (concepts, policies and case-studies): Ground water depletion/recharging, Climate change, Acid rain, Ozone depletion. Radon and Fluoride problem in drinking water; Resettlement and Rehabilitation of people, Environmental Toxicology.	**04 Hours/ L2**

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Module 4 **Sources:** Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Solid waste management rules in India. Sources and management of E-waste, Biomedical waste, Hazardous waste and construction waste at individual and community level. Socio-economic aspect of waste management**.**	**04 Hours/ L2**
Module 5 **Latest development in Environmental Pollution Mitigation Tools (Concept of Applications):** Environmental impact assessment, Environmental Management systems, ISO14001; Environmental stewardship- NGOs.	**04 Hours/ L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand holistically the key concepts of "Environment and Biodiversity"
CO2	Understand the types of Natural resources available and the effects of anthropogenic interventions.
CO3	Understand the gravity of various Global concerns
CO4	Understand the types of waste generated and their handling at a basic level.
CO5	Understand the importance of environmental law and policies.

Textbooks:

1. Benny Joseph, Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006
2. Gilbert M Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2006.

Reference books:

1. Rajagopalan R, "Environmental Studies-From Crisis to Cure", Oxford University press, 2005.
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT LTD, Delhi, 2014.
3.

Web References:

1. https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
3. https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Scheme of Examination:

Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.

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Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
21CIV57.1/67.1	2	-	-	-	-	-	3	-	-	-	-	-	1	-	-
21CIV57.2/67.2	2	1	-	-	-	-	3	-	-	-	-	1	1	-	1
21CIV57.3/67.3	2	-	2	-	-	2	3	1	-	-	-	1	1	-	1
21CIV57.4/67.4	2	2	-	-	-	2	3	-	-	-	-	-	-	-	1
21CIV57.5/67.5	2	-	-	-	-	2	3	-	-	-	-	-	-	1	1
Average	**2**	**1.5**	**2**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

Low-1: Medium-2: High-3

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SEMESTER -V

COURSE: UNIVERSAL HUMAN VALUES

Course Code	**21UHV57/67**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**1 hour**

Course Objectives:

CLO1	To create an awareness on Engineering Ethics and Human Values.
CLO2	To understand social responsibility of an engineer.
CLO3	To appreciate ethical dilemma while discharging duties in professional life.

Content	No. of Hours
Module 1 **INTRODUCTION TO VALUE EDUCATION** Value Education, Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education. Self-exploration as a means of Value Education. Happiness and Prosperity as parts of Value Education.	**05 Hours**
Module 2 **HARMONY IN THE HUMAN BEING** Human Being is more than just the Body. Harmony of the Self ('I') with the Body. Understanding Myself as Co-existence of the Self and the Body. Understanding Needs of the Self and the needs of the Body. Understanding the activities in the Self and the activities in the Body.	**05 Hours**
Module 3 **HARMONY IN THE FAMILY AND SOCIETY AND HARMONY IN THE NATURE** Family as a basic unit of Human Interaction and Values in Relationships. The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour. Harmony in Nature: The Four Orders in Nature. The Holistic Perception of Harmony in Existence.	**05 Hours**

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Module 4	05 Hours
SOCIAL ETHICS The Basics for Ethical Human Conduct. Defects in Ethical Human Conduct. Holistic Alternative and Universal Order. Universal Human Order and Ethical Conduct. Human Rights violation and Social Disparities.	
Module 5	**05 Hours**
PROFESSIONAL ETHICS Value based Life and Profession. Professional Ethics and Right Understanding. Competence in Professional Ethics. Issues in Professional Ethics – The Current Scenario. Vision for Holistic Technologies, Production System and Management Models.	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3	Understand the role of a human being in ensuring harmony in society and nature.
CO4	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

Textbooks:

1. A.N Tripathy, New Age International Publishers, 2003.
2. Bajpai. B. L, New Royal Book Co, Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Corliss Lamont, Philosophy of Humanism Gaur. R.R. , Sangal. R, Bagari G.P, A Foundation Course in Value Education, Excel Books, 2009.
4. Gaur. R.R. , Sangal R , Bagaria G.P, Teachers Manual, Excel Books, 2009.
5. I.C. Sharma, Ethical Philosophy of India, Nagin & co, Julundhar William Lilly- Introduction to Ethics -Allied Publisher

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Scheme of Examination:

Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.

Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

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

Low-1: Medium-2: High-3

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SEMESTER -V

COURSE: AIRCRAFT STRUCTURES LAB

Course Code	**21ANEL58**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Objectives:

CLO1	To understand the behavior of beams under different loading conditions
CLO2	To understand about different loads buckling and shear load
CLO3	To understand about fundamental frequency under vibrational load

S.N	LIST OF EXPERIMENTS	RBT levels
1.	Deflection of a Simply Supported, Cantilever, Fixed and Continuous Beam	L4
2.	Verification of Maxwell's Reciprocal Theorem.	L4
3.	Determination of Young's Modulus and Poisson's Ratio	L4
4.	Verification of Superposition Theorem	L4
5.	Buckling load of slender Eccentric Columns and Construction of South well Plot	L4
6.	Determination of forces in the Truss structure	L4
7.	Determination of Unsymmetrical Bending stresses	L4
8.	Determination of fundamental frequency of a cantilever beam and harmonics and Frequency spectrum analysis for a cantilever beam.	L4
9.	Determination of Shear Centre for open section and Closed section	L4
10.	Composite hand layup/ Vacuum Bagging process	L4
11.	Determining the stress patterns and stress concentration using Photo elastic apparatus	L4
12.	Determining the stress, strain in Constant Strength Beam	L4

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Calculate the deflections of simply supported beams and cantilever beams.
CO2	Apply Maxwell reciprocal theorem and superposition theorem for simply supported beam and cantilever beam respectively.
CO3	Find the buckling load of the column for fixed and hinged conditions by applying South Well's theorem.
CO4	Fabricate the composite using hand layup/Vacuum bagging process
CO5	Examine frequency spectrum analysis of cantilever beam.

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Scheme of Examination:

Semester End Examination (SEE): Distribution of weightage for SEE of Regular courses

	Component	Marks	Total Marks
SEE	PART- A	**20**	**50**
	PART- B	**20**	
	VIVA-VOCE	**10**	
SEE Total			**50**

Continuous Internal Evaluation (CIE): Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	MANUAL / RECORD	**20**	**50**
	CIE Test-1	**20**	
	VIVA-VOCE	**10**	
CIE Total			**50**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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PROGRAM ELECTIVE 1
SEMESTER -V

COURSE: AIRCRAFT MATERIALS AND MANUFACTURING

Course Code	**21ANE541**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Aircraft Materials and Production in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Learn about engineering materials and phase diagram
CLO2	Know about casting and welding process
CLO3	Familiarize with the sheet metal and riveting process
CLO4	To study about conventional and modern manufacturing processes
CLO5	Use of composite materials in aircraft industries

Content	No. of Hours/RBT levels
Module 1 **AIRCRAFT ENGINEERING MATERIALS:** Engineering materials Steels, Solid solutions, Binary phase diagrams, study of iron, iron carbon phase diagram, heat treatment, annealing, normalizing, hardening and tempering of Aluminum and steel, Non-Ferrous metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys.	**08 Hours/ L2**
Module 2 **CASTING, WELDING AND INSPECTION TECHNIQUES:** General principles of various casting processes Sand casting, die-casting, centrifugal casting, investment casting, Shell molding types; Principles and equipment used in arc welding, gas welding, resistance welding, solid, laser welding, and electron beam welding, soldering and brazing techniques.	**08 Hours/ L2**
Module 3 **SHEET METAL PROCESSES IN AIRCRAFT INDUSTRY**: Sheet metal operations: shearing, punching, super plastic forming; operations in bending like stretch forming spinning drawing. Riveting, types and techniques, equipment, fasteners, integral tanks, Jigs and Fixtures.	**08 Hours/ L2**
Module 4 **CONVENTIONAL AND MODERN MANUFACTURING PROCESSES:** General working principles, applications and operations of lathe, shaper, milling machines, grinding, drilling machine, computer numeric control machining. Working principles and applications of abrasive jet machining, ultrasonic machining, Electric discharge machining and electro chemical machining, laser beam, electron beam, plasma arc machining. Rapid prototyping, Additive manufacturing process.	**08 Hours/ L2**

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Module 5	
INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification of composite materials, classification of reinforcement - particulate, short fiber, whiskers, long fibers composites. matrix materials – metals, ceramics, polymers (including thermoplastics and thermosets), Carbon-Carbon Composites Metal. **MATRIX COMPOSITES:** MMC with particulate and short fiber reinforcement, liquid and solid state processing of MMC – stir casting, squeeze casting. Properties of MMCs, Applications of Al, Mg, Ti based MMC. **PROCESSING OF POLYMER MATRIX COMPOSITES:** Thermoset Polymers, Hand layup Process, Vacuum Bagging Process, Post Curing Process, Filament winding, Pultrusion, Autoclave Process, VARTM, resin film infusion	**08 Hours/ L2**

COURSE OUTCOMES: Upon completion of this course, student will be able to:

CO1	Understand about the basics of phase diagrams, equilibrium diagrams.
CO2	Describe the basics of manufacturing processes, patterns, properties of molding sands.
CO3	Explain about the importance of various materials for aircraft industry
CO4	Comprehend the various conventional and modern manufacturing processes
CO5	Understand the need of composite materials for aircraft industries

Textbooks:

1. S. Kalpakjian, Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley, 5th Edition, 1991.
2. S. C. Keshu, K. K Ganapathy, "Aircraft production technology and management", Interline Publishing House, Bangalore, 3rd Edition, 1993.
3. Douglas F. Horne – "Aircraft production technology" – Cambridge University Press, 1st Edition,1986.

Reference books:

1. R. K. Jain, "Production technology", McGraw Hill, 1st Edition, 2002.
2. O. P. Khanna, M. Lal, "Production technology", Dhanpat Rai Publications, 5th Edition, 1997

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – V

Program Elective 1

COURSE: AIRCRAFT SYSTEMS AND INSTRUMENTATION

Course Code	**21ANE542**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

COURSE LEARNING OBJECTIVES: To enable students to apply the knowledge of aircraft systems and instrumentation in broad domain of aeronautical engineering by making them to learn:

CLO1	To provide the knowledge on the aircraft control systems.
CLO2	learn about the aircraft systems
CLO3	Acquire the knowledge of aircraft engine systems
CLO4	To provide the basic knowledge of Aircraft auxiliary systems
CLO5	Acquire the knowledge on aircraft and air data instruments.

Content	No. of Hours/ RBT levels
Module 1 **AIRCRAFT CONTROL SYSTEMS:** Conventional Systems, fully powered flight controls, Power actuated systems, Modern control systems, Digital fly by wire systems, Auto pilot system active control Technology.	**08 Hours/ L2**
Module 2 **AIRCRAFT SYSTEMS:** Hydraulic systems, Study of typical workable system, components, Pneumatic systems, **Advantages**, Working principles, Typical Air pressure system, Brake system, Typical Pneumatic power system, Components, Landing Gear systems, Classification.	**08 Hours/ L2**
Module 3 **ENGINE SYSTEMS:** Fuel systems for Piston and jet engines, Components of multi engines. lubricating **systems** for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.	**08 Hours/ L2**
Module 4 **AUXILIARY SYSTEM**: **Basic** Air cycle systems, Vapour Cycle systems, Evaporative vapor cycle systems, Evaporative air cycle systems, Fire protection systems, Deicing and anti-icing systems.	**08 Hours/ L2**
Module 5 **AIRCRAFT INSTRUMENTS**: Flight Instruments and Navigation Instruments, Gyroscope, Accelerometers, Air speed **Indicators**, TAS, EAS, Mach Meters, Altimeters, Principles and operation, Study of various types of engine instruments, Tachometers, Temperature gauges, Pressure gauges, Operation and Principles.	**08 Hours/ L2**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Distinguish the conventional and modern control systems.
CO2	Classify the aircraft systems.
CO3	Categorize different types of aircraft instruments.
CO4	Comprehend the engine and fuel systems
CO5	Understand the basic flight and air data instrumentation

Textbooks:

1. Ian Moir and Allan Seabridge, " Aircraft Systems: Mechanical, Electrical and Avionics- Subsystem Integration ", Wiley India Pvt Ltd, 3rd edition, 2012.
2. Pallet, E.H.J, "Aircraft Instruments and Integrated Systems ", Longman Scientific and Technical Institute, 1996.

Reference books:

1. Lalit Gupta and OP. Sharma, "Aircraft Systems (Fundamentals of Flight Vol. IV) Himalayan Books 2006.
2. R.W. Sloley and W.H. Coulthard, "The aircraft Engineers Handbook, No4, Instruments", 6th Edition, 2005.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – V

Program Elective 1

COURSE: COMPOSITE MATERIALS AND STRUCTURES

Course Code	**21ANE543**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Materials and Manufacturing Process **Course Objectives:** To enable students to apply the knowledge of Composite Materials and Structures in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Understand the behavior of constituents in the composite materials and its applications
CLO2	Understand the various manufacturing processes of Composite materials
CLO3	Apply constitutive equations of composite materials and understand mechanical behavior at micro level.
CLO4	Evaluate the elastic stresses and strains in composites considering different laminate configurations
CLO5	Inspection & Quality Control, Applications of composites in different fields of engineering.

Content	**No. of Hours/RBT levels**
Module 1 **INTRODUCTION TO COMPOSITE MATERIALS:** Definition, classification of composite materials, classification of reinforcement - particulate, short fiber, whiskers, long fibers composites. matrix materials – metals, ceramics, polymers (including thermoplastics and thermosets), Carbon-Carbon Composites Metal. **MATRIX COMPOSITES:** MMC with particulate and short fiber reinforcement, liquid and solid state processing of MMC – stir casting, squeeze casting. Properties of MMCs, Applications of Al, Mg, Ti based MMC.	**08 Hours / L2**
Module 2 **PROCESSING OF POLYMER MATRIX COMPOSITES:** Thermoset Polymers, Hand layup Process, Vacuum Bagging Process, Post Curing Process, Filament winding, Pultrusion, Autoclave Process, VARTM, resin film infusion. **PROCESSING OF POLYMER MATRIX COMPOSITES:** Thermoplastic Polymers, Extrusion process, Injection Moulding Process, Thermo-forming process. Post Processing of Composites – Adhesive bonding, drilling, cutting processes	**08 Hours / L2**
Module 3 **MICROMECHANICS:** Introduction – advantages and application of composite materials – types of reinforcements and matrices – micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites. Effect of voids in composites.	**08 Hours / L3**

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Module 4 **MACROMECHANICS:** Generalized Hooke's Law – elastic constants for anisotropic, orthotropic and isotropic materials – macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina – experimental characterization of lamina. **FAILURE THEORY :** Tsai-Hill, Tsai-Wu, Max Stress and Max Strain	**08 Hours / L3**
Module 5 **INSPECTION & QUALITY CONTROL:** Destructive & Non-Destructive Testing, Tensile, Compression, Flexural, Shear, Hardness; ultrasonic testing – A-B-C scan **REPAIRS OF COMPOSITE MATERIALS AND APPLICATIONS:** Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.	**08 Hours / L3**

COURSE OUTCOMES: Upon completion of this course, student will be able to:

CO1	Understanding the mechanics of composite materials.
CO2	Understand the processing methods in composite materials.
CO3	Apply the characterization methods for various engineering materials.
CO4	Comprehend and apply theories of structures for engineering problems.
CO5	Understand the inspection techniques used for composite and various application of composite in different fields of engineering.

Textbooks:

1. K.K Chawla, Composite Materials- Science and Engineering, Springer Verlag, II edition,1998.
2. Autar Kaw, Mechanics of Composites, CRC Press, II edition,2006.

