KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

(APPROVED BY AICTE, NEW DELHI)

3rd to 8th sem B.E.

(2022 Scheme)

AERONAUTICAL ENGINEERING

INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem solving ability with an analytical and innovative mindset.

QUALITY POLICY

- Imparting value added technical education with state-of-the-art technology in a congenial, disciplined and a research oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

DEPARTMENT VISION
The vision of the department of aeronautical engineering is to be recognized globally as a centre of excellence for education leading to well qualified professional engineers who are innovative, industry ready and also cater to the needs of the society.

MISSION
The mission of the department of aeronautical Engineering is to educate, inspire and mentor students to excel as professional with strong leadership skills and commitment to the society.

PROGRAM OUTCOMES (POs)	
1.	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.	Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4.	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6.	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7.	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

KLS Gogte Institute of Technology
3rd to 8th sem B.E.
Scheme of Teaching and Examination- 2022
Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023-24)

Total credits for B.E. Program: 160

Credit definition:

Offline Courses	Online Courses
• 1-hour Lecture **(L)** per week = 1 Credit • 2 hours Tutorial **(T)** per week = 1 Credit, • 2 hours Practical /Drawing **(P)** per week = 1 Credit	04 weeks =1 Credit 08 weeks = 2 Credit 12 weeks = 3 Credit

Semester wise distribution of credits for B.E program

Year	Semester	Credits	Total/Year	Cumulative Credits
1st	I	20	40	40
	II	20		
2nd	III	20	40	80
	IV	20		
3rd	V	22	40	120
	VI	18		
4th	VII	24	40	160
	VIII	16		
Total			160	

Curriculum frame work:

Structure of Undergraduate Engineering program

S.No.	Category of courses	VTU Breakup of credits	KLSGIT Breakup of credits
1	Humanities and Social Sciences including Management courses (English, Kannada, Indian Constitution, Environmental Sciences and Management)	10	
2	Basic Science courses	23	
3	Engineering Science courses including workshop, drawing	20	
4	Professional Core Courses	46	
5	Professional Elective courses relevant to chosen specialization/branch	9	
6	Open subjects – Electives from other technical, emerging, arts commerce and	6	
7	Mini, Project, Major Project work and Seminar	13	
8	Summer Internship and Research /Industrial Internship	20	
9	Ability Enhancement Courses, including Research Methodology, NCC/NSS/ Sports/Ex- Curricular, Online Certification Course	11	
10	Universal Human Values	2	
	TOTAL	**160**	**160**

L-T-P Model for Courses

	Contact Hours				Credits	
S.No.	**L-T-P**	**Lecture**	**Tutorial**	**Practical**	**L-T-P**	**Total**
1	3 - 0 - 0	3	0	0	3 - 0 - 0	3
2	3 - 2 - 0	3	2	0	3 - 1 - 0	4
3	3 - 0 - 2	3	0	2	3 - 0 - 1	4
4	2 - 0 - 2	2	0	2	2 - 0 - 1	3
5	1 - 0 - 4	1	0	4	1 - 0 - 2	3

Theory courses having the corresponding lab are converted to integrated type course. Also, the electives (if possible) can also be made integrated type.

Integrated courses (Professional Core/Electives): Integrated courses will have **Theory Syllabus with Practical Syllabus of the same course**. In such a course there could be **no Semester End Examination (SEE) for the practical syllabus** of the course, however, Continuous Internal Evaluation (CIE) will be conducted for the practical topics.SEE should include questions from practical topics.

SDA-Skill Development Activities, TD/PSB- Teaching Department / Paper Setting Board, ASC-Applied Science Course, ESC- Engineering Science Courses, ETC- Emerging Technology Course, AEC- Ability Enhancement Course, HSMS-Humanity and Social Science and Management Course, SDC- Skill Development Course,