Reference books:

1. Mein Schwartz, Composite Materials Handbook, Department of Defense, USA, 2002
2. Ajay Kapadia, Non-Destructive Testing of Composite Materials, TWI Publications, 2006.
3. R M Jones, Mechanics of Composite Materials, Taylor & Francis, 2nd Edn,2015

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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PROGRAM ELECTIVE 1
SEMESTER -V

COURSE: WIND TUNNEL TECHNIQUES

Course Code	**21ANE544**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aerodynamics, Aerodynamics Lab

Course Learning Objectives:

CO1	Types and techniques of Aerodynamic data generation
CO2	Theoretical foundation behind experimentation in the various speed ranges corresponding to subsonic, supersonic and hypersonic Mach numbers
CO3	classical and state of the art measurement devices and techniques for measurement parameters such as pressure, temperature and velocity.
CO4	Flow visualization techniques meant for incompressible and compressible flows

CONTENT	**No. of Hours/ RBT levels**
Module 1 **LOW SPEED WIND TUNNELS:** Introduction, Wind tunnel- Classification, Applications, Model making, non-dimensional parameters, Low speed wind tunnel-Irregularities of flow in low speed tunnels, Reduction of turbulence, Effect of screens on turbulence, Honey combs, Wind tunnel contractions, The diffuser, Losses in wind tunnel circuit Power requirements – power economy	**08 Hours / L2**
Module 2 **HIGH SPEED WIND TUNNELS:** Introduction, Types of high-speed tunnels, Supersonic wind tunnels - Test section flow parameters, Components of supersonic wind tunnels, Power required for the operation of supersonic wind tunnels, Closed circuit supersonic wind tunnel, Actual flow in the supersonic wind tunnel	**08 Hours/ L3**
Module 3 **SHOCK TUBES:** Introduction to shock tube, Shock tube equations, Comparison between shock heating and isentropic heating, Particle velocity behind moving shock, Dependence of shock strength on diaphragm pressure ratio, Reflected shocks, Viscous effects and the shock tube boundary layer, Observation time in shock tube, Interaction of reflected shock and the contact surface, Shock tube diaphragm and bursting techniques Measurement of shock speed	**08 Hours/ L4**
Module 4 **WIND TUNNEL INSTRUMENTATION:** **Measurement of Pressure**: Introduction, Manometers, Pressure transducers, Measurement of high pressures, Ranges of different manometers, Measurement of vacuum, Measurement of pressure in flows, Measurement of stagnation or total pressure, Lag in monomeric systems	**08 Hour/ L3**

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Measurement of Temperature: Introduction, Expansion thermometer or liquid in glass thermometer (LIG), Change of state thermometers, Electrical resistance thermometry, Thermoelectric thermometry, Temperature measurement problems in flows, Sensors/probes for measuring stagnation temperature **Measurement of Velocity**: Anemometric methods, Measurement in compressible flows, Measurement of supersonic velocity /Mach number, Hot wire anemometer (HWA)	
Module 5 **FLOW VISUALIZATION and NON-INTRUSIVE FLOW DIAGNOSTICS:** Introduction, Flow visualisation by direct injection (Tracer methods) , Smoke and Tuft grid techniques – Dye injection special techniques – Oil flow visualization, Index of refraction methods, Theoretical background, Deflection of light ray in a medium of constant density gradient ,The schlieren method, Colour schlieren ,Shadowgraph method ,Interferometer method ,Glow discharge visualization for low density flows	**08 Hours/ L4**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Summarize the classifications, working principle, design features and power considerations of low speed wind tunnel configurations.
CO2	Comprehend/Apply the operational requirements, design features and power consideration of supersonic wind tunnel configurations.
CO3	Analyze the principles governing shock tube equations, reflected shocks, shock tube boundary layer and the measurement of shock speed.
CO4	Identify different conventional and state of the art instruments for measuring pressure, temperature and velocity
CO5	Infer the flow pattern effectively using various flow visualization techniques

Textbooks:

1. Rae, W.H. and Pope, A., "**Low Speed Wind Tunnel Testing**", John Wiley Publication, 3rd edition, 2010
2. Rae, W.H. and Pope, A. ‘’**High Speed Wind Tunnel Testing**’’ John Wiley Publication, 1984.
3. Gaydon,A.G. and Hurle, J.R. “Shock Tubes in high temperature chemical physics”
4. Slezinger. “Wind Tunnels and their Instrumentation”

Reference books:

1. Rathakrishnan, E., “**Instrumentation, Measurements, and Experiments in Fluids**,” CRC Press – Taylor & Francis, 2007.
2. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore.
3. Doeblin. ”Measurement Systems:Application & Design”

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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VI Semester Syllabus

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SEMESTER – VI

COURSE: AIRCRAFT PERFORMANCE

Course Code	**21ANE61**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aerodynamics I.

Course Learning Objectives: To enable students to apply the knowledge of airplane performance and design in broad domain of aeronautical engineering by making them to learn:

CLO1	Understand the principles of aircraft performance in both steady un-accelerated and accelerated flight.
CLO2	Define and apply key aircraft performance parameters in steady flight.
CLO3	Calculate and interpret the range and endurance of propeller and jet-driven airplanes.
CLO4	Explain the factors influencing aircraft take-off, landing and maneuvering performance

Content	No. of Hours/ RBT levels
Module 1 **INTRODUCTION:** The evolution of the airplane and the performance, a short history. Variation of lift, drag and moment coefficient with angle of attack and Mach number. **THE EQUATIONS OF MOTION STEADY UN-ACCELERATED FLIGHT:** Introduction, four forces of flight, General equation of motion, Power available and power required curves. Thrust available and thrust required curves. Conditions for power required and thrust required minimum. Altitude effects on power available and power required; thrust available and thrust required.	**08 Hours / L3**
MODULE 2 **STEADY PERFORMANCE:** Level Flight, Climb &Glide: Equation of motion for steady level flight, Performance of airplane in level flight. Maximum speed in level flight, Climb **Performance**: Equation of motion for Rate of climb- graphical and analytical approach - Absolute ceiling, Service ceiling, Time to climb – graphical and analytical approach, climb performance graph (hodograph diagram); **FUNDAMENTAL AIRPLANE PERFORMANCE PARAMETERS:** Thrust – to – weight **ratio**, Wing loading, Drag polar, and lift-to – drag ratio. Minimum velocity: Stall and High lift devices.	**08 Hours / L3**
Module 3 **RANGE AND ENDURANCE:** Propeller driven Airplane: Physical consideration, Quantitative formulation, Breguet equation for Range and Endurance, Conditions for maximum range and endurance. **JET AIRPLANE:** Physical consideration, Quantitative formulation, Equation for Range and Endurance, Conditions for maximum range and endurance, Effect of head wind tail wind.	**08 Hours / L3**

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Module 4 **AIRCRAFT PERFORMANCE IN ACCELERATED FLIGHT**: Take-off Performance: Calculation of Ground roll, Calculation of distance while airborne to clear obstacle, Balanced field length. **LANDING PERFORMANCE AND ACCELERATED CLIMB:** Calculation of approach distance, Calculation of flare distance, Calculation of ground roll, ground effects. Acceleration in climb.	**08 Hours / L3**
Module 5 **MANEUVER PERFORMANCE:** Turning performance: Level turn, load factor, Constraints on load factor, Minimum turn radius, Maximum turn rate. Pull-up and Pull-down maneuvers: (Turning rate, turn radius). Limiting case for large load factor. The V-n diagram. Limitations of pull up and push over.	**08 Hours / L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the aircraft performance in steady un-accelerated and accelerated flight.
CO2	Understand the airplane performance parameters.
CO3	Determine the range and endurance of propeller and jet driven airplane.
CO4	Comprehend the aircraft take-off and landing performance.
CO5	Describe the different aircraft maneuvers.

Textbooks:

1. John D. Anderson, Jr., "Aircraft Performance and Design", McGraw-Hill International, 1999.
2. John D. Anderson, Jr., "Introduction to flight", McGraw-Hill International, 2000.

Reference books:

1. Perkins, C.D., and Hage, R.E, "Airplane Performance stability and Control", John Wiley Son Inc, New York, company, 1988.
2. Barnes W. McCormick, "Aerodynamics, Aeronautics, and Flight Mechanics", John Wiley & Sons, 2nd Edition, 1994.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER VI

COURSE: AERODYNAMICS-II

Course Code	**21ANE62**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Pre requisite: Aerodynamics I

Course Learning Objectives: To enable students to apply the knowledge of Aerodynamics in broad domain of Aeronautical Engineering by making them to learn:

CLO1	To Introduce the Concepts of compressibility
CLO2	To make the student understand the theory behind the formation of Shocks and Expansion fans in Supersonic flows.
CLO3	To introduce the methodology of measurements in Supersonic flows.

Content	No. of Hours RBT levels
Module 1 **ONE DIMENSIONAL COMPRESSIBLE FLOW:** Review of Thermodynamics and State Equations, Compressibility, Velocity of Sound, Adiabatic Steady-State flow Equations, Flow-through Convergent- Divergent Passage.	**10 Hours/ L3**
Module 2 **NORMAL SHOCK WAVES:** Alternative form of the One-dimensional Energy Equation, Prandtl Meyer Equation and Rankine – Hugonoit Relation, Normal Shock Equations, Velocity measurements in Subsonic and Supersonic flows, Pitot Static Tube, Rayleigh and Fanno Flow.	**10 Hours/ L3**
Module 3 **OBLIQUE SHOCK WAVE EXPANSION WAVES:** Oblique Shocks and Corresponding Equations, Flow past wedges and Concave corners, Flow past Convex corners, Strong & weak Shocks, Attached & Detached Shocks. Reflection, and Interaction of Shocks, Expansion waves.	**10 Hours/ L3**
Module 4 **LINEARIZED FLOW:** Velocity Potential equation, Small Perturbation Potential Theory, Linearized Subsonic and Supersonic Pressure Co-efficient, Mach waves and Mach angles, Prandtl - Glauert compressibility Correction.	**10 Hours/ L3**
Module 5 **TRANSONIC FLOW OVER WING:** Lower and upper Critical Mach numbers, Lift and Drag Divergence Mach number, Shock induced separation, Characteristics of Swept wings, Transonic Area rule. Introduction to Hypersonic Aerodynamics.	**10 Hours/ L3**

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Laboratory Exercise

S.N	List of Experiments	RBT Levels
1	Grid Generation over a 2D airfoil geometry	L4
2	Flow analysis through Parallel Plates	L4
3	Viscous Flow analysis over a Circular cylinder at low Reynolds Number (2D)	L4
4	Flow analysis over a 3D Finite wing Structure	L4
5	Supersonic flow analysis over a 2D wedge	L4
6	Compressible flow over a Hemispherical Object (Blunt Body)	L4
7	Flow through a convergent Nozzle	L4
8	Flow through a Divergent Nozzle	L4
9	Supersonic Inlet flow analysis	L4
10	Combustion analysis for a Ramjet Engine	L4

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Calculate the Thermodynamic state variables in Compressible Flow.
CO2	Estimate the flow of Properties across Normal Shock Waves.
CO3	Evaluate and analyze the flow Properties across Oblique Shock Waves
CO4	Understand the Linearization of the governing equations in compressible flow.
CO5	Predict the flow Properties of Transonic and Hypersonic flows.

Textbooks:

1. J. D. Anderson, "**Fundamentals of Aerodynamics**", 5th Edition, McGraw Hill Education India Private Limited, 2010.
2. Rathakrishnan, E., "**Gas Dynamics**", 6th Edition, Prentice Hall of India, 2017.
3. Aerodynamics for Engineers- John J Bertin and Michael L Smith,1979
4. Aerodynamics for Engineering Students - E. L Houghton and P W Carpenter,5th Edition 2003

Reference books:

1. J. D. Anderson, "**Modern Compressible Flow**", 3rd Edition, McGraw Hill Education 16 August 2002.
2. V. Babu**, "Fundamentals of Gas Dynamics**", 2nd Edition, John Wiley & Sons Ltd, (2015)
3. Shapiro, A.H., "**Dynamics and Thermodynamics of Compressible Fluid Flow**", Ronald Press, 1982.

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for **40 marks each. Marks scored in each test is reduced to 30 and added to test component.**

CIE is executed by way of Three tests.

Laboratory CIE is conducted for 20 Marks and Added to CIE component

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**30**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	LAB CIE	**20**	**20**
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VI

COURSE: FINITE ELEMENT METHODS

Course Code	**21ANE63**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aircraft Structures

Course Learning Objectives: To enable students to apply the knowledge of finite element methods in broad domain of aeronautical engineering by making them to learn:

CLO1	To give exposure to various methods of solution, in particular the finite element method.
CLO2	To expose the student to a wide variety of problems involving discrete and continuum elements
CLO3	To impart knowledge in the basic theory of finite element formulation
CLO4	To allow the student to learn and understanding how element characteristic matrices are generated
CLO5	To impart knowledge in assembly of finite element equations, and solve for the unknowns.

Content	No. of Hours/ RBT levels
Module 1 **INTRODUCTION:** Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods Governing equation and convergence criteria of finite element method. Introduction to FEM,FVM,FDM,FBM and differences.	**08 Hours/ L3**
Module 2 **DISCRETE ELEMENTS:** Bar elements, uniform sections, mechanical and thermal loading, varying section, truss analysis. Beam element with various loadings and boundary conditions - longitudinal and lateral vibration. Use of local and natural coordinates.	**10 Hours/ L3**
Module 3 **CONTINUUM ELEMENTS:** Plane stress, Plane strain and axisymmetric problems, constant and linear strain triangular elements, stiffness matrix, axisymmetric load vector, shape functions of Hexahedron and tetrahedron(3D Elements)	**08 Hours/ L3**
Module 4 **ISOPARAMETRIC ELEMENTS:** Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector, Gaussian integration.	**08 Hours/ L3**
Module 5 **FIELD PROBLEM**: Heat transfer problems, Steady state fin problems, Derivation of element matrices for two dimensional problems, Torsion problems.	**08 Hours/ L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the approximate methods used for solving structural mechanics problems and formulation of governing equation for the finite element method, convergence criteria and advantage over other approximate method
CO2	Solve 1-D problems related to static analysis of structural members
CO3	Formulate the elemental matrices for 2-D problems.
CO4	Exposure to iso-parametric element formulations and importance of numerical integration.
CO5	Solve Eigen value problems and scalar field problems.

Textbooks:

1. Dhanaraj. R and K.Prabhakaran Nair, "Finite Element Method ", Oxford university press, India, 2015.
2. Rao. S.S., The Finite Element Methods in Engineering, Butterworth and Heinemann, 5th edition, 2010.
3. Reddy J.N. – An Introduction to Finite Element Method – McGraw Hill, 3rd edition, 2005.
4. Tirupathi.R. Chandrapatha and Ashok D. Belegundu – Introduction to Finite Elements in Engineering – Prentice Hall India, 3rd Edition, 2003.

Reference books:

1. Bathe K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2nd edition, 2001.
3. Larry J Segerlind, 'Applied Finite Element Analysis', 2nd Edition, John Wiley and Sons, Inc. 1985.
4. Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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PROGRAM ELECTIVE 2
SEMESTER VI

COURSE: THEORY OF VIBRATION

Course Code	**21ANE641**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aircraft Structures-I,II

Course Learning Objectives: To enable students to apply the knowledge Theory of Vibration in broad domain of aeronautical engineering by making them to learn:

CLO1	Basic concepts of vibrations, types of vibrations.
CLO2	Understand the working principle of vibration measuring instruments.
CLO3	Differentiate types of vibrations - according to dampness and particle motion.
CLO4	Acquire the knowledge of numerical methods for multi-degree freedom systems.
CLO5	To study the aero elastic effects of aircraft wing.

Content	No. of Hours, RBT levels
Module 1 **INTRODUCTION:** Types of vibrations, S.H.M, principle of super position applied to Simple Harmonic Motions, Fourier theorem and simple problems.	**08 Hours/ L3**
Module 2 **UNDAMPED FREE VIBRATIONS:** Single degree of freedom systems. Undamped free vibration, natural frequency of free vibration, Spring and Mass elements, effect of mass of spring, Compound Pendulum. **DAMPED FREE VIBRATIONS:** Single degree of freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.	**08 Hours/ L3**
Module 3 **FORCED VIBRATION:** Single degree of freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation, transmissibility ratio due to harmonic excitation and support motion.	**08 Hours/ L3**
Module 4 **SYSTEMS WITH TWO DEGREES OF FREEDOM:** Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, Free vibration in terms of initial conditions. Applications: Vehicle suspension, Dynamic vibration absorber and Dynamics of reciprocating Engines.	**08 Hours/ L3**
Module 5 **MULTI DEGREES OF FREEDOM SYSTEMS:** Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley's equation. Orthogonality of principal modes, Method of matrix Iteration-Method of determination of all the natural frequencies using sweeping	**08 Hours/ L3**

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matrix and Orthogonality principle. Holzer's method, Stodola method.	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the basic concepts of vibrations.
CO2	Formulate the mathematical models for Undamped and damped mechanical vibrations Systems.
CO3	Formulate the mathematical models for forced vibrations Systems
CO4	Predict the frequency response for mechanical vibration systems under loading conditions
CO5	Analyze the multi-degree freedom systems.

Textbooks:

1. Grover. G.K., "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India, 2003.
2. V.P. Singh., "Mechanical Vibrations", DhanpatRai & Company Pvt. Ltd, 2016.

Reference books:

1. Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.
2. Bisplinghoff R.L., Ashely H and Hogman R.L., "Aeroelasticity", Dover Publication, New York, 1983.
3. Leonard Meirovitch, "Elements of Vibration Analysis". McGraw Hill International Edition, 2007.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 mark

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER VI
PROFESSIONAL ELECTIVE 2

COURSE: ROCKET AND MISSILES

Course Code	**21ANE642**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aerodynamics and Propulsion

Objectives:

To give revelation on basic concepts of rocket motion, rocket aerodynamics, staging & control of rockets, materials and propulsion systems of rockets and missiles to students to augment their knowledge in the region of rockets and missile flight.

CLO1	Understand the Current scenario of rockets and Missiles.
CLO2	Analyze the Aerodynamic Characteristics of Rockets and Missiles.
CLO3	Gaining the knowledge about the Trajectory Motion of Rockets and Missiles.
CLO4	Gain the knowledge on the separation of stages of rocket and its control
CLO5	Understand the Propulsion Systems and Materials used in Rockets and Missiles

Content	No. of Hours/ RBT levels
Module 1 **CLASSIFICATION OF ROCKETS AND MISSILES:** History of rockets and missiles, Various methods of classification of missiles and rockets – Basic aerodynamic characteristics of surface to surface, surface to air, air to surface and air to air missiles – Examples of various Indian space launch vehicles and missiles – Current status of Indian rocket and missile program.	**08 Hours/ L2**
Module 2 **ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD:** One Dimensional and Two Dimensional Rocket Motions in Free Space and Homogeneous Gravitational Fields – description of Vertical, Inclined and Gravity Turn Trajectories – Determination of range and Altitude.	**08 Hours/ L3**
Module 3 **AERODYNAMICS OF ROCKETS AND MISSILES:** Forces Acting on a Missile While Passing Through atmosphere, methods of Describing Aerodynamic Forces and Moments – Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces.	**08 Hours/ L3**

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Module 4 **STAGING AND CONTROL OF ROCKETS AND MISSILES:** Multi staging of rockets and ballistic missiles – Multistage Vehicle Optimization – Stage Separation Dynamics – Stage Separation Techniques in atmosphere and in space, Introduction to aerodynamic and jet control methods – various types of aerodynamic control methods for tactical and short range missiles.	**10 Hours/ L3**
Module 5 **MATERIALS FOR ROCKETS AND MISSILES:** Criteria for selection of materials for rockets and missiles, requirements for choice of materials for propellant tanks, liners, insulators, inhibitors, at cryogenic temperatures, requirements of materials at extremely high temperatures, requirements of materials for thermal protection and for pressure vessels.	**08 Hours/ L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the Current scenario of rockets and Missiles.
CO2	Analyze the Aerodynamic Characteristics of Rockets and Missiles.
CO3	Gaining the knowledge about the Trajectory Motion of Rockets and Missiles.
CO4	Gain the knowledge on the separation of stages of rocket and its control
CO5	Understand the Propulsion Systems and Materials used in Rockets and Missiles

Textbooks:

1. Cornelisse, J.W., "**Rocket Propulsion and Space Dynamics**", J.W., Freeman & Co. Ltd. London, 1982.
2. Sutton, G.P., et al., "**Rocket Propulsion Elements**", 8th edition John Wiley & Sons Inc., New York.

Reference books:

1. Mathur, M., and Sharma, R.P., "**Gas Turbines and Jet and Rocket Propulsion**", Standard Publishers, New Delhi 1998.
2. Parker, E.R., "**Materials for Missiles and Spacecraft**", McGraw-Hill Book Co. Inc., 1982.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER VI

PROGRAM ELECTIVE 2

COURSE: THEORY OF ELASTICITY

Course Code	**21ANE643**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aircraft Structures-I

Course Leaning Objectives: To enable students to apply the knowledge of Theory of Elasticity in broad domain of aeronautical engineering by making them to learn:

CLO1	To make the student understand the elastic behavior of different structural components under various loadings and boundary conditions.
CLO2	Describe the Plane stress and Plane strain Problems
CLO3	Knowledge to formulate and derive static and dynamic aero elastic equations of motion.

Content	No. of Hours/RBT levels
Module 1 **BASIC EQUATIONS OF ELASTICITY:** Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariant	**08 Hours/ L3**
Module 2 **PLANE STRESS AND PLANE STRAIN PROBLEMS:** Airy's stress function, Bi- harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.	**08 Hours/ L3**
Module 3 **POLAR COORDINATES:** Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.	**08 Hours/ L3**
Module 4 **TORSION:** Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi-inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.	**08 Hours/ L3**
Module 5 **INTRODUCTION TO THEORY OF PLATES AND SHELLS:** Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's methodof solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.	**08 Hours/ L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Ability to use mathematical knowledge to solve problem related to structural elasticity.
CO2	Identify stress-strain relation in 3D, principal stress and principal strain.
CO3	Analyze a structure using Elasticity concepts.
CO4	Use analytical techniques to predict deformation, internal force and failure of simple solids and structural components.
CO5	Solve aerospace-relevant problems in plane strain and plane stress in Cartesian and polar coordinates.

Textbooks:

1. Ansel C Ugural and Saul K Fenster, "Advanced Strength and Applied Elasticity", 4th Edition, Prentice Hall, New Jersey, 2003. 100
2. Bhaskar, K., and Varadan, T. K., "Theory of Isotropic/Orthotropic Elasticity", CRC Press USA, 2009.
3. Timoshenko, S., and Goodier, T.N.,"Theory of Elasticity", McGraw–Hill Ltd., Tokyo, 1990.

Reference books:

1. Barber, J. R., "Elasticity", Kluwer Academic Publishers, 2004
2. Sokolnikoff, I. S.,"Mathematical Theory of Elasticity", McGraw– Hill, New York, 1978.
3. Volterra& J.H. Caines,"Advanced Strength ofMaterials", Prentice Hall,NewJersey,1991
4. Wang, C. T., "Applied Elasticity", McGraw – Hill Co., New York, 1993.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

ThreeTestsaretobeconductedfor40markseach.CIEisexecutedbywayofquizzes/Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3 Course:

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SEMESTER VI

PROGRAM ELECTIVE 2

COURSE: FUELS AND COMBUSTION

Course Code	**21ANE644**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aero Propulsion-II

Course Learning Objectives: To enable students to apply the knowledge of Fuels and Combustion in broaddomain of aeronautical engineering by making them to learn:

CLO1	About the fuel properties
CLO2	Fuel treatment and Alternative fuels for Aerospace applications
CLO3	Combustion chemistry and basic fundamentals
CLO4	Flame characterization, stabilization and combustion performance
CLO5	Fuels of aircraft and rocket fuel and their properties.

Content	No.of Hours/ RBT levels
Module 1 **FUEL PROPERTIES**: Fuel Properties, Combustion Properties of Fuels, Calorific Value, Enthalpy, Spontaneous-Ignition temperature, Limits of Flammability, Smoke Point, Luminometer Number, Smoke Volatility Index, Pressure and Temperature Effects, Sub atmospheric Pressure, Low Temperature, High Temperature.	**08 Hours/ L3**
Module 2 **FUEL TREATMENT**: Introduction, types of Hydrocarbons. Production of Liquid Fuels. Removal of Sulfur Compounds, Contaminants. Additives, Gum Prevention, Corrosion Inhibition/Lubricity Improvers, Anti-Icing, Antistatic–Static Dissipaters, Metal Deactivators and Antismoke. **ALTERNATIVE FUELS FOR AEROSPACE APPLICATIONS**: Hydrogen, Methane, Propane, Ammonia, Alcohols, Slurry fuels, Synthetic fuels, Fuels Produced by Fischer–Tropsch, Synthesis of Coal/Biomass, Biofuels, Alternative fuel Properties, Biodiesel Fuels.	**08 Hours/ L3**
Module 3 **BASIC CONSIDERATIONS**: Introduction, Basic Design Features, Combustor Requirements, Fuel Preparation, Atomizers, liner wall-cooling Techniques, combustor stability limits, combustor exit temperature traverse quality (pattern factors), Combustors for Low Emissions. **COMBUSTION FUNDAMENTALS:** Deflagration, Detonation, Classification of Flames, Physics of combustion Chemistry, Flammability Limits, Global Reaction-Rate Theory, Weak Mixtures, Rich Mixtures, Laminar Premixed Flames. Equivalence Ratio, Initial Temperature, Pressure, Turbulent Premixed Flames, Flame Propagation in Heterogeneous Mixtures of Fuel Drops.	**08 Hours/ L3**

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Module 4 **COMBUSTION FLAME CHARACTERIZATION AND STABILIZATION**: Droplet and Spray Evaporation, Heat-Up Period, Evaporation Constant, Convective Effects, Ignition Theory, Gaseous Mixtures, Heterogeneous Mixtures, Spontaneous Ignition, Adiabatic Flame Temperature, Factors Influencing the Adiabatic Flame Temperature. Definition of Stability Performance, Measurement of Stability Performance, Bluff-Body Flame holders, Stabilization, Mechanisms of Flame Stabilization, Flame Stabilization in Combustion Chambers. **COMBUSTION PERFORMANCE**: Combustion Efficiency, The Combustion Process, Reaction-Controlled Systems, Burning Velocity Model, Stirred Reactor Model, Mixing-Controlled Systems, Evaporation-Controlled Systems, Reaction- and Evaporation-Controlled Systems.	**08 Hours/ L3**
Module 5 **FUEL CLASSIFICATION AND ROCKET FUELS:** Classification of Liquid Fuels, Aircraft Gas Turbine Fuels. Classification of Gaseous Fuels. Classification of rocket fuels, rocket fuel specifications and fuels properties.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Distinguish fuels and their properties and their treatment for aerospace applications.
CO2	Understand the basics of fuel treatment and alternative fuel for combustion
CO3	Comprehend the combustion fundamentals terms and definitions
CO4	Understand the combustion flame characterization, stabilization and combustion performance.
CO5	Classify fuels of aircraft and rocket fuel and their properties.

Textbooks:

1. Arthur H. Lefebvre & Dilip R. Ballal, "Gas Turbine Combustion, Alternative fuels and Emissions ", CRC Press, 3rd Edition, 2010.
2. Minkoff, G.J., and C.F.H. Tipper, "Chemistry of Combustion Reaction ", Butterworths, London, 1962.
3. Samir Sarkar, “Fuels & Combustion”, Orient Long man, 1996.

Reference books:

1. C George Segeler**,** "Gas Engineers Handbook ", Industrial Press, New York, 1966.
2. Williams, D.A. and G. James, "Liquid Fuels ",London Pergamon, London, 1963.
3. Wilson, P.J. and J.H. Wells, “Coal, Coke and Coal Chemicals”, McGraw-Hill, New York, 1960

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Scheme of Examination: Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be reduced proportionately to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER VI

OPEN ELECTIVE 1

COURSE: INTRODUCTION TO AERONAUTICAL ENGINEERING

Course Code	**21ANE651**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Introduction to Aeronautical Engineering in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Understand the Historical evaluation of Airplanes & different structures & construction
CLO2	Understand the basic properties and principles behind the flight
CLO3	understand the structures and structural components of an aircraft
CLO4	Study the various types of power plants used in aircrafts
CLO5	Study the different component systems and functions

Content	No. of Hours/ RBT levels
Module 1 **HISTORY OF AVIATION AND SPACE TECHNOLOGY** First Aeronautical Engineers, Atmosphere and its properties - The International Standard Atmosphere, the Physical Properties of Air, classification of aircrafts- lighter than aircraft, heavier than aircraft, basic components of an aircraft, roles of aircrafts development in military aviation	**08 Hours/ L3**
Module 2 **BASIC AERODYNAMICS :** Bernoulli's Principle, Airfoils, nomenclature, wing planform, angle of attack, **forces** over wing section-lift, drag, Thrust, weight and moments, measurement of airspeed, aircraft motions, control surfaces and high lift devices.	**08 Hours/ L3**
Module 3 **AIRCRAFT STRUCTURES AND MATERIALS:** Properties of flight vehicle Materials; importance of strength to weight ratio, classification and characteristics of composite materials.	**08 Hours / L3**
Module 4 **AIRCRAFT PROPULSION**: Aircraft power plants, classification based on power plant engine and principle of operation. Turboprop, turbojet and turbofan engines; ramjets and scramjets, use of propellers, Introduction to types of rockets, missiles.	**10 Hours / L3**

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Module 5	08 Hours/ L3
AIRCRAFT INSTRUMENTS**:** Flight instruments and navigation instruments – accelerometers, air speed indicators – Mach meters – altimeters – gyroscopic instruments. Principles and operation.	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the History and introduction to Aviation and effect on environment.
CO2	Understand the basic concept of Aerodynamics
CO3	Understand the basic Structures and Materials of Aircrafts
CO4	Understand the basics of Aerospace Engineering propulsion system and Power Plants
CO5	Understand the basic Aircraft systems and instrumentation

Textbooks:

1. A.C. Kermode, "**Flight without formulae**", Pearson Education India, 1989. ISBN: 9788131713891.
2. John D. Anderson, "**Introduction to Flight**", McGraw-Hill Education, 2011. ISBN 9780071086059.

Reference books:

1. Nelson R.C., "**Flight stability and automatic control**", McGraw-Hill International Editions, 1998. ISBN 9780071158381.
2. Ian Moir, Allan Seabridge, "**Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration**", John Wiley & Sons, 2011. ISBN 978111965006.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VI

OPEN ELECTIVE 1

COURSE: AIRCRAFT SYSTEMS AND INSTRUMENTATION

Course Code	**21ANE652**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

COURSE LEARNING OBJECTIVES: To enable students to apply the knowledge of aircraft systems and instrumentation in broad domain of aeronautical engineering by making them to learn:

CLO1	About the aircraft control systems.
CLO2	About the aircraft systems
CLO3	Acquire the knowledge of aircraft engine systems
CLO4	About the auxiliary systems
CLO5	About aircraft and air data instruments.

Content	No. of Hours/ RBT levels
Module 1 **AIRCRAFT CONTROL SYSTEMS:** Conventional Systems, fully powered flight controls, Power actuated systems, Modern control systems, Digital fly by wire systems, Auto pilot system active control Technology.	**08 Hours/ L2**
Module 2 **AIRCRAFT SYSTEMS:** Hydraulic systems, Study of typical workable system, components, Pneumatic systems, Advantages, Working principles, Typical Air pressure system, Brake system, Typical Pneumatic power system, Components, Landing Gear systems, Classification.	**08 Hours/ L2**
Module 3 **ENGINE SYSTEMS:** Fuel systems for Piston and jet engines, Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.	**08 Hours/ L2**
Module 4 **AUXILIARY SYSTEM**: Basic Air cycle systems, Vapour Cycle systems, Evaporative vapor cycle systems, Evaporative air cycle systems, Fire protection systems, Deicing and anti-icing systems.	**08 Hours/ L2**
Module 5 **AIRCRAFT INSTRUMENTS**: Flight Instruments and Navigation Instruments, Gyroscope, Accelerometers, Air speed Indicators, TAS, EAS, Mach Meters, Altimeters, Principles and operation, Study of various types of engine instruments, Tachometers, Temperature gauges, Pressure gauges, Operation and Principles.	**08 Hours/ L2**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Distinguish the conventional and modern control systems.
CO2	Classify the aircraft systems.
CO3	Categorize different types of aircraft instruments.
CO4	Comprehend the engine and fuel systems
CO5	Understand the basic flight and air data instrumentation

Textbooks:

1. Ian Moir and Allan Seabridge, " Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration ", Wiley India Pvt Ltd, 3rd edition, 2012.
2. Pallet, E.H.J, "Aircraft Instruments and Integrated Systems ", Longman Scientific and Technical Institute, 1996.