KLS Gogte Institute of Technology

2nd Year B.E. Scheme of Teaching and Examination 2022

3rd Semester					**Hours/week**			**Total contact hours/week**	**Credits**	**Examination**		
S.No.	**Course Type**	**Course Code**	**Course Title**	**Teaching Dept.**	**L**	**T**	**P**			**CIE**	**SEE**	**Total**
1	PCC/BSC		Fourier Techniques and Probability Theory	Maths	3	0	0	03	3	100	100	200
2	IPCC		Mechanics of Materials	AE	3	0	2	05	4	100	100	200
3	IPCC		Fluid Mechanics	AE	3	0	2	05	4	100	100	200
4	PCC		Aircraft Materials & Processes	AE	3	0	0	03	3	100	100	200
5	PCCL		Aircraft Component Modeling Lab	AE	0	0	2	02	1	50	50	100
6	ESC		ESC/ETC/PLC	AE	3	0	0	03	3	100	100	200
7	UHV		**Social Connect and Responsibility**	AE	0	0	2	02	1	100	--	100
8	AEC/ SEC		Ability Enhancement Course/Skill Enhancement Course – III	AE	If the course is a Theory			01	1	50	50	100
					1	0	0					
					If a course is a laboratory			02				
					0	0	2					
9	MC		National Service Scheme (NSS)	NSS coordinator	0	0	2		0	100	--	100
			Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
			Clubs- Social, Cultural & Academic	Coordinators								
Total									**20**	**800**	**600**	**1400**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, **S:** SDA: Skill Development Activity, **CIE**:

Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering. **ESC**: Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course

Engineering Science Course (ESC/ETC/PLC)			
Code1	Aircraft maintenance Repair & Overhaul	Code3	Introduction to Air Armament
Code2	Introduction to UAS Technology	Code4	Cyber Security & Safety
Ability Enhancement Course – III			
Code1	Technical Writing and Presentation	Code3	Introduction to MATLAB & SIMULINK

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be referred.

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

4th Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	**Course Type**	**Course Code**	**Course Title**	**Teaching Dept.**	**L**	**T**	**P**			**CIE**	**SEE**	**Total**
1	PCC/BSC		Aircraft Propulsion I	AE	3	0	0	03	3	100	100	200
2	IPCC		Aerodynamics	AE	3	0	2	05	4	100	100	200
3	PCC		Aircraft Structures I	AE	4	0	0	04	4	100	100	200
4	PCCL		Aircraft Structures Lab	AE	0	0	2	02	1	50	50	100
5	ESC		ESC/ETC/PLC	AE	3	0	0	03	3	100	100	200
6	AEC/ SEC		Ability Enhancement Course/Skill Enhancement Course- IV	AE	If the course is Theory			01	1	50	50	100
					1	0	0					
					If the course is a lab			02				
					0	0	2					
7	BSC		Biology For Engineers		3	0	0	03	3	100	100	200
8	UHV		Universal human values course	AE	1	0	0	01	1	50	50	100
9	MC		National Service Scheme (NSS)	NSS coordinator	0	0	2	02	**0**	100	--	100
			Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
			Clubs- Social, Cultural & Academic	Coordinators								
Total									**20**	**750**	**650**	**1400**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.

Ability Enhancement Course / Skill Enhancement Course - IV

Code1	FEAST Lab	Code3	PYTHON for Aeronautics Lab
Code2	Introduction to SCILAB & SCICOS	Code4	Unmanned Aerial Systems Lab

Engineering Science Course (ESC/ETC/PLC)			
Code1	Mechanics	Code3	Air Traffic Control
Code2	Introduction to space technology	Code4	Renewable Energy

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23.

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

KLS Gogte Institute of Technology

3rdYear B.E. Scheme of Teaching and Examination 2022

5th Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	HSMS		Aviation Planning & Management	AE	3	0	0	03	3	100	100	200
2	IPCC		Aircraft Propulsion II	AE	3	0	2	05	4	100	100	200
3	PCC		Aircraft Performance	AE	4	0	0	04	4	100	100	200
4	PCCL		Modeling & Analysis Lab	AE	0	0	2	02	1	50	50	100
5	PEC		Professional Elective Course	AE	3	0	0	03	3	100	100	200
6	PROJ		Mini Project	AE	0	0	4	04	2	100	-	100
7	AEC		Research Methodology and IPR		2	0	0	02	2	100	100	200
8	AEC		Employability Skills -1	Bizotic	1	0	0	01	1	100	-	100
9	MC		Environmental Studies		2	0	0	02	2	100	100	200
10	MC		National Service Scheme (NSS)	NSS coordinator	0	0	2	02	0	100	-	100
			Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
			Clubs- Social, Cultural & Academic	Coordinators								
Total									**22**	**950**	**650**	**1600**

Professional Elective Course			
Code1	Finite Element Analysis	Code3	Gas Dynamics
Code2	Helicopter Dynamics	Code4	Experimental Stress Analysis