Reference books:

1. Lalit Gupta and OP. Sharma, "Aircraft Systems (Fundamentals of Flight Vol. IV) Himalayan Books 2006.
2. R.W. Sloley and W.H. Coulthard, "The aircraft Engineers Handbook, No4, Instruments", 6th Edition, 2005.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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CO/PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	2	-
Average	3	3											2	

Low-1: Medium-2: High-3

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SEMESTER VI
OPEN ELECTIVE 1

COURSE: AIRCRAFT MAINTENANCE AND PRACTICE

Course Code	**21ANE653**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

COURSE LEARNING OBJECTIVES: To enable students to apply the knowledge of aircraft systems and instrumentation in broad domain of aeronautical engineering by making them to learn:

CLO1	About the aircraft maintenance practices
CLO2	About the aircraft tools used for maintenance practices
CLO3	Acquire the knowledge of aircraft materials & their properties.
CLO4	About the welding in aircraft structural components & sheet metal repair and maintenance
CLO5	About aircraft Electrical cables, equipment & system.

Content	No. of Hours/ RBT levels
Module 1 **AIRCRAFT MAINTENANCE PRACTICES:** Standard maintenance practices-aircraft maintenance practices-general purpose tools-measuring tools-torque wrenches and torque loading practice.	**08 Hours/ L2**
Module 2 **TOOLS**: Aircraft fastening devices-bolts and screws, nuts and washers, locking devices and springs, engineering drawings and diagrams, bearings and gears.	**08 Hours/ L2**
Module 3 **AIRCRAFT MATERIALS**: Aircraft materials-ferrous, nonferrous and composite/non-metallic, Corrosion and corrosion control and protection.	**08 Hours/ L2**
Module 4 **WELDING IN AIRCRAFT STRUCTURAL COMPONENTS:** Equipment used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing. **SHEET METAL REPAIR AND MAINTENANCE** : Inspection of damage - Classification - Repair or replacement - Sheet metal inspection - N.D.T. Testing - Riveted repair design, Damage investigation - reverse technology.	**08 Hours/ L2**
Module 5 **AIRCRAFT MISCELLANEOUS:** Electrical cables and connectors, usage of electrical instruments and equipment, testing and calibration methods, pipes, hoses and control cables, aircraft weight and balance control, quality system and procedures.	**08 Hours/ L2**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understanding about the aircraft maintenance practices adopted in aviation industry.
CO2	Explain the use of various tools used in aircraft maintenance
CO3	Identify various materials used in aircrafts
CO4	Describe welding process sheet metal repair used I aircraft maintenance
CO5	Explain the methods of harnessing Electrical cables and connectors in aircraft.

Textbooks:

1. Kinnison H A, "Aviation Maintenance Management", McGraw-Hill, Second Edition, 2013.
2. McKinley J L, Bent R D, "Maintenance and Repair of Aerospace Vehicles", Northrop Institute of Technology, McGraw-Hill, 1967.

Reference books:

1. Friend, C H, "Aircraft Maintenance Management", Longman, 1992.
2. Kroes. M, Watkins. W and Delp. F, "Aircraft Maintenance and Repair", Tata McGraw- Hill, 2010.
3. Patankar M S and Taylor J C, "Risk Management and Error Reduction in Aviation Maintence", Ashgate ISBN 0-7546-1941-9, 2004.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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CO/PO Mapping														
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	2	-
Average	3	2											2	

Low-1: Medium-2: High-3

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SEMESTER VI
ABILITY ENHANCEMENT COURSE-V

COURSE: URBAN AIR MOBILITY

Course Code	**21ANE661**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Urban air mobility in broad domain of aeronautical engineering by making them to learn:

CLO1	To gain knowledge of Urban Air Mobility (UAM) .
CLO2	Acquire in-depth knowledge about the classification and operational aspects of UAM vehicles
CLO3	Comprehend the evolving ecosystem and infrastructure developments required to support UAM.
CLO4	Gain an an insights to the rules and regulations governing UAM and drones in India,
CLO5	Describe the process and importance of type certification for UAM vehicles

Content	**No. of h r / RBT levels**
Module 1 **INTRODUCTION:** UAM, the evolving landscape of urban air mobility in india, UAM around the globe and its progress, enabling ecosystem for UAM in India, policy support	**03 Hours / L3**
Module 2 **The Unmanned Aircraft System Rules, 2021**, Category - The unmanned aircraft are classified based on the maximum all up weight including its pay load, DGCA Guidelines for UAS, Operations of UAS, Drone Port	**03 Hours/ L2**
Module 3 **VEHICLE TYPES**, Main Use Cases And Infrastructure, **UDAN-RCS Scheme of Government of India**	**03 Hours/ L3**
Module 4 **UNMANNED AIRCRAFT SYSTEM(UAS)**, Drone Rules 2021, Amendment Rules 2022	**03 Hours/ L3**
Module 5 **Digital sky platform**, type certificate, RPCS details, list of RPTOS, UIN details	**03 Hours/ L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand UAM and its ecosystem in India
CO2	Acquire knowledge on the classification and operations of UAM
CO3	Comprehend the ecosystem and infrastructure developments for UAM
CO4	Appreciate the UAM and DRONE rules and regulation
CO5	Describe the type certification for UAM

Textbooks:

1. Paul Gerin Fahlstrom, "Thomas James Gleason, Introduction to UAV Systems", Wiley Publication John Wiley & Sons, Ltd, 4th Edition 2012.
2. Landen Rosen, "Unmanned Aerial Vehicle, Alpha Editions", N.Y., 2012

Reference books:

1. Valavanis, Kimon P, "Unmanned Aerial Vehicles", Springer, 2011.
2. Valavanis, K., Vachtsevanos, George J, "Unmanned Aerial Vehicles", Springer, 2015.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least**one full question from each module.**

Continuous Internal Evaluation (CIE):

ThreeTestsaretobeconductedfor40markseach.CIEisexecutedbywayofquizzes/Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER-VI

COURSE: ENVIRONMENTALSCIENCE

Course Code	**21CIV57/67**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**1 hour**

Pre requisite: NIL

Course Learning Objectives: To enable students to apply the knowledge of Environmental science in daily life:

CLO1	The fundamentals of environmental science
CLO2	The types of natural resources
CLO3	Various global environmental concerns
CLO4	The types of wastes generated and their handling at a basic level
CLO5	The environmental law and policies with a few important acts in the field

CONTENT	**No. of Hours/RBT levels**
Module 1 **Environment:** Definition, scope & importance components of environmental eco system: Structure and function of various types of eco systems. Human activities- Food, Shelter, Economic and Social security. Population- Growth, variation among nations- population explosion and impact on environment. **Biodiversity:** Types, value; Hot-spots; Threats and Conservation of Biodiversity, Forest Wealth and Deforestation.	**04Hours/ L2**
Module 2 **Natural Resources:** Forest, Water, Mineral, Food, Energy, Land **Environmental Pollution-**Definition-causes, effects and control measures of (a) Air pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear hazards	**04Hours/ L2**
Module 3 **Global Environmental Concerns:** (concepts, policies and case-studies): Ground water depletion/recharging, Climate change, Acid rain, Ozone depletion. Radon and Fluoride problem in drinking water; Resettlement and Rehabilitation of people, Environmental Toxicology.	**04 Hours/ L2**

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Module 4 **Sources:** Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Solid waste management rules in India. Sources and management of E-waste, Biomedical waste, Hazardous waste and construction waste at individual and community level. Socio-economic aspect of waste management**.**	**04 Hours/ L2**
Module 5 **Latest development in Environmental Pollution Mitigation Tools (Concept of Applications):** Environmental impact assessment, Environmental Management systems, ISO14001; Environmental stewardship- NGOs.	**04 Hours/ L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand holistically the key concepts of "Environment and Biodiversity"
CO2	Understand the types of Natural resources available and the effects of anthropogenic interventions.
CO3	Understand the gravity of various Global concerns
CO4	Understand the types of waste generated and their handling at a basic level.
CO5	Understand the importance of environmental law and policies.

Textbooks:

3. Benny Joseph, Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006
4. Gilbert M Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2006.

Reference books:

4. Rajagopalan R, "Environmental Studies-From Crisis to Cure", Oxford University press, 2005.
5. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT LTD, Delhi, 2014.
6.

Web References:

4. https://www.hzu.edu.in/bed/E%20V%20S.pdf
5. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
6. https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Scheme of Examination:

Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.

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Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
21CIV57.1/67.1	2	-	-	-	-	-	3	-	-	-	-	-	1	-	-
21CIV57.2/67.2	2	1	-	-	-	-	3	-	-	-	-	1	1	-	1
21CIV57.3/67.3	2	-	2	-	-	2	3	1	-	-	-	1	1	-	1
21CIV57.4/67.4	2	2	-	-	-	2	3	-	-	-	-	-	-	-	1
21CIV57.5/67.5	2	-	-	-	-	2	3	-	-	-	-	-	-	1	1
Average	**2**	**1.5**	**2**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

Low-1: Medium-2: High-3

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SEMESTER –VI

COURSE: UNIVERSAL HUMAN VALUES

Course Code	**21UHV57/67**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:0**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**1 hour**

Course Objectives:

CLO1	To create an awareness on Engineering Ethics and Human Values.
CLO2	To understand social responsibility of an engineer.
CLO3	To appreciate ethical dilemma while discharging duties in professional life.

Content	No. of Hours
Module 1 **INTRODUCTION TO VALUE EDUCATION** Value Education, Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education. Self-exploration as a means of Value Education. Happiness and Prosperity as parts of Value Education.	**05 Hours**
Module 2 **HARMONY IN THE HUMAN BEING** Human Being is more than just the Body. Harmony of the Self ('I') with the Body. Understanding Myself as Co-existence of the Self and the Body. Understanding Needs of the Self and the needs of the Body. Understanding the activities in the Self and the activities in the Body.	**05 Hours**
Module 3 **HARMONY IN THE FAMILY AND SOCIETY AND HARMONY IN THE NATURE** Family as a basic unit of Human Interaction and Values in Relationships. The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour. Harmony in Nature: The Four Orders in Nature. The Holistic Perception of Harmony in Existence.	**05 Hours**

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Module 4	05 Hours
SOCIAL ETHICS The Basics for Ethical Human Conduct. Defects in Ethical Human Conduct. Holistic Alternative and Universal Order. Universal Human Order and Ethical Conduct. Human Rights violation and Social Disparities.	
Module 5	**05 Hours**
PROFESSIONAL ETHICS Value based Life and Profession. Professional Ethics and Right Understanding. Competence in Professional Ethics. Issues in Professional Ethics – The Current Scenario. Vision for Holistic Technologies, Production System and Management Models.	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3	Understand the role of a human being in ensuring harmony in society and nature.
CO4	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

Textbooks:

4. A.N Tripathy, New Age International Publishers, 2003.
5. Bajpai. B. L, New Royal Book Co, Lucknow, Reprinted, 2004
6. Bertrand Russell Human Society in Ethics & Politics

Reference Books:

6. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
7. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
8. Corliss Lamont, Philosophy of Humanism Gaur. R.R. , Sangal. R, Bagari G.P, A Foundation Course in Value Education, Excel Books, 2009.
9. Gaur. R.R. , Sangal R , Bagaria G.P, Teachers Manual, Excel Books, 2009.
10. I.C. Sharma, Ethical Philosophy of India, Nagin & co, Julundhar William Lilly- Introduction to Ethics -Allied Publisher

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Scheme of Examination:

Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.

Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

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

Low-1: Medium-2: High-3

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SEMESTER VI

COURSE: MINI-PROJECT

Course Code	**21MPT68**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:4**	**SEE Marks**	**50**
No. of Credits	**2**	**Examination Hours**	**03**

Mini-project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

Individual student performance are evaluated based on the following COs :

Course Outcomes

CO1	Able to make comprehensive use of the technical knowledge gained from previous courses
CO2	Able to understand technologies concerned with the project
CO3	Able to apply project management skills (scheduling work, procuring parts and documenting expenditures and working within the confines of a deadline).
CO4	Able to analyze, develop and demonstrate the proposed work
CO5	Able to communicate technical information by means of ethical writing and presentation.

CIE procedure for Mini-Project:

a. **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

b. **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini-Project shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-Project:

a. Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

b. Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong.

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Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**50**	**50**
	Review-2		
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER VI

Course: MODELLING AND ANALYSIS LAB

Course Code	**21ANEL69**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Learning Objectives: To enable students to apply the knowledge of Flight dynamics in broad domain of aeronautical engineering by making them to learn:

CLO1	Understand about the concept of mesh generation.
CLO2	Learn about how to apply boundary condition.
CLO3	To analyze the stress of different structural components in aircraft.

S.N	Content	RBT levels
1.	Geometric Modeling and Mesh Generation of symmetric Airfoil Geometry.	L4
2.	Geometric Modeling and Mesh Generation of unsymmetrical Airfoil Geometry	L4
3.	Computations and Analysis of 2-D Incompressible and Inviscid Flow over symmetric and unsymmetrical Airfoil.	L4
4.	Geometric Modeling, Mesh Generation and flow analysis of 2-D Convergent-Divergent Nozzle.	L4
5.	Generation of body fitting hexagonal mesh and flow analysis of serpentine inlet duct	L4
6.	Structural Modeling of Sandwich Beam of Rectangular Cross-Section and Analyses for Stresses.	L4
7.	Structural Modeling of a Three Dimensional Wing.	L4
8.	Structural Modeling and Stress Analysis of a Fuselage Bulk Head.	L4
9.	Structural Modeling and Stress Analysis of a Simply Supported Rectangular Plate Uniformly Compressed in one Direction.	L4
10.	Structural Modeling and Stress Analysis of a Simply Supported Rectangular Plate Uniformly Compressed In one Direction with a Cut- Out in Center.	L4

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COURSE OUTCOMES:
Upon completion of this course, student will be able to:

CO1	Model and analyze symmetric and unsymmetrical Aero foil Geometry.
CO2	Model and analyze 2D Convergent- Divergent Nozzle and 3Dserpentine inlet duct
CO3	Analyze Sandwich Beam, 3D Wing and bulk head.
CO4	Perform Structural Modeling and Stress Analysis of a Simply Supported.
CO5	Model and analyze symmetric and unsymmetrical Aero foil Geometry.

Scheme of Examination:
Semester End Examination (SEE): Distribution of weightage for SEE of Regular courses

	Component	Marks	Total Marks
SEE	PART- A	**20**	**50**
	PART- B	**20**	
	VIVA-VOCE	**10**	
SEE Total			**50**

Continuous Internal Evaluation (CIE): Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	MANUAL / RECORD	**20**	**50**
	CIE Test-1	**20**	
	VIVA-VOCE	**10**	
CIE Total			**50**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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VII Semester Syllabus

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SEMESTER – VII

COURSE: COMPUTATIONAL FLUID DYNAMICS

Course Code	**21ANE71**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Learning Objectives: Enable students to gain a comprehensive understanding of CFD theory, its mathematical foundations, and practical applications, enabling them to solve complex fluid dynamics problems using computational methods.

CLO1	Understand the Fundamentals of CFD, Derive the Governing Equations, Explore Shock Capturing and Shock Fitting methods
CLO2	Classify Partial Differential Equations (PDEs), Analyse their Case Studies
CLO3	Understand Finite Difference Methods, Explore Time and Space Marching, Implement Numerical Schemes
CLO4	Recognize Grid Generation Methods, Explore Structured/Unstructured Grids, Evaluate Grid Quality and Adaptive Grids:
CLO5	Understand finite volume techniques, applications and their solution schemes

CONTENT	**No. of Hrs /RB Levels**
MODULE-1 **INTRODUCTION AND GOVERNING EQUATIONS** CFD ideas to understand, CFD Application, Need for high speed Parallel Computing, Substantial derivative, Divergence of velocity, Flow models, Continuity Equation, Momentum Equation, and Energy Equations in various forms. Physical Boundary conditions. Shock capturing, Shock fitting.	**8 Hours L1, L2**
MODULE-2 **MATHEMATICAL BEHAVIOUR OF PARTIAL DIFFERENTIAL EQUATIONS**: Classification of partial differential equations – Cramer Rule, Eigenvalue method. Hyperbolic, parabolic, and elliptic form of equations. Impact of classification on physical and computational fluid dynamics. Case studies-steady inviscid supersonic flow, unsteady inviscid flow, steady boundary layer flow, unsteady thermal conduction, and steady subsonic inviscid flow.	**10 Hours L2,L3**
MODULE-3 **DISCRETIZATION TECHNIQUES** Finite differences methods, and difference equations. Explicit and Implicit Approach Errors and stability analysis. Time marching and space marching. Reflection boundary condition. Relaxation techniques. Successive over relaxation/under relaxation. Second order Lax-Wendroff method, mid-point Leap frog method, Alternating Direction Implicit (ADI) Method, upwind scheme, numerical viscosity, and artificial viscosity.	**8 Hours L2,L3, L4**
MODULE-4 **GRID GENERATION AND ADAPTIVE GRID METHODS** Need for grid generation and Body-fitted coordinate system. Structured Grids-essential features. Structured Grid generation techniques- algebraic and numerical methods. Unstructured Grids-essential features. Unstructured Grid generation techniques- Delaunay-Voronoi diagram, Advancing Front Method	**8 Hours L2,L3**

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(AFM). multi-block grid generation, Surface grid generation, multi-block grid generation, and meshless methods. Grid quality, adaptive grids and Adaptive Structured Grid Generation, Unstructured adaptive grid Methods.	
MODULE-5 **FINITE VOLUME TECHNIQUES AND APPLICATIONS** Spatial discretization- cell centered and cell vertex techniques (overlapping control volume, duel control volume). Temporal discretization- Explicit time stepping, and implicit time stepping. Time step calculation. Applications: Aspects of numerical dissipation & dispersion. Approximate factorization, Flux Vector splitting. Diffusion problem	**8 Hours** **L2,L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Comprehend the fundamental concepts of CFD and derive basic Governing Equations.
CO2	Assimilate Mathematical behavior of PDEs vis a vis nature of flow
CO3	Analyze FDM techniques for Time/Space marching and numerical schemes.
CO4	Describe Grid generation and utilization techniques.
CO5	Apply Spatial/Temporal discretization in FVM applications.

Textbooks:

1. Anderson, J.D., "Computational Fluid Dynamics – the basics with applications", McGraw-Hill, 1995.
2. Versteeg, H.K. and Malalasekara, W. "Introduction to Computational Fluid Dynamics: The Finite Volume Method". Second Edition (Indian Reprint) Pearson Education.
3. Dale A. Anderson, John C. Tannehill, Richard H. Pletcher, Munipalli Ramakanth, VijayaShankar,"Computational Fluid Mechanics and Heat Transfer", 4th edition, CRC Press, https://doi.org/10.1201/9781351124027, eBook ISBN9781351124027, 2020

Reference books:

1. John F. Wendt, "Computational Fluid Dynamics: An Introduction" third edition, Springer, 2008
2. Suhas V. Patankar, "Numerical Heat Transfer and Fluid Flow", McGraw-Hill, reprint 2017.
3. Ferziger, J. H. and Peric, M. Computational Methods for Fluid Dynamics. Third Edition, Springer Verlag, Berlin
4. S. C Gupta , "Applied Computational Fluid Dynamics" Publisher-Wiley, 2019 ; ISBN, 8126587571, 9788126587575

Web references/ Additional online information (related to module if any):

1. https://nptel.ac.in/courses/112/105/112105045/.
2. https://nptel.ac.in/courses/112/105/112105254/.

Practical knowledge references

1. https://ocw.mit.edu/courses/2-29-numerical-fluid-mechanics-spring-2015/pages/lecture-notes-and-references/
2. https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately

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reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes/ Alternate Assessment Tools (AATs) for 10 marks. Typical Evaluation pattern for regular courses is shown in Table 1.

Table1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping														
COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	-	-	-	1	1	1	-	1	1
CO2	3	3	2	2	1	-	-	-	1	1	1	-	1	1
CO3	3	3	2	2	1	-	-	-	1	1	1	-	1	1
CO4	3	3	2	2	1	-	-	-	1	1	1	-	1	1
CO5	3	3	2	2	1	-	-	-	1	1	1	-	1	1
Average	**3**	3	**2**	**2**	**1**	-	-	-	**1**	**1**	**1**	-	**1**	**1**

Low-1: Medium-2: High-3

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SEMESTER – VII

COURSE: AIRCRAFT STABILITY AND CONTROL

Course Code	**21ANE72**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aircraft Performance

Course Objectives: To enable students to apply the knowledge of Aircraft Stability and Control in broad domain of aeronautical engineering by making them to learn:

CLO1	To impart knowledge on the criteria for longitudinally stable configuration.
CLO2	To provide the aspects of weathercock stability and requirements of rudder.
CLO3	To impart knowledge on dihedral effect and aileron control power.
CLO4	To provide the methodology to obtain the characteristic modes of an airplane in longitudinal motion.
CLO5	To impart knowledge on autorotation and spin and Dutch roll motions of airplanes.

Content	No. of Hours/RBT levels
Module 1 **STATIC LONGITUDINAL STABILITY AND CONTROL:** General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, Need for stability in an airplane, inherently and marginally stable airplanes, Stability and Controllability, Requirements of control surfaces, criteria for longitudinal static stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, Free elevator factor, static margin, Hinge moment, Power effects on stability-propeller and jet aircrafts, longitudinal control, Movement of centre of gravity, elevator control effectiveness, elevator control power, elevator angle to trim, elevator angle per g, maneuver point, Stick force gradient and stick force per g, Aerodynamic balancing.	**08 Hours/ L3**
Module 2 **STATIC DIRECTIONAL STABILITY AND CONTROL:** Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Power effects on directional stability-propeller and jet aircrafts, Rudder fixed and rudder free aspects, Rudder lock and Dorsal fin, Directional control, rudder control effectiveness, rudder requirements, adverse yaw, asymmetric power condition, spin recovery.	**08 Hours/ L3**

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Module 3	
STATIC LATERAL STABILTY AND CONTROL: Lateral Stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability contribution of fuselage, wing, wing fuselage, tail, total static lateral stability, lateral control, aileron control power, aileron effectiveness, strip theory estimation of aileron effectiveness, roll control by spoilers, aileron reversal, aileron reversal speed	**08 Hours/ L3**

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Module 4 **DYNAMIC LONGITUDINAL STABILITY:** Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quadratic, Phugoid motion, Factors affecting the period and damping.	**08 Hours/ L3**
Module 5 **DYNAMIC LATERAL AND DIRECTIONAL STABILITY:** Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Obtain static margin of airplane in stick fixed and free aspects.
CO2	Understand the design concept of rudder by considering the critical situations that demand the use of rudder.
CO3	Estimate total lateral stability of an airplane.
CO4	Determine the natural frequency and damping ratio of Phugoid and short period motions.
CO5	Explain the recovery procedure of an airplane from dangerous situations like autorotation and spin.

Textbooks:

1. Nelson, R.C. Flight Stability & Automatic Control, McGraw Hill, 1998.
2. Perkins C.D. & Hage R.E. Airplane performance, stability and control, John Wiley & Sons 1967.

Reference books:

1. Babister, A.W. Aircraft Stability and response, Pergamon Press, 1980.
2. Etkin, B., Dynamics of Flight Stability and Control, Wiley, third edition 1995.
3. McCormick, B.W. Aerodynamics, Aeronautics & Flight Mechanics John Wiley, 1995.
4. Pamadi, B.N. Performance, Stability, Dynamics, and Control of Airplanes, AIAA Education Series, 2004.

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VII

COURSE: AVIONICS

Course Code	**21ANE73**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Pre requisite: NILP

Course Objectives: To enable students to apply the knowledge of Avionics in broad domain of Aeronautical Engineering by making them to learn:

CLO1	To know about the basics of avionics and its need for civil and military aircrafts
CLO2	To impart knowledge about the avionic architecture and various avionics data buses
CLO3	Knowledge on various avionics subsystems
CLO4	Learn about different navigation systems
CLO5	Learn about air data systems and auto pilot

Content	No. of Hours/RBT levels
Module 1 **Introduction to Digital Electronics** Logic Gates, Boolean Algebra, Encoders, Decoders, Multiplexer and Demultiplexer, Microprocessor-Introduction to VLSI.Antenna-types, radiation pattern ,voltage and current distribution, polarization. Introduction to digital computer and memories.	**08 Hours/L2**
Module 2 **Introduction to Avionics** Need for avionics, Typical avionics subsystems, design, technologies –Avionics Bus Architecture-Digital Data Buses, Fiber Optic Buses, integrated avionics and weapon systems, Different types of co-ordinate systems	**08 Hours/L2**
Module 3 **Flight Sensors and Displays** Air Data Sensing, Air Data Computer, Magnetic Sensing – Magnetic Heading Reference System (MHRS), Inertial Sensing, Radar Altimeter (RADALT), Doppler Radar, Weather Radar - Cathode Ray Tube (CRT), Active Matrix Liquid Crystal Display (AMLCD), Head Down Display (HDD), Head Up Display (HUD), Helmet Mounted Display (HMD), Integrated Standby Instrument System (ISIS). Direct voice input (DVI), Touch Screen, HOTAS.	**08 Hours/L2**
Module 4 **Communication and Automatic Flight Control** HF, U/VHF, Satellite Communication, Terrain communication, Air Traffic Control (ATC) Transponder, Traffic Collision & Avoidance System (TCAS), Identification of Friend & Foe (IFF). Emergency locator transmitters Longitudinal, Lateral & Direction Autopilot.	**08 Hours/L2**

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Module 5 **Navigation** Automatic Direction Finding, Very High Frequency Omni-Range (VOR), Distance Measuring Equipment (DME), Tactical Air Navigation (TACAN), VORTAC (VOR+TACAN), Hyperbolic navigation, Satellite Navigation System-Global Positioning System (GPS), Differential GPS, Instrument Landing System (ILS), Transponder Landing System (TLS), Microwave Landing System (MLS), Laser based landing and RF based landing system, Astronavigation.	**10 Hours/L2**

Sl.No.	**LIST OF EXPERIMENTS**	**RBT LEVELS**
1	Calibration and measurement with Air Speed Indicator.	**L3**
2	Calibration and measurement with Altimeter	**L3**
3	Calibration and measurement with Rate of Climb Indicator and Attitude Indicator	**L3**
4	Calibration and measurement with - Turn and Slip Indicator	**L3**
5	Gyroscopic Instruments – Demonstration for vertical speed hold	**L3**
6	Gyroscopic Instruments – Demonstrate for rate feedback modeling	**L3**
7	Demonstration of use of Radio Magnetic Indicator (RMI)	**L3**
8	16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave.	**L3**
9	Study of Pulse Amplitude Modulation (PAM) and Demodulation	**L3**
10	Study of MIL-STD-1553 B Data Bus	**L3**
11	Addition and Subtraction of 8-bit and 16-bit numbers using Microprocessor.	**L3**
12	Interface programming with 4-digit 7 segment display and switches and LED's.	**L3**
13	Encoder/Decoder Circuits, Multiplexer/DE multiplexer Circuits and Addition/Subtraction of binary numbers.	**L3**
14	Timer Circuits, Shift Registers, Binary Comparator Circuits	**L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Describe the need for avionics in civil and military aircraft.
CO2	Understand modern Aviation and avionics architecture.
CO3	Familiarize about control and display technologies used
CO4	Describe about the different navigation systems
CO5	Identify and understand the use of air data systems and auto pilot

Textbooks:

1. Civil Avionics Systems: Ian Moir, Allan Seabridge, AIAA Education Series.
2. Aircraft System : Ian Moir & Allan Seabridge, John Wiley.
3. Aircraft Electricity & Electronics : T.K. Eismin, Macmillan.
4. Geroge Kannedy : Electronic Communication System, McGraw Hill.
5. Myron Kayton and Walter R fried, Avionics Navigation Systems, John Wiley and Sons.
6. J. Powell: Aircraft Radio Systems, Himalayan Books, 1990.
7. L Tetley and D Calcutt, Electronic Aids to Navigation, Edward Arnold Publishers Ltd.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VII

PROGRAM ELECTIVE 3

COURSE: HELICOPTER ENGINEERING

Course Code	**21ANE741**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Basics of Aeronautical Engineering

Course Objectives:

To make the student familiarize with the Principles involved in helicopters and to study the performance and stability aspects of Helicopter under different operating conditions.

CLO1	Understand how helicopters work and their historical development
CLO2	Apply the concept of momentum theory and Blade element theory to analyze helicopter aerodynamics
CLO4	Evaluate the helicopters performance.
CLO5	Explore the dynamics and vibration aspects of helicopters

Content	No. of Hours/ RBT levels
Module 1 **Brief overview and basics of Helicopter** Historical development of rotorcraft, comparison of helicopter with fixed wing aircraft, features, roles, parts of helicopter, propulsion & power transmission, basic controls, reaction torque, anti-torque mechanisms, Autorotation concept, different helicopter configurations. Helicopter complexities – Rotor wake, Dissymmetry of Lift in forward flight, Control mechanism, ground resonance, stability & control issues.	**08 Hours / L2**
Momentum theory in hover and axial flight Modeling rotor as an actuator disc, momentum theory, concept of induced velocity, development of simplified models for induced velocity, induced power, and figure of merit, momentum theory in vertical climb, flow states in climb, descent and vortex ring state.	**08 Hours / L2**
Module 3 **Blade element theory in hover and vertical climb** Combined momentum and blade element theory, Ideal twist and taper distribution, rotor solidity, general equation for induced velocity, thrust & torque equations, tip losses, ground effect and autorotation in vertical descent.	**08 Hours / L2**
Module 4 **Helicopter in forward flight & performance Analysis** Momentum theory, induced velocity & induced power variation with forward speed. Blade motion in forward flight, reverse flow region, blade element theory, expression for thrust, torque and H-force. Hover performance, Hover in ground Effect, Hover out of ground effect, hover ceiling, forward flight performance and power required	**08 Hours/ L2**

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Module 5	
Rotor Dynamics & Vibration Dissymmetry of Lift, flapping Hinge, flapping motion in hover: flapping equilibrium, coning – Causes & Effects, static & dynamic stability of flapping motion in hover. Rotor as Gyroscope – Gyroscopic Effect on Rotor response, Rotor Pitch Control: Collective & Cyclic. Rotor dynamics with Flap- Hinge Offset and Flapping Dynamics, Brief introduction to helicopter vibration.	**10 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Explain the Parts of Helicopters and their functionality
CO2	Apply the Momentum theory for Analysis of Helicopter Aerodynamics
CO3	Apply the Blade Element theory for Analysis of Helicopter Aerodynamics
CO4	Calculate the performance parameters in various flight Conditions
CO5	Understand the complexity of rotor dynamics and helicopter vibrations

Textbooks:

1. Alfred Gessow & Garry C. Myers, Jr, Aerodynamics of the helicopter, 8th printing, 1895, Frederick Ungar Publishing Co. New York.
2. R. W. Prouty, Helicopter Aerodynamics, Sterling Book House
3. J.Gordon Leishman, Principles of Helicopter Aerodynamics, Second Edition, Cambridge University Press.

Reference books:

1. John Seddon and Simon Newmann Basic Helicopter Aerodynamics, 3rd Edition, Wiley Aerospace Series, London.
2.A.R.S. Bramwell, George Done and Davis Balmford, Bramwell's Helicopter Dynamics, 2nd Edition, Butterworth-Heinemann (Reed Educational & Professional Publishing Ltd.), 2001.
3.Helicopter Flying Handbook, 2012 by U.S. Department of Transportation, FAA

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER VII

PROGRAM ELECTIVE 3

COURSE: SPACE MECHANICS

Course Code	**21ANE742**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: NIL

Course Learning Objectives:

CLO1	To introduce the basic concepts of astronomy
CLO2	To understand the motion of the space craft in their relative gravitational filed
CLO3	Learn about the satellite injection and perturbation in various orbits
CLO4	To provide insight of interplanetary spacecraft mission .
CLO5	Understand the Ballistic Missile Trajectories and Re-entry phase.