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SXX**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented/hands-on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. 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.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project publication/technical paper, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

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

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

6th Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	IPCC		Avionics	AE	3	0	2	05	4	100	100	200
2	PCC		Aircraft Stability & Control	AE	3	0	2	04	4	100	100	200
3	PEC		Professional Elective Course	AE	3	0	0	03	3	100	100	200
4	OEC		Open Elective Course	AE	3	0	0	03	3	100	100	200
5	PROJ		Major Project Phase I	AE	0	0	4	04	2	100	--	100
6	PCCL		Simulation Lab	AE	0	0	2	02	1	50	50	100
7	AEC/SDC		Ability Enhancement Course/Skill Development Course V- **Employability Skills -2**	Bizotic	1	0	0	01	1	100	-	100
8	MC		National Service Scheme (NSS)	NSS coordinator	0	0	2		0	100	--	100
			Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
			Clubs- Social, Cultural & Academic	Coordinators								
Total									**18**	**750**	**450**	**1200**

Professional Elective Course			
Code1	Aircraft Sensors & Instrumentation	Code3	Computational Fluid Dynamics
Code2	Mechanics of Composite Materials	Code4	Aircraft Certification & Airworthiness

Open Elective Course			
Code1	Wind Tunnel Techniques	Code3	Introduction to Space Technology
Code2	Introduction to Composites	Code4	Organizational Behavior

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**:

Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course
Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 **National Service Scheme /Physical Education/Yoga/Clubs:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.
Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.
Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.
Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

KLS Gogte Institute of Technology

4thYear B.E. Scheme of Teaching and Examination 2022

7th Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	IPCC		Flight Vehicle Design	AE	3	0	2	05	4	100	100	200
2	IPCC		Vibrations & Aero-elasticity	AE	3	0	2	05	4	100	100	200
3	PCC		Guidance Navigation & Control	AE	4	0	0	04	4	100	100	200
4	PEC		**Professional Elective Course**	AE	3	0	0	03	3	100	100	200
5	OEC		**Open Elective Course**	AE	3	0	0	03	3	100	100	200
6	PROJ		**Major Project Phase-II**	AE	0	0	12	12	6	100	100	200
Total									**24**	**600**	**600**	**1200**

Professional Elective Course

Code1	Experimental Aerodynamics	Code3	Design of UAS
Code2	Noise, Vibrations & Harshness	Code4	Aircraft Systems

Open Elective Course

Code1	Integrated Vehicle Health Monitoring	Code3	Control Engineering
Code2	Basics of Flight Simulation	Code4	Air-breathing engines

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK: The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) 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, shall be based on the evaluation of the project work 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.

(2) 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, shall be based on the evaluation of project work 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 procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the COE. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

8th Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	PEC		Professional Elective (Online Courses)	TD-PSB	3	0	0	03	3	100	-	100
2	OEC		Open Elective (Online Courses)	TD: PSB	3	0	0	03	3	100	-	100
3	INT		Internship (Industry/Research) (14 - 20 weeks)	TD: PSB	0	0	20	20	10	100	100	200
Total									**16**	**300**	**100**	**400**

Professional Elective Course (Online courses)			
Code1	Space Flight Mechanics	Code3	Smart Structures
Code2	Lighter Than Air Systems	Code4	Hypersonic Aerodynamics

Open Elective Courses (Online Courses			
Code1	IOT	Code3	Robotics & Automation
Code2	Artificial Intelligence & Machine Learning	Code4	Data Sciences

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institution can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship. The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **College shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. The online courses can be NPTEL/SWAYAM/NASSCOM/Industry certified and for a duration of 12 weeks. Details of these courses shall be made available for students on the college web portal.

Fourier Techniques and Probability Theory

Course Code:	22MATM\A31	Course type	Theory	Credits L-T-P	3 – 0– 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0Hrs;P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
At the end of the course students should be able to	
1.	Fit a suitable curve for the data using regression.
2.	Get knowledge about various probability distributions involving discrete /continuous random variable.
3.	Get familiar with various sampling distributions and estimation of various parameters.
4.	Get acquainted with various hypothesis testing techniques.
5.	Understand Joint discrete PDF and various stochastic processes.

Pre-requisites : Basic statistics, Basic probability.

Unit – I	Contact Hours = 8 Hours
Correlation and Regression: Curve fitting by least square method $y=a+bx$, $y=ae^{bx}$, $y=ax^b$. Karl Pearson coefficient of correlation, Regression: Lines of regression Problems. Multiple correlation and regression. Partial correlation and regression.	