Content	No. of Hours/ RBT levels
Module 1 **INTRODUCTION TO SPACE MECHANICS:** Basic concepts: The solar system, Reference frames and coordinate systems, The celestial sphere, The ecliptic, Motion of vernal equinox, Sidereal time, Solar Time, Standard Time, The earth 's atmosphere.	**08 Hours/ L3**
Module 2 **THE GENERAL N- BODY PROBLEM:** Conic Sections, Two-Body Problem, Conservation of Angular Momentum and Energy, Kepler's laws of planetary motion and proof of the laws, Trajectory Equation, Elliptical Orbit, Circular Orbit, Parabolic Trajectory, Hyperbolic Trajectory, the circular restricted three body problem– the general N-body problem.	**10 Hours/ L3**
Module 3 **SATELLITE INJECTION AND SATELLITE PERTURBATIONS:** Classical Orbital Elements, Time of Flight, General aspects of satellite injection – satellite orbit transfer, Hohmann Transfer – orbit deviations due to injection errors – special and general perturbations – method of variations of orbital elements .	**08 Hours/ L3**
Module 4 **INTERPLANETARY TRAJECTORIES:** Introduction, Patched-Conic Method, concept of sphere of influence – launch of interplanetary spacecraft – trajectory estimation about the target planet, Phase Angle at Departure, Planetary Arrival, Gravity Assists.	**08 Hours/ L3**
Module 5 **ATMOSPHERIC ENTRY:** Introduction to ballistic missile trajectories – Entry Flight Mechanics– Ballistic Entry– Gliding Entry– Skip Entry– Entry Heating– Space Shuttle Entry.	**08 Hours/ L3**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the basic Concepts in Orbital Mechanics and Attitude Dynamics.
CO2	Analyze the Orbital motion of a satellite relative to their gravitational body.
CO3	Understand the Orbital elements to define the shape, size and orientation of an orbit for satellite injection.
CO4	Estimate the trajectory/orbit of a space vehicle or a satellite in a suitable coordinate system.
CO5	Understand the Ballistic Missile Trajectories and Re-entry phase.

Textbooks:

1. David A. Vallado., "**Fundamentals of Astrodynamics and Applications"** Microcosm Press Hawthorne, CA.
2. Craig A. Kluever, **"Space Flight Dynamic"** John Wiley & Sons, Inc, 2018.

Reference books:

1. Cornelisse, J.W., "**Rocket Propulsion and Space Dynamics**", J.W. Freeman & Co.,Ltd, London,1982
2. Howard D. Curtis., **"Orbital Mechanics for Engineering Students"** Second Edition, Elsevier Ltd

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER VII

PROGRAM ELECTIVE 3

COURSE: EXPERIMENTAL AERODYNAMICS

Course Code	**21ANE743**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aerodynamics-II

Course Learning Objectives:

CLO1	To provide extensive treatment of the operating principles and limitations of pressure and temperature measurements
CLO2	To cover both operating and application procedures of hot wire anemometer.
CLO3	To describe flow visualization techniques and to highlight in depth discussion of analogue methods.
CLO4	To understand the pressure and velocity measuring instruments
CLO5	To understand DAQ and Error estimation

Content	No. of Hours/ RBT levels
Module 1 **BASIC MEASUREMENTS IN FLUID MECHANICS** Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements – Analogue methods – Flow visualization.	**08 Hours/ L3**
Module 2 **WIND TUNNEL MEASUREMENTS:** Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels – Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Wind tunnel balance – Wire balance – Strut-type – Platform-type – Yoke-type – Pyramid type – Strain gauge balance.	**10 Hours/ L3**
Module 3 **FLOW VISUALIZATION AND ANALOGUE METHODS:** Visualization techniques – Smoke tunnel – Hele-Shaw apparatus – Interferometer – Fringe – Displacement method – Schlieren system – Shadowgraph – Hydraulic analogy – Hydraulic jumps – Electrolytic tank.	**08 Hours/ L3**
Module 4 **PRESSURE, VELOCITY AND TEMPERATUREMEASUREMENTS:** Pitot – static tube characteristics – Velocity measurements – Hot-wire anemometry – Constant current and Constant Temperature Hot-Wire anemometer – Pressure measurement techniques – Pressure transducers – Temperature measurements.	**08 Hours/ L3**

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Module 5	
SPECIAL FLOWS AND UNCERTAINTY ANALYSIS: Measurements in boundary layers – Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation – Uses of uncertainty analysis.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Knowledge on Measurement Techniques in Aerodynamic flow.
CO2	Acquiring the basic knowledge of Wind Tunnel Measurement systems
CO3	Understand the use of specific instruments for Flow Parameter measurement like Pressure, Velocity.
CO4	Analyze the model measurements, Lift and Drag measurements through various techniques and testing of different models.
CO5	Acquire the Knowledge on DAQ and Error estimation

Textbooks:

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

Reference books:

1. Bradsaw "**Experimental Fluid Mechanics**", Elsevier, 2nd edition, 1970.
2. Pope, A., and Goin, L., "**High Speed Wind Tunnel Testing**", John Wiley, 1985.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER VII
PROGRAM ELECTIVE 3

COURSE: AIRCRAFT MAINTENANCE, REPAIR & OVERHAUL

Course Code	**21ANE744**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: NIL

Course Learning Objectives: To enable students to apply the knowledge aircraft maintenance, repair & overhaul in broad domain of aeronautical engineering by making them to learn:

CLO1	To provide the fundamentals of maintenance and certification
CLO2	To provide knowledge of documentation for maintenance
CLO3	To describe the role of aviation management and skill required by the maintenance crew
CLO4	To understand aircrafts hanger maintenance , materials support & management
CLO5	To understand aircraft Maintenance, safety and trouble shooting

Content	**No. of Hours/ RBT levels**
Module 1 **Maintenance & Certification:** Fundamentals of Maintenance & Certification Types of maintenance, Redesign, Failure rate pattern, Other maintenance considerations. Aviation industry certification requirements, Type certificate (FAA form 8110.9), Airworthiness certificate (FAA form 8100-2), Aviation maintenance certifications, General, Airframe, Power plant, Avionics courses.	**8 Hours/ L3**
Module 2 **Documentation of aircraft Maintenance** :Documentation for Maintenance Manufacturers documentation, Airplane maintenance manual, Fault insulation manual, Illustrated parts catalogue, structural repair manual, wiring diagram manual, Master minimum equipment, Federal Aviation regulation (FAR), Advisory circulars, Airworthiness direction ATA document standards, Technical policies and procedure manuals (TPPM).	**08 Hours / L3**
Module 3 **Aviation management system:** Aircraft Management Maintenance Structure, Role of aviation management, Line supervisory management, Management areas of concern in an airlines, Manager of overhaul shops, Line maintenance control centre flight line (preflight & post flight), Aircraft Logbook, Maintenance crew skill requirements.	**08 Hours/ L3**

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Module 4 **Hanger Maintenance :**Hanger Maintenance (on Aircraft) & Material Support Introduction, organization of hanger maintenance, Non- routine item, parts availability, cannibalization, Types of shops- sheet metal shop, Aircraft interior shop, Engine shop, Avionics shop, ground support equipment, outsourcing of shop maintenance work, operation of overhaul shops, Material support, Material management inventory control, Support functions of material, Parts ordering, Storage, Issue, control and handling, Parts receiving quality control, calibration program, stock level adjustments, shelf life, exchanges, warranty & modifications of parts.	**08 Hours / L3**
Module 5 **Maintenance Safety & Trouble shooting:** Maintenance Safety & Trouble shooting Safety regulations, occupational safety and health standards maintenance safety program, Airlines safety management, General safety rules, Accident & injury reporting, Hazardous materials storage and handling aircraft furnishing practices trouble shooting, Reliable quality, Knowledge of malfunctions.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the fundamentals of maintenance and certification
CO2	Acquire the knowledge of documentation for maintenance
CO3	Familiarize the role of aviation management and skill required by the maintenance crew
CO4	Comprehend hanger maintenance of aircrafts, materials support & management.
CO5	Acquire the knowledge of Aircraft Maintenance, safety and trouble shooting

Textbooks:

1. **Harry A Kinnison, Tariq Siddiqui**, " Aviation Maintenance Management ", Mc Graw Hill education (India) Private Ltd, 2013.
2. **Kroes, Watkins, Delp Larry Reithmaier,** “Aircraft Repair Manual”, Mc Graw-Hill Education, 2013.

Reference books:

1. **Brimm. D J, Bogges, H E,** “Aircraft Maintenance”, Pitman publishing corp, London, 1952

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VII

OPEN ELECTIVE 2

COURSE: DRONE TECHNOLOGY

Course Code	**21ANE751**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to understand the drone and its functioning

CLO1	To Identify & select different types of drones, drone rules and regulations
CLO2	Select different drone parts and to understand aerodynamics
CLO3	Understand BLDC motors and different type of batteries
CLO4	Understand different sensors and Flight Control System

Content	No. of Hours/ RBT levels
Module 1 **Introduction:** Different types of Drones, Nomenclatures, History of aerial drones, reputation, airframe, Configurations, basic components, current/future uses of drones. DGCA regulations	**08 Hours L1, L2**
Module 2 **Air vehicle and Propulsion system:** Basics of aerodynamics**,** Introduction to different electric motors like DC, BLDC, servo motors, working, understanding its functioning, speed torque characteristics, degree of freedom in drone. Introduction Electronic Speed Controller. Performing payload calculation, speed control techniques, thrust to weight ratio.	**08 Hours L1, L2**
Module 3 **Battery System:** Introduction of different types of batteries used in drone. Understand different specifications and their significance of batteries. Different charging circuits or batteries, battery management system (BMS) and Building Blocks of BMS.	**08 Hours L1, L2**
Module 4 **Sensors:** Introduction of different sensors used in drone like accelerometers, inertial measurement units, tilt and lidar sensor, gyro sensor. Principle of operation, their roles and characteristics. Selection of appropriate sensor as per requirement. Introduction to Flight controller system	**08 Hours L1, L2**
Module 5 **Mission Planning and Control**: Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems,	**08 Hours L1, L2**

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Recovery Systems, Launch and Recovery Tradeoffs, Current trends/ Technologies	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Identify different types of drones and drone rules and regulations
CO2	Explain the forces acting on Drone during flight
CO3	Comprehend the Drone propulsion system
CO4	Acquire the knowledge of battery system
CO5	Describe different sensors and Flight Control System

Textbooks:

1. The Drone Rules, 2021. The Gazette of India: Extraordinary [Part II—Sec. 3(i)].
2. John Baichtal "Building Your Own Drones" A Beginner's Guide to Drones, UAVs, and ROVs Que Publishing, ISBN - 9780789755988
3. Julio Alberto Mendoza "Drones to Go" A Crash Course for Scientists and Makers, Apress ISBN-978-1-4842-6787-5

Reference books:

1. Paul Gerin Fahlstrom, Thomas James Gleason, Introduction to UAV Systems, Wiley Publication John Wiley & Sons, Ltd, 4th Edition 2012.
2. Landen Rosen, Unmanned Aerial Vehicle, Alpha Editions, N.Y., 2012
3. Valavanis, Kimon P, Unmanned Aerial Vehicles, Springer, 2011.
4. Valavanis, K., Vachtsevanos, George J, Unmanned Aerial Vehicles, Springer, 2015.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping														
CO/PO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	-	-	-	-	-	1	1	-	-	-	1	1	-
CO2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	1	-	-	-	-	-	1	-	-	-	-	1	1	-
CO4	1	-	-	-	-	-	1	-	-	-	-	1	1	-
Average	1						1	1				1	1	

Low-1: Medium-2: High-3

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SEMESTER- VII

OPEN ELECTIVE 2

COURSE: AIRPORT PLANNING & MANAGEMENT

Course Code	**21ANE752**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of Airport Planning and Management by making them to learn typical operations of airport operations, economic, political and social role of airports and its management.

CLO1	To gain knowledge of the typical operations of airports from a management perspective
CLO2	To provide insights of economic, political and social role of airports
CLO3	Acquire the knowledge of airport operations
CLO4	Acquire the knowledge airport financial management
CLO5	Provide insights into the operational delay and capacity management

Content	**No. of Hours/ RBT levels**
Module 1 **AIRPORTS AND AIRPORT SYSTEMS:** Introduction: Airport management on an international level; The national plan of integrated airport systems; The nation's airport system plan; The rules that govern airport management; Organizations that influence airport regulatory policies; A historical and legislative perspective: Introduction the formative period of aviation and airports, Airport growth: World War-II and the postwar period airport modernization: The early jet age.	**08 Hours/ L2**
Module 2 **COMPONENTS OF THE AIRPORT** The components of an airport, the airfield. Navigational aids (NAVAIDS) located on airfields; Air traffic control and surveillance facilities located on the airfield; Weather reporting facilities located on airfields; Security infrastructure on airfields; Airspace and air traffic control: Brief history of air traffic control; The basics of air traffic control; Current and future enhancements to air traffic control; Airport terminals and ground access: The historical development of airport terminals; Components of the airport terminal; Airport ground access	**08 Hours/ L2**
Module 3 **AIRPORT OPERATIONS AND FINANCIAL MANAGEMENT** Airport operations management: Introduction, pavement management, aircraft rescue and firefighting (ARFF); Snow and ice control, safety inspection programs. Bird and wildlife hazard management; Airport security: Security at commercial service airports, security at general aviation airports; the future of airport security	**08 Hours/ L2**

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Module 4 **AIRPORT FINANCIAL MANAGEMENT** Airport financial accounting, revenue strategies at commercial airports, pricing of airport facilities and services, variation in the sources of operating revenues, rise in airport financial burdens, airport funding, grant programs, airport financing, private investment sale of the airport.	**08 Hours/L2**
Module 5 **AIRPORT CAPACITY AND DELAY** Defining capacity, factors affecting capacity and delay, estimating capacity, analytical estimates of delay: The queuing diagram; The future of airport management: Introduction, restructuring of commercial air carriers, new large aircraft and small aircraft transportation systems. restructuring of commercial air carriers, new large aircraft and small aircraft transportation systems.	**08 Hours/ L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Explain the typical operations of airports from a management perspective
CO2	Identify the economic, political and social role of airports
CO3	Describe the airport operations
CO4	Discuss the airport financial management
CO5	Explain and defining capacity, factors affecting capacity and delay

Textbooks:

1.Alexander T Wells, Ed. D Seth Young ''Airport planning and Management'' McGraw-Hill Education 6th Edition, 2011.

Reference books:

1. Norman J. Ashford, H. P. Martin Stanton, Clifton A. Moore, Pierre Coutu "Airport Operations", McGraw Hill 3rd Edition, 2013.

Scheme of Examination: Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER- VII

OPEN ELECTIVE 2

COURSE: AVIATION SAFETY MANAGEMENT AND ACCIDENT INVESTIGATIONS

Course Code	**21ANE753**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Course Objectives: To enable students to apply the knowledge of **Aviation Safety Management and Accident Investigations** by making them to learn typical operations of airport operations, economic, political and social role of airports and its management.

CLO1	To Gain the knowledge of Aviation Safety Management and Accident Investigations
CLO2	learn typical operations of airport operations, economic, political and social role of airports
CLO3	Learn about the financial management of airport
CLO4	Gain the knowledge about helicopter operation during emergency

Content	No. of Hours/ RBT levels
Module 1 **INTRODUCTION**-Aviation safety -Meaning -Need -Economic of Aviation Safety -Safety Vs Mission -Randomness of Damage and Injury -Zero Accident Rate -Accident causes -Multiple Vs Single Cause -Aircraft Accident -Aircraft Mischap -Aircraft Incident -Building Aviation Safety Program -Prevention Methodology -Risk Management	**08 Hours/ L2**
Module 2 **HUMAN FACTORS IN AVIATION SAFETY**-Theory of Risk -Changing the Behaviour of the risk takers -Attitudes -Discipline -Punishment -Protection of Safety -Motivating Safe Behaviour -Human factors difficulties -Training invlovling human factors -Human Performance Concerns -Human Performance Factors.	**08 Hours/ L2**
Module 3 **AVIATION SAFETY PROGRAM ELEMENTS**-Internal Reporting Systems - Information Distribution systems -Aviation Safety Committees -Aviation Safety Inspection Programs -Aviation safety program Evaluation -Flight Operation Safety Inspection -Safety Inspection report Format -Aviation Safety Education and Training -Aviation Safety Awards Programs -Accident Preparation and Investigation.	**08 Hours/ L2**
Module 4 **AIRCRAFT MAINTENANCE SAFETY-**Aircraft Discrepancies -Delayed and Deferred Descrepancies -Training -Configuration Control -Maintenance Engine Runs and Taxiing Maintenance Test Flights -maintenance Analysis -Tool Control -Hazarodous Waste Disposal -Bogus parts -Technical Data -maintenance Inspections -Flight Line Practices - Maintenance Safety Programs -Maintenance Safety Inspections.	**08 Hours/ L2**
Module 5 **AIRPORTS AND HELIPORTS**-Airport Certification Manual -Airport Emergency Plan -Airports/Heliports criteria -Airfield Criteria -Airspace Criteria -Foreign Object Control -Bird Hazards -Snow and Ice Removal -Fuel Handling -Vehicle Control -Airport and Heliport Safety Inspections.	**08 Hours/ L2**

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COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Build and implement aviation safety management programs in aviation related organizations.
CO2	Explain the importance of human factor and thereby build human factor training for their organization to reduce accidents and incidents occurring because of human factor.
CO3	Formulate and implement aviation safety management programs and to prepare accident and incident reports.
CO4	Plan and schedule maintenance activities for the aircrafts.
CO5	Understand maintain the airport certification manual and to conduct airport and helipad inspection program.

Textbooks:

1. Richard H. Wood 'Aviation Safety Programs -A Management Handbook'' SIU Press, 1986.
2. Alan J. Stolzer, John J. Goglia, "Safety Management Systems in Aviation", Routledge 2nd edition, 2015

Reference books:

1. Shari Stamford Krause, "Aircraft Safety: Accident Investigations, Analyses& Applications", McGraw-Hill Education Second Edition, 2003.

Scheme of Examination: Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VII

COURSE: PROJECT PHASE 1

Course Code	**21ANE76**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:4**	**SEE Marks**	**-**
No. of Credits	**2**	**Examination Hours**	**-**

Content	No. of Hours/RBT levels
Project work phase - 1: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6. CIE procedure for Project Work Phase - 1: **a. Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology) using Rubrics, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the Project report shall be the same for all the batch mates. **b. Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates as per Rubrics covering all Program Outcomes.	**04 Hours**

Individual student performance are evaluated based on the following COs :

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CO1	Able to make comprehensive use of the technical knowledge gained from previous courses
CO2	Able to understand technologies concerned with the project
CO3	Able to apply project management skills (scheduling work, procuring parts and documenting expenditures and working within the confines of a deadline).
CO4	Able to analyze, develop and demonstrate the proposed work
CO5	Able to communicate technical information by means of ethical writing and presentation.

Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	--	--
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VII

COURSE: FLIGHT SIMULATION LAB

Course Code	**21ANEL77**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Course Learning Objectives:

CLO1	Plot the root locus and bode plot
CLO2	Calculate the dynamic response of aircraft
CLO3	Use computational tools to model aircraft trajectory.

S.N	LIST OF EXPERIMENTS	RBT LEVELS
1	Draw Pole-Zero map of dynamic system model with plot customization option	**L3**
2	Plot root locus with variables in transfer function through MATLAB	**L3**
3	Plot root locus for a dynamic system though MATLAB	**L3**
4	Draw Bode plot from a transfer function in MATLAB and explain the gain and phase margins	**L3**
5	Simulate a spring- mass- damper system with and without a forcing function though SIMULINK	**L3**
6	Simulate a bomb drop from an aircraft on a moving tank in pure pursuit motion	**L3**
7	Develop a straight and level flight simulation program using MATLAB	**L3**
8	Simulate aircraft Take-off and Landing with trajectory tracing	**L3**
9	Simulate stall of aircraft and show the effect of variation in static margin on stalling characteristics	**L3**
10	Simulate aircraft longitudinal motion and demonstrate the effect of static margin variation for a pulse input in pitch that is intended to bleed the airspeed.	**L3**
11	Simulate aircraft longitudinal motion and demonstrate the effect of static margin variation for a doublet input in pitch.	**L3**
12	Given a Quartic characteristic equation, determine two quadratics that shall result in poles of shortperiod oscillations and poles of Phugoid. Vary the coefficients of polynomial to study the movement of poles.	**L3**
13	Given a Quartic characteristics equitation, determine Poles and Time constants for Roll mode, Spiral motion, and Dutch roll. Vary the coefficients of polynomial to study the movement of poles	**L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Plot the root locus and bode plot
CO2	Calculate the dynamic response of aircraft
CO3	Use computational tools to model aircraft trajectory
CO4	Analyze the impact of static margin and input response for various inflight scenarios
CO5	Analyze the dynamic stability of an aircraft subjected to uncertain environments

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Scheme of Examination:

Semester End Examination (SEE): Distribution of weightage for SEE of Regular courses

	Component	Marks	Total Marks
SEE	PART- A	20	50
	PART- B	20	
	VIVA-VOCE	10	
SEE Total			50

Continuous Internal Evaluation (CIE): Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	MANUAL / RECORD	20	50
	CIE Test-1	20	
	VIVA-VOCE	10	
CIE Total			50

CO/PO Mapping

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

Low-1: Medium-2: High-3

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VIII Semester Syllabus

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SEMESTER – VIII

PROGRAM ELECTIVE 4

COURSE: SATELLITE TECHNOLOGY

Course Code	**21ANE811**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: NIL

Course Learning Objectives: To enable students to apply the knowledge Satellite Technology in broad domain of Aeronautical Engineering by making them to learn:

CLO1	To introduce basic aspects of satellite subsystems and their functions peculiarities of space environment and types of satellite orbits to students.
CLO2	To impart knowledge to students on orbit determination and manoeuvres and ground station network requirements.
CLO3	To make students familiarize with satellite mechanical and structural configurations and satellite thermal control systems.
CLO4	To acquaint students with satellite control requirements and type of control manoeuvres and sensors needed for control.
CLO5	To impart knowledge to students on satellite power electronics telemetry and tele-command systems.

Content	**No. of Hours/RBT level**
Module 1 **INTRODUCTION TO SATELLITE SYSTEMS:** Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics)	**10 Hours/ L3**
Module 2 **ORBITAL MECHANICS:** Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination –Ground station network requirements.	**08 Hours/ L3**
Module 3 **SATELLITE STRUCTURES & THERMAL CONTROL:** Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.	**08 Hours/ L3**

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Module 4 **SPACECRAFT CONTROL:** Control requirements: attitude control and station keeping functions, type of control maneuvers –Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors.	**08 Hours/ L3**
Module 5 **POWER SYSTEM AND BUS ELECTRONICS:** Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Ka etc), their characteristics and applications. Coding Systems – Onboard computer- Ground checkout Systems	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Explain the concepts of Orbits and their mechanics.
CO2	Explain the concepts of structural design, analyzing techniques and various types of loads in satellite structural subsystem.
CO3	Acquire knowledge on the importance of thermal control subsystem and its design studies
CO4	Explain the concepts of satellite sensors and actuators that needed for Attitude control subsystem development.
CO5	Acquire the knowledge of satellite attitude as well as orbital dynamics in order to design the satellite control subsystem

Textbooks:

1. E.F Bruhn, “Analysis and Design of Flight Vehicle Structures”, Tri-State off set company, USA, 1980.
2. Francis J. Hale , “Introduction Space Flight”, Prentice Hall, 1994.
3. Rilay, FF , “Space Systems Engineering”, McGraw Hill, 1982.
4. Michael D. Griffin and James R. French , “Space Vehicle Design”, , AIAA Education Series, 1991.
5. Vertregt.M, “Principles of Astronautics”., Elsevier Publishing Company, 1985.

Reference books:

1. Craft Lewis H. Abraham, “Structural Design of Missiles & Space”, McGraw Hill, 1992.
2. Hughes P.C. , “Spacecraft Altitude Dynamics”, Wilsey, 1986.
3. Richard.F, Filipowsky Eugen I Muehllorf , “Space Communications Systems”, Prentice Hall, 1995.
4. “Spacecraft Thermal Control”, Hand Book, Aerospace Press, 2002.

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes/ Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1. Table1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

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

Low-1: Medium-2: High-3

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SEMESTER – VIII

PROGRAM ELECTIVE 4

COURSE: UAV ARTIFICIAL INTELLIGENCE SYSTEMS

Course Code	**21ANE812**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Drone Technology

Course Learning Objectives: To enable students to apply the knowledge of Drones and Intelligent Systems in broad domain of Aeronautical Engineering by making them to learn:

CLO1	To Gain the Knowledge of UAS and Artificial intelligence systems
CLO2	To Inculcate the Knowledge of UAS in various applications
CLO3	To insight the communications of UAS
CLO4	To comprehend the DRONE usage in image processing applications
CLO5	To impart the Practice the UAV maintenance and operations regulations

Content	No. of Hours/RBT levels
Module 1 **UNMANNED AERIAL SYSTEMS** Drone Basics, Unmanned Aerial Systems (UAS), Drone Sensors, Micro Controllers, Internet of Thinks (IOT) Systems, IOT Controls, Different Types of UAV and its Applications, Recent Trends in Artificial Intelligence Systems	**8 Hours/ L3**
Module 2 **UAV SENSORS** UAV Sensor Systems, Different Sensor Modules, Monitoring Systems – Pollution, Air Quality, Weather, Medical, Traffic, Surveillance, Tracking, Agriculture, Space. Sensor Integrations, Sensor Programming.	**08 Hours/ L3**
Module 3 **UAV COMMUNICATION SYSTEMS** Autonomous - Waypoints Navigations, Ground Control Station (GCS), UAV Telemetry Systems - Various Flight Controllers, Radar Communication Systems, UAV Stealth Technology, Radar Absorbing Material, Drone Jamming Technology.	**08 Hours/ L3**

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Module 4 **IMAGE PROCESSING** Drone Intelligent Modes, Drone Smart Modes, FPV & Image Processing Systems, Image Processing, Multispectral Camera, Lidar, GIS Mapping.	**08 Hours/ L**
Module 5 **UAV MAINTENANCE** Vehicle Test Controller Duties, UAV Checklist – Pre Flight Checklist, Post Flight Checklist, UAV Maintenance Process, UAV Overhauling, RC Simulators and Control DGCA-Drone Regulations, DGCA Drone Pilot Rule.	**08 Hours/ L**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the UAS and Artificial intelligence systems
CO2	Comprehend the UAS in various applications
CO3	Describe communications of UAS
CO4	summarize the DRONE usage in image processing applications
CO5	Practice the UAV maintenance and operations regulations

Textbooks:

1. Unmanned Aircraft Systems: UAVS Design, Development and Deployment, Reg Austin 2010 John Wiley & Sons, Ltd
2. Design of Unmanned Aerial Systems, Dr. Mohammad H. Sadraey, 2020 John Wiley & Sons Ltd.

Reference books:

1. Introduction to UAV Systems, Jean-Marc Moschetta and Kamesh Namuduri
2. UAV Networks and Communications, Edited by Kamesh Namuduri, University of North Texas, Serge Chaumette, Université de Bordeaux, Jae H. Kim, Boeing Research and Technology, James P. G. Sterbenz, University of KansasCambridge University Press,November 2017

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module**Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1. Table 1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VIII

PROGRAM ELECTIVE 4

COURSE: GUIDANCE AND CONTROL

Course Code	**21ANE813**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Control engineering

Course Learning Objectives: To enable students to apply the knowledge of guidance, navigation & control in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Comprehend the basic concepts of navigation, guidance and control.
CLO2	Acquire the knowledge of radar systems and other guidance systems
CLO3	Understand the missile guidance and
CLO4	summarize missile control system.
CLO5	Describe the flight control and fire control of the system

Content	No. of Hours/RBT levels
Module 1 **Introduction** Concepts of navigation, guidance and control. Introduction to basic principles. Air data information. **Radar Systems** Principle of working of radar. MTI and Pulse Doppler radar. Moving target detector. Limitation of MTI performance. MTI from a moving platform (AMTI)	**8 Hours/ L3**
Module 2 **Tracking with Radar** Mono pulse tracking. Conical scan and sequential lobbing. Automatic tracking with surveillance radar (ADT). **Other Guidance Systems** Gyros and stabilized platforms. Inertial guidance and Laser based guidance. Components of Inertial Navigation System. Imaging Infrared guidance. Satellite navigation. GPS	**08 Hours/ L3**
Module 3 **Transfer Functions** Input-output Transfer function. Basic altitude reference. Concepts of Open loop and Close Loop. **Missile Control System** Guided missile concept. Roll stabilization. Control of aerodynamic missile. Missile parameters for dynamic analysis. Missile autopilot schematics. Acceleration command and root locus	**08 Hours/ L3**

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Module 4 **Missile Guidance** Proportional navigation guidance; command guidance. Comparison of guidance system performance. Bank to turn missile guidance	**08 Hours/ L3**
Module 5 **Integrated Flight/Fire Control System** Director fire control system. Tracking control laws. Longitudinal flight control system. Lateral flight control system. Rate of change of Euler angle, Auto Pilot.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Comprehend the basic concepts of navigation, guidance and control.
CO2	Acquire the knowledge of radar systems and other guidance systems
CO3	Understand the missile guidance and
CO4	summarize missile control system.
CO5	Describe the flight control and fire control of the system

Textbooks:

1. Fundamentals of Aerospace Navigation and Guidance P.T. Kabamba and A.R. Girard Cambridge Aerospace Series 2014

2. Automatic control of Aircraft & Missiles, John H Blakelock Wile –Inter SciencePublication 2 nd edition

Reference books:

Navigation, R.B. Underdown& Tony Palmer Black Well Publishing 2001

Introduction to Radar Systems Merrilh I. Skolnik Tata Mc Graw Hill 3 rd edition,2001

Missile Guidance and Control Systems George M. Siouris Springer 2004 Editor

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Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module**Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1. Table 1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER VIII
PROGRAM ELECTIVE 4

COURSE: FLIGHT VEHICLE DESIGN

Course Code	**21ANE814**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**4:0:0**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Pre requisite: Aircraft Structures-I,II

Course Learning Objectives: To enable students to apply the knowledge of Flight Vehicle Design in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Conceptual design process of an aircraft, airfoil and wing geometry.
CLO2	Design geometry, thrust to weight ratio and wing loading of an aircraft.
CLO3	Initial sizing and configuration layout.
CLO4	Application of aerodynamics, propulsion and aircraft structures in design.
CLO5	Design aspects of sub systems in flight vehicles.

Content	**No. of Hours/RBT levels**
Module 1 **OVERVIEW OF DESIGN PROCESS:** Introduction, Typical requirements for a civil transport and a military fighter aircraft, Phases of design, Aircraft conceptual design process, Take-off weight build up, Empty weight estimation, Fuel fraction estimation, Take- off weight calculation, Trade studies. **AIRFOIL SELECTION:** Airfoil geometry, Airfoil lift and drag, Airfoil families, Airfoil design, Airfoil lift coefficient, Airfoil thickness, Camber, Stall, Reynolds number effects.	**10 Hours/ L3**
Module 2 **GEOMETRY:** Wing geometry, Aspect ratio, Sweep, Taper ratio, Twist, Incidence, Dihedral, Wing vertical location of wings, Wing tips, Biplane wings, Tail geometry and arrangement **THRUST TO WEIGHT RATIO & WING LOADING:** Thrust to weight definitions, Power loading, Statistical estimate of T/W. Thrust matching, Wing Loading and its effect on Stall speed, Take-off Distance, Catapult take-off, and Landing Distance. Wing Loading for Cruise, Loiter, Endurance, Instantaneous Turn rate, Sustained Turn rate, Climb, & Glide, Maximum ceiling, Selection of Thrust to Weight Ratio & Wing Loading	**08 Hours/ L3**
Module 3 **INITIAL SIZING:** Rubber engine sizing, Fixed engine sizing, Geometry sizing – Fuselage, Wing, Tail volume coefficient, and Control surface sizing, **CONFIGURATION LAYOUT &** LOFT**:** Conic lofting, Conic fuselage development, Conic shape parameter, Wing-tail layout & Loft. aerofoil linear interpolation. Aerofoil flat- wrap interpolation. Wing aerofoil layout-flap wrap. Wetted area determination. Special considerations in configuration layout: Aerodynamic, Structural, Detectability. Crew station, Passenger, and Payload arrangements.	**08 Hours/ L3**
Module 4 **AERODYNAMICS & PROPULSION:** A brief overview of aerodynamic coefficients and forces, Types of propulsion systems, Jet engine thrust considerations, Thrust-drag book keeping, installed thrust methodology, Piston engine	**08 Hours/ L3**

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performance – propeller performance and piston-prop thrust correction, Turboprop performance. **STRUCTURAL LOADS:** Structures fundamentals, Loads categories, Air loads – maneuver loads, gust loads, air loads on lifting surface, air loads due to control deflection, Inertial loads, Power-plant loads, Landing gear loads.	
Module 5 **DESIGN ASPECTS OF SUBSYSTEMS:** Flight Control system, Landing Gear and subsystem, Propulsion and Fuel System Integration, Air Pressurization and Air Conditioning System, Electrical & Avionic Systems, Safety constraints, Material selection criteria.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Overview of conceptual design process of an aircraft, airfoil and wing geometry.
CO2	Estimate the design geometry, thrust to weight ratio and wing loading of an aircraft.
CO3	Discuss initial sizing and configuration layout.
CO4	Explain the application of aerodynamics, propulsion and aircraft structures in design.
CO5	Discuss the design aspects of sub systems in flight vehicles.