Unit – II	Contact Hours = 8 Hours
Random Variable: Revision of basic probability , conditional probability up to Baye's theorem. Discrete and Continuous Random Variable, (DRV,CRV) Probability Distribution Functions (PDF) and Cumulative Distribution Functions(CDF), Expectations, Mean, Variance. Binomial, Poisson, Exponential and Normal Distributions. Practical examples.	

Unit – III	Contact Hours = 8 Hours
Fourier Series: Periodic functions. Drichlet's conditions, Fourier series, Half range Fourier sine and cosine series. Practical examples, Harmonic analysis.	

Unit – IV	Contact Hours = 8 Hours
Fourier Transforms: Infinite Fourier Transform and Properties. Fourier Sine and Cosine Transforms Properties and Problems.	

Unit –V	Contact Hours = 8 Hours
Calculus of variations: Concept of a Functional, Extremal of a Functional, Euler's equation and equivalents. Standard problems. **Applications**: Geodesics, Hanging chain, Minimal surface of revolution and Brachistochrone problem.	

Unit No.	Self-Study Topics
1	Regression models, Regression strategies.
2	Discrete and Continuous Random vectors in different areas such as Mutual funds, lottery draw, decision making, decision trees etc…
3	Basic theorems on Real Analysis, Parsvel Identities.
4	Fourier Transforms in sound waves, radio waves, computer data.
5	Multivariable Calculus and Linear Algebra concepts.

Books	
	Text Books:
1.	B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 42thEd., 2021 onwards.
2.	Erwin Kreyszig: "Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006 and onwards.
	Reference Books:
1.	B.V. Ramana**: "**Higher Engineering Mathematics"McGraw-Hill Education, 11thEd., 2004 onwards.
2.	Srimanta Pal &Subodh C. Bhunia: "Engineering Mathematics″Oxford University Press, 3rd Ed., 2016 onwards
3	N.P Bali and Manish Goyal:"A textbook of Engineering Mathematics″Laxmi Publications, 10th Ed., 2022 onwards
4	C. Ray Wylie, Louis C. Barrett: **"**Advanced Engineering Mathematics"McGraw −Hill Book Co., New york, 6thEd., 2017 onwards
5	H. K. Dass and Er. RajnishVerma**:** ″Higher Engineering Mathematics"S. Chand Publication, 3rd Ed., 2014.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/111106111
2.	https://nptel.ac.in/courses/111106111
3	https://nptel.ac.in/courses/111104025
4	https://nptel.ac.in/courses/117105085
5	https://nptel.ac.in/courses/111105042

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)
3.	Flipped Classes	3.	Course Seminar
4.	Practice session/Demonstrations in Labs	4.	Quizzes

5.	Virtual Labs (if present)	5.	Semester End Examination

Course Outcome (COs)				
Learning Levels: **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand regression analysis for data analysis.	**Re,Un,Ap**	**1**	
2.	Apply the knowledge of Discrete and Continuous Random vectors in different areas such as Mutual funds, lottery draw, decision making, decision trees etc…	**Re,Un,Ap**	**1**	
3.	**Develop** frequency bond series from time bond functions using Fourier series and **Understand** Fourier Transforms and its properties.	**Re,Un,Ap**	**1**	
4.	Apply the concept of functionals to solve complex optimization problems.	**Re,Un,Ap**	**1**	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/Python	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for CIE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (planned)	**CO-PSO Mapping(planned)**

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	✓														
2	✓														
3	✓														
4	✓														
Tick mark the CO, PO and PSO mapping															

Mechanics of Materials

Course Code		**Course type**	**IPCC**	**Credits L-T-P**	3 - 0 - 1
Hours/week: L - T- P	3 - 0 - 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Explain basic concept of stress, strain, transformation of stress/strain and strength of materials.
2.	Teach the concepts and calculation of shear force, bending moments, deflections and stresses in the beams due to various loading and boundary conditions.
3.	Introduction to the concept of torsion and shear stresses in shafts.
4.	Introduction to the concept of buckling of simple columns subjected to various boundary conditions