Textbooks:

1. Daniel P. Raymer, "**Aircraft Design - A Conceptual Approach** ", AIAA Education Series, IV Edition © 2006.
2. Thomas C Corke, "**Design of Aircraft**", Pearson, Edition. Inc. © 2003.

Reference books:

1. J Roskam, "**Introduction to Aircraft Design** ", DAR corporation 2016.
2. John Fielding, "**Introduction to Aircraft Design**", Cambridge University Press, 2009.
3. Editor Mark Davies, "**Standard Handbook for Aeronautical & Astronautical Engineers**", Tata McGraw Hill 2000

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VIII
PROGRAM ELECTIVE 5

COURSE: CIVIL AVIATION REQUIREMENT

Course Code	**21ANE821**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: NIL

Course Learning Objectives: To enable students to apply the knowledge of Civial aviation requirements in broad domain of Aeronautical Engineering by making them to learn:

CLO1	knowledge of Indian Aircraft Rules 1937 and related publication
CLO2	knowledge CAR series B and C (MEL, cockpit and emergency check list and Defects rectification and analysis)
CLO3	knowledge CAR series E for approval of organizations: in various categories and CAR series M.
CLO4	the knowledge CAR145, CAR -21 Type certificate and Noise certificate
CLO5	the knowledge C.A.R. series F airworthiness and continued airworthiness, Registration / deregistration of aircraft, Micro light and Hot air balloons, Issue/Renewal and Suspension of Special Certificate of Airworthiness

Content	No. of Hours/RBT levels
Module 1 **INDIAN AIRCRAFT RULES 1937 AND RELATED PUBLICATIONS:** Knowledge of aircraft act, 1934, aircraft rules, 1937 as far as they related to airworthiness and safety of aircraft. Knowledge of civil airworthiness requirements, aeronautical information circulars, aeronautical information publications- (relating to airworthiness), advisory circulars & A.M.E. notices (NOTAMS) by DGCA	**08 Hours/ L3**
Module 2 **C.A.R. SERIES "B "and "C":** C.A.R. series "B" Minimum Equipment List (MEL), preparation and use of cockpit check list and emergency check list. C.A.R. series 'C' – Defect recording, reporting, investigation, rectification and analysis	**08 Hours/ L3**
Module 3 **C.A.R. SERIES "E":** C.A.R. Series E- approval of organizations: Approval in categories E & G;CAR M- Objective, Definitions, Continuing Airworthiness Requirement.	**08 Hours/ L3**
Module 4 **C.A.R. SERIES CAR 145** : General, Scope, Terms of Approval, Facility Requirement, Personnel Requirement, Certifying Staff, Safety and Quality policy, maintenance procedures and quality system. CAR -21, Type certificate, Noise certificate.	**08 Hours/ L3**

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Module 5	
C.A.R. SERIES "F ": C.A.R. SERIES "F" Airworthiness and continued airworthiness: Procedure relating to Registration / deregistration of aircraft, , Issue/validation and suspension of Certificate of Airworthiness, Special Flight permits, Airworthiness requirements for Gliders , Design, Manufacture, Registration and Operation of Micro light Aircraft., Requirements for manufacture, registration and airworthiness control of hot air balloons, Age of Aircraft to be imported for Scheduled / Non-Scheduled including Charter, General Aviation and other Operations, Issue/Renewal and Suspension of Special Certificate of Airworthiness.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Should be able to have the knowledge of Indian Aircraft Rules 1937 and related publication
CO2	Should be able to have the knowledge CAR series B and C (MEL, cockpit and emergency check list and Defects rectification and analysis)
CO3	Should be able to have the knowledge CAR series E for approval of organizations: in various categories and CAR series M.
CO4	Should be able to have the knowledge CAR145, CAR -21 Type certificate and Noise certificate
CO5	Should be able to have the knowledge C.A.R. series F airworthiness and continued airworthiness, Registration / deregistration of aircraft, Micro light and Hot air balloons, Issue/Renewal and Suspension of Special Certificate of Airworthiness

Textbooks:

1. Aircraft manual (India) volume – latest edition, the English book store, 17-l, Connaught circus, New Delhi.

Reference books:

1. Civil aviation requirements with latest amendment (section 2 airworthiness) – published by DGCA, the English book store, 17-l, Connaught circus, New Delhi.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes/ Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1. Table1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

FwindLow-1: Medium-2: High-3

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SEMESTER – VIII

PROGRAM ELECTIVE 5

COURSE: FLIGHT TESTING

Course Code	**21ANE822**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Aircraft Performance
Aircraft Stability and control

Course Learning Objectives: To enable students to apply the knowledge of Flight Testing in broad domain of Aeronautical Engineering by making them to learn:

CLO1	Scope of flight testing, its types and reducing uncertainty.
CLO2	Purpose, scope and working of various instruments employed for flight-testing.
CLO3	Performance of flight at different operating conditions.
CLO4	Stability and control aspects at various flight condition.
CLO5	Various regulations and recovery techniques.

Content	**No. of Hours/RBT level**
Module 1 **INTRODUCTION:** Purpose and scope of flight-testing, basic definition, types of flight tests, sequence of flight testing, planning the test program, governing regulations. Aircraft weight and center of gravity, flight testing tolerances. Method of reducing data uncertainty in flight test data -sources and magnitudes of error,avoiding and minimizing errors.	**08 Hours/ L3**
Module 2 **FLIGHT TEST INSTRUMENTATION:** Planning flight test instrumentation, sensing and transducing techniques. Measurement of linear and angular displacements, velocities and accelerations, vibration, force, temperature - onboard and ground based data acquisition system. Radio telemetry	**08 Hours/ L3**
Module 3 **PERFORMANCE FLIGHT TESTING - RANGE, ENDURANCE AND CLIMB:** Airspeed –in flight calibration. Level flight performance for propeller driven aircraft and for Jet aircraft - Techniques and data reduction. Range and endurance estimation of propeller and jet aircraft. Climb performance methods. **PERFORMANCE FLIGHT TESTING -TAKE-OFF, LANDING, TURNING FLIGHT:** Turning performance limitations. Drag estimation. Take-off and landing - methods, procedures and data reduction.	**08 Hours/ L3**

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Module 4 **STABILITY AND CONTROL - LONGITUDINAL AND MANOEUVRING:** Flight test Methods: Static longitudinal stability; Dynamic longitudinal stability. Data reduction. Maneuvering stability methods & data reduction. **STABILITY AND CONTROL - LATERAL & DIRECTIONAL:** Flight Test methods: - Lateral and directional static stability: Lateral and directional dynamic stability. Regulations and data reduction.	**10 Hours/ L3**
Module 5 **FLYING QUALITIES:** MIL and FAR regulations. Cooper-Harper scale. Pilot rating. Flight test procedures. **HAZARDOUS FLIGHT TESTING:** Stall and spin- regulations, test and recovery techniques. Dive testing for flutter, vibration and buffeting.	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Review the scope of flight testing, its types and reducing uncertainty.
CO2	Identify the purpose, scope and working of various instruments employed for flight-testing.
CO3	Examine the performance of flight at different operating conditions.
CO4	Illustrate the stability and control aspects at various flight condition.
CO5	Explain the various regulations and recovery techniques.

Textbooks:

1. Ralph D Kimberlin, "**Flight Testing of Fixed Wing Aircraft**", AIAA educational Series, 2003.

Reference books:

1. AGARD," **Flight Test Manual** ", Vol. I to IV.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes/ Alternate Assessment Tools (AATs) for 10 marks.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table1: Distribution of weightage for CIE& SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VIII

PROGRAM ELECTIVE 5

COURSE: TOTAL QUALITY MANAGEMENT

Course Code	**21ANE823**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Management of Entrepreneurship

Course Objectives: To enable students to apply the knowledge of Total Quality Management in broad domain of aeronautical engineering by making them to learn:

CLO1	To learn about the evolution and the basic concepts of quality.
CLO2	To understand the various principles, practices of TQM to achieve quality.
CLO3	To learn the various statistical approaches for Quality control.
CLO4	To understand the TQM tools for continuous process improvement.
CLO5	To learn the importance of ISO and Quality systems.

Content	No. of Hours/RBT levels
Module 1 **INTRODUCTION:** Need for quality – Evolution of quality – Definition of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Barriers to TQM Contributions of Quality Gurus — Deming's 14 point principles – Crosby's 14 point principles – Juran Triology.	**08 Hours/ L3**
Module 2 **TQM PRINCIPLES:** Quality statements – Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Continuous process improvement – PDCA cycle, 5s, Kaizen – Supplier partnership –Partnering, Supplier selection, Supplier Rating	**08 Hours/ L3**
Module 3 **TOOLS & TECHNIQUES I:** The seven traditional tools of quality- Histogram – Pareto diagram – Cause and effect diagram – Flow charts –Check sheet – Scatter diagram – Quality control charts – The seven new tools of quality – Why-why analysis – Affinity diagram – Interrelationship digraph – Tree diagram –Prioritization matrix – Process decision program chart – Activity network diagram.	**10 Hours/ L3**
Module 4 **TQM TOOLS AND TECHNIQUES II**: Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.	**08 Hours/ L3**

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Module 5	
QUALITY MANAGEMENT SYSTEM: Introduction—Benefits of ISO Registration— ISO 9000 Series of Standards—Sector-Specific Standards— AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements— Implementation— Documentation— Internal Audits—Registration-- **ENVIRONMENTAL MANAGEMENT SYSTEM**: Introduction—ISO 14000 S	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Familiarize basic concepts of quality gurus.
CO2	Gain and apply the knowledge of TQM principles.
CO3	Identify the appropriate the statistical tool to achieve the quality control.
CO4	Employ the principles of continuous process improvement tools.
CO5	Gain and apply the knowledge of quality systems.

Textbooks:

1. Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary BesterfiedSacre, Hemant Urdhwareshe, Rashmi Urdhwareshe, "Total Quality Management, Pearson Publications, 3rd Edition, 2003.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

Reference books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Chapman and Hall, "Total Quality Management", 2 nd Edition, 1995.
4. Mukherjee,P.N "Total Quality Management", Prentice- Hall iof India Private Limited, 2006.
5. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

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Scheme of Examination: Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quiz 1/AAT	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER – VII
PROGRAM ELECTIVE 5

Course: NDT IN AEROSPACE ENGINEERING

Course Code	**21ANE824**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**03**

Pre requisite: Materials and Manufacturing

Course Objectives: To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

CLO1	understand the various Non Destructive Methods
CLO2	Acquire the Knowledge on Surface NDT Methods
CLO3	Explain the concept of Thermography and Eddy current testing
CLO4	Explain the concept of Ultrasonic Testing and Acoustic Emission
CLO4	Acquire the Knowledge on Radiography

Content	No. of Hours/ RBT levels
Module 1 **OVERVIEW OF NDT:** NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT. Visual inspection – Unaided and aided.	**08 Hours/ L3**
Module 2 **SURFACE NON-DESTRUCTIVE EXAMINATION METHODS:** **Liquid Penetrant Testing:** Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. **Magnetic particle testing:** Theory of magnetism, inspection materials magnetisation methods, interpretation and evaluation of test indications, principles and methods of demagnetization, residual magnetism.	**08 Hours/ L3**
Module 3 **THERMOGRAPHY AND EDDY CURRENT TESTING:** **Thermography** Principles, contact and non-contact inspection methods, Techniques for applying liquid crystals. Advantages and limitation, infrared radiation and infrared detectors, instrumentations and methods, applications. **Eddy Current Testing**- Generation of eddy currents, properties of eddy currents, Eddy current sensing elements, probes, instrumentation, types of arrangement, applications, advantages, limitations, interpretation/evaluation.	**08 Hours/ L3**

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R.R. Nagar, Bengaluru - 560 098

Module 4 **ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE):** Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications	**10 Hours/ L3**
Module 5 **RADIOGRAPHY (RT)** Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Explain the fundamental concepts of NDT
CO2	Discuss the different methods of NDT
CO3	Explain the concept of Thermography and Eddy current testing
CO4	Explain the concept of Ultrasonic Testing and Acoustic Emission
CO4	Explain the concept of Radiography

Textbooks:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

Reference books:

1. ASM Metals Handbook," Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Charles, J. Hellier, "Handbook of Non-destructive evaluation", McGraw Hill, New York 2001.
3. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs) for 10 marks

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Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2		
	CIE Test-3		
	Quizzes /Assignment	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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SEMESTER -VIII

Project Phase II

Course Code	**21ANE83**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:20**	**SEE Marks**	**50**
No. of Credits	**12**	**Examination Hours**	**03**

CONTENT	No. of Hours/ RBT levels
CIE procedure for Project Work Phase - II: **a. Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates using Rubrics. **b. Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates as per Rubrics covering all Program Outcomes. **SEE for Project Work Phase - II:** **a. Single discipline**: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department. **b. Interdisciplinary:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong.	

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Individual student performance are evaluated based on the following COs :

CO1	Able to make comprehensive use of the technical knowledge gained from previous courses
CO2	Able to understand technologies concerned with the project
CO3	Able to apply project management skills (scheduling work, procuring parts and documenting expenditures and working within the confines of a deadline).
CO4	Able to analyze, develop and demonstrate the proposed work
CO5	Able to communicate technical information by means of ethical writing and presentation.

Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	**100**	**100**
Grand Total			**200**

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

Low-1: Medium-2: High-3

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SEMESTER -VIII

COURSE: TECHNICAL SEMINAR

Course Code	**21ANE84**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
No. of Credits	**1**	**Examination Hours**	**03**

Technical Seminar:

All the students admitted to IV year of BE/B. Tech shall have to do power point presentation on any topic related to Aeronautical Engineering during VIII Semester and make a report of the presented topic referring to journals in that area. The prescribed credit shall be included in VIII Semester and shall be considered for the award of bachelor's degree. Those who do not present the Technical Seminar shall be declared fail and shall have to complete during subsequent University examination after satisfying the Technical Seminar requirements.

Course Outcomes

CO1	Analyze and review various research papers to identify Aeronautical related topic
CO2	Understand new trends in Aeronautical field having cutting edge technologies in the selected topic
CO3	Impart skills in preparing detailed report describing the topic and results
CO4	Able to analyze and summarize the proposed topic
CO5	Able to communicate technical information by means of ethical writing and presentation.

CIE procedure for Seminar:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Seminar shall be based on the evaluation of Seminar report, presentation skill and question and answer session in the ratio 50:25:25.

Typical Evaluation pattern for regular courses is shown in Table 1:

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review	**50**	**50**
SEE	Technical Seminar Presentation + Report	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

SEMESTER -VIII

COURSE: INTERNSHIP

Course Code	**21ANE85**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:4**	**SEE Marks**	**50**
No. of Credits	**2**	**Examination Hours**	**03**

Internship:

All the students admitted to III year of BE/B. Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters.

Internship examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

Course Outcomes

CO1	Analyze and review various research papers to identify Aeronautical related topic
CO2	Understand new trends in Aeronautical field having cutting edge technologies in the selected topic
CO3	Impart skills in preparing detailed report describing the topic and results
CO4	Able to summarize the industrial Exposure and practices
CO5	Able to communicate technical information by means of ethical writing and presentation.

CIE procedure for Internship:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Internship shall be based on the evaluation of Internship report, presentation skill and question and answer session in the ratio 50:25:25.

SEE for Internship:

Contribution to the Internship and the performance of each Student shall be assessed individually in the semester end examination (SEE) conducted at the department.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review-2	**50**	**50**

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SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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

Low-1: Medium-2: High-3

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