Required Knowledge of : Engineering Mechanics, Engineering Mathematics

Unit – I	**Contact Hours = 8 Hours**
Concept of Stress: Introduction, definition, Types of Stresses: Normal stress and shear stress, Uni-axial, Bi-axial and Tri-axial stresses, plane stress condition, bearing stress. **Concept of strain**: Introduction, Type of Strains: Normal strain, shear strain, Lateral strain, Longitudinal strain, Volumetric strain. Introduction to strain energy, **Analysis of Bars:** Deformation of bars under axial loading, Analysis of stepped bar. **Stress-Strain Relations:**Hooke's Law, Stress-strain diagrams, Elastic Limit, Poisson's Ratio, Modulus of elasticity, Bulk Modulus, Modulus of Rigidity, Factor of Safety, Margin of Safety. Introduction to Mechanical Properties of Aircraft Materials.	

Unit – II	**Contact Hours = 8 Hours**
Thermal Stresses: Deformation, Stress and Strain due to Temperature difference. Temperature stresses in composite bars. **Transformation of Stresses (2D):** Stresses on oblique plane, Principal Stresses and planes, Maximum shear stress and planes, Mohr's Stress Circle. **Theories of failure:** Maximum principal stress theory, maximum shear stress theory, maximum strain theory, maximum strain energy theory and maximum shear strain energy theory.	

Unit – III	Contact Hours = 8 Hours
Types of Loads: Point load, UDL, UVL, Couple**. Types of Support:** Simply support, fixed, hinged, roller supports, Internal hinge, Shear force and bending moment diagram for various types of beams with various support conditions subjected to different loads.	

Unit – IV	Contact Hours = 8 Hours
Bending Stresses in the beam: Introduction, Pure Bending, Theory of Simple Bending, Bending Stress Equation, Section Modulus, Bending of composite sections. **Shear stresses:** Shear stress equation, shear stress distribution in various cross sections. **Deflection:** Deflection in simply supported and cantilevers beams with concentrated loads, and uniformly distributed loads by Double integral Method, Macaulay's method, moment area method.	

Unit – V	Contact Hours = 8 Hours
Torsion of Circular Shafts and Elastic Stability of Columns: Introduction, Pure torsion, derivation of torsional equations, torsional rigidity/stiffness of shafts. Power transmitted by solid and hollow circular shafts. **Columns:** Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for hinged ends conditions only, Numerical on Euler's formula for different end conditions, limitations of Euler's theory. Derivation of Rankine's Equation. Introduction to the Beam-Columns.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	01	02	02	03	02

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	5	1. Tensile test on Mild Steel
		2. Compression test on Wooden Block
		3. Shear of bars
		4. Hardness Test: Rockwell, Brinell, Vickers.
		5. Impact Test: Izod and Charpy
4	2	6. Deflection of beams
		7. Experimental evaluation of Young's modulus using beam set-up.
		8. Torsion of Shaft

5	2	9. Buckling of Long Column

Unit No.	Self-Study Topics
I	Analysis of tapered bars (Circular and Rectangular) under axial load, Analysis of bars under self-weight
II	Stresses in thin-walled pressure vessel.
III	Relation between load intensity, shear force and bending moment, Point of contra-flexure. Overhang beams.
IV	Section modulus for T, I sections, Shear stresses in circular sections
V	Buckling load for Euler's column with various support conditions, Buckling of column with eccentric axial load

Books	
	Text Books:
1.	R. C. Hibbeler, "Mechanics of Materials", Prentice Hall. Pearson Edu. 9th edition, 2005 ISBN-13: 978-9332584037
2.	Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials" Laxmi Publications Pvt. Ltd. 1st edition, 2016.
3.	James M. Gere, "Mechanics of Materials", Thomson, Fifth edition 2004.
4.	Andrew Pytel, JaanKiusalaas, "Mechanics of Materials", Cengage Learning Publishers, 2011.
	Reference Books:
1.	S. S. Rattan , "Strength of Materials", Tata McGraw Hill, 2009
2.	S.S.Bhavikatti , "Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3.	Ferdinand Beer & Russell Johnston, "Mechanics of Materials", McGraw Hill Education India Private Limited; Seventh edition, 2017.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL course: Strength of Materials, by Dr. Satish C Sharma, IIT Roorkee. https://nptel.ac.in/courses/112107146
2.	NPTEL course: Mechanics of Materials by Dr. U Saravanan, IIT Madras. https://nptel.ac.in/courses/105106172/
3.	Mechanics of Solids by Prof. Priyanka Ghosh, IIT Kanpur. https://onlinecourses.nptel.ac.in/noc22_ce46/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests

2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain and evaluate the mechanical properties of the materials	AN	1,2,3,8,9,10	1
2.	Explain the basic concept of various loads, stresses, strains, and transformation of stresses for various structures.	UN	1, 2	1
3.	Describe and calculate the shear force and bending moment variation for different beams, loads and draw shear force and bending moment diagram.	AP	1, 2	1
4.	Calculate or evaluate experimentally deformations, slopes, stresses, and strains for a given bar/beam/shaft/column structure under various loading conditions.	AN	1, 2, 3,8,9,10	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks					

2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√	√					√	√	√			√		
2	√	√											√		
3	√	√											√		
4	√	√	√					√	√	√			√		

Sl. No.	**Skill & Competence enhanced after undergoing the course**	**Applicable sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Operations and Failure Mechanism of Structural Components in different engineering fields**	**Mechanical Sciences**	**Stress Analyst Stress Engineer Safety Engineer**

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Dr. L. Chikmath	**Prof. P. M. Banakar**

Fluid Mechanics

Course Code		**Course type**	IPCC	**Credits L-T-P**	3 – 0 - 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4

Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs	**CIE Marks**	100
Flipped Classes content	10 Hours	**SEE Marks**	100

Course learning objectives	
1.	Explain the mechanics of fluids at rest by observing the fluid Phenomena
2.	Compute the pressure measurement and stability of submerged bodies.
3.	Explain the mechanics of fluids in motion under ideal and real conditions.
4.	Examine energy losses in pipe transitions. Apply Buckingham Pi theorem for various cases of fluid flow.
5.	Evaluate pressure drop in pipe flow using Hagen-Poiseuille equation for laminar flow in a pipe. Distinguish types of flows

Pre-requisites : Knowledge of basic engineering mathematics and mechanics.

Unit – I	**Contact Hours = 8 Hours**
Introduction, Properties of fluids, Newton's law of viscosity, variation of viscosity with temperature, surface tension and capillarity. Newtonian and Non-Newtonian fluids. **Fluid Statics:** Pascal's law, Hydrostatic Law, levels of pressure. Units and Inter conversion. Pressure measurement by simple, differential manometers. Total force and center of pressure for inclined plane surface submerged in static fluid.	

Unit – II	**Contact Hours = 8 Hours**
Buoyancy: Buoyancy, center of buoyancy, meta center and meta centric height. Stability of floating bodies. **Fluid Kinematics:** Introduction, Eulerian and Lagrangian description of fluid motion, types of flows, velocity and acceleration of a fluid particle, concept of local and convective accelerations. Law of conservation of mass in 2D and 3D Cartesian coordinates, Discharge and mean velocity.	

Unit – III	**Contact Hours = 8 Hours**
Fluid Dynamics: Introduction, Euler's equation of motion and subsequent derivation of Bernoulli's equation, Bernoulli's equation for real fluids, Laplace equation for flow and boundary conditions. Introduction to Streamlines, Pathlines, two dimensional source, Uniform flow,sink and doublet flows. **Flow measurements:** Application of Bernoulli's theorem such as venturimeter, pitot tube, orifices etc. Discharge over rectangular notch and triangular notch. Numerical examples.	

Unit – IV	**Contact Hours = 8 Hours**
Losses in fluid flow: Energy consideration in pipe flow, Losses in pipe flow, Darcy Weisbach formula, major losses. Minor losses in pipe flow. Numerical on combined losses. **Dimensional analysis:** Dimensions and units, Dimensional Homogeneity and dimensionless ratios, methods of dimensional analysis, Buckingham Pi theorem, Numerical, types of Similitude and non-dimensional parameters used in Fluid Mechanics.	

Unit – V	Contact Hours = 8 Hours
Laminar flow and viscous effects: Entrance flow and Developed flow, fully developed laminar flow in circular pipes, Hagen – Poiseuille equation, Numerical. **Flow past immersed bodies:** Drag, Lift, expression for lift and drag (no derivation), pressure drag and friction drag, streamlined and bluff bodies. Numerical Examples **Introduction to compressible flow:** Propagation of sound waves through compressible fluids, sonic velocity and Mach number. Numerical.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	1	1. Conduct an experiment on Hydraulic fluid to determine viscosity of the fluid
2&3	5	2. Conduct an experiment to determine the metacentric height of a floating body and evaluate its stability. 3. An experiment on Venturimeter to determine the co efficient of discharge. Compare the experimental Coefficient of Discharge value with that obtained graphically. 4. An experiment on Orifice meter to determine the co efficient of discharge. Compare the experimental Coefficient of Discharge value with that obtained graphically. 5. To determine the coefficient of discharge of a triangular notch (V-notch. 6. To determine the coefficient of discharge of a rectangular notch (R-notch.
4	2	7. Conduct an experiment on frictional losses in pipe flow. Compare the theoretical and experimental values of friction loss and friction factor with Moody's chart. 8. Conduct an experiment for minor losses in pipe flow. Compare the theoretical and experimental minor losses (bend, elbow, expansion, contraction and gate valve).
5	1	9. An experiment on Reynolds apparatus and classify the flow as laminar and turbulent.

Books	
	Text Books:
1.	K.L. Kumar, "Engineering Fluid Mechanics", Multicolor revised edition, S. Chand and Co, Eurasia Publishing House, New Delhi, 2010 ISBN-13: 978-8121901000
2.	R.K. Bansal, "A text book of Fluid Mechanics", Laxmi Publications Pvt. Ltd., New Delhi.2018, ISBN-13: 978-8131808153

	Reference Books:
1.	Yunus A. Cenegal, and John M. Cimbala, "Fluid Mechanics", Second edition, McGraw Hill Education (India) Pvt. Ltd. 2017, ISBN-13: 978-9339204655
2.	Fox, McDonald, Introduction to Fluid Mechanics, John Wiley Publications, 6th edition onwards.
3.	Anderson, Jr. J.D. "Fundamentals of Aerodynamics", McGraw-Hill Education / Asia; 5 edition (16 May 2011). ISBN-13: 978-0071289085
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL:** Online Resources: Lecture by: Prof Suman Chakraborty, IIT Kharagpur. (https://onlinecourses.nptel.ac.in/noc17_me04/preview)
2.	**NPTEL:** Online Resources: Lecture by: Prof S. Datta and Prof NiranjanSahoo., IITG (Guwahati) (http://www.nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/fluid_mechanics/index.htm)
3.	**NPTEL**: Online Resources: Lecture by: Prof Viswanathan Shankar (IIT Kanpur) (http://nptel.ac.in/courses/103104044/)

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the mechanics and properties of fluids at rest and in motion by observing the fluid phenomena.	UN	1,2,8,9,10,12	1,2,3
2.	**Develop** the dimensional equations and **analyze** the various types of flows over different bodies.	AN	1,2,8,9,10,12	1,2,3
3.	**Analyze** the flow using different basic principles for **understanding** various flow measuring devices and losses in flows.	AP	1,2,8,9,10,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test:					

1. No objective part in IA question paper 2. All questions descriptive
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√						√	√	√		√	√	√	√
2	√	√						√	√	√		√	√	√	√
3	√	√						√	√	√		√	√	√	√

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Fluid Mechanics	Mechanical sector	Flow analysis Engineer
2	Fluid flow Analysis needs	Civil sector	

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**

Prof. D A Ponnaswami	Prof. A. K. Nakkala

Aircraft Materials and Process

Course Code		Course type	PCC	Credits L-T-P	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3

Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs	**CIE Marks**	100
Flipped Classes content	10 Hours	**SEE Marks**	100

Course learning objectives	
1.	Study the aircraft engineering materials with heat treatment techniques.
2.	Understand the various manufacturing processes and selection of process for suitable applications.
3.	Understand the working principles and applications of conventional and non-conventional machining along with their advantages and disadvantages.
4.	Demonstrate the importance of composites & its applications in different streams of aerospace industry

Pre-requisites : Knowledge of basic engineering mathematics and mechanics

Unit – I	**Contact Hours = 8 Hours**
Aircraft Engineering Materials & Heat treatment: Classification of aircraft materials - Materials used for aircraft components, Heat treatment of carbon steel, aluminium alloys, magnesium alloys and titanium alloys used in aircraft. Types of corrosions - Effect of corrosion on mechanical properties - Protection against corrosion - Corrosion resistant materials used in aircraft.	

Unit – II	**Contact Hours = 8 Hours**
Casting, Welding and Inspection Techniques: General principles of various casting processes Sandcasting, die-casting, centrifugal casting, investment casting, Shell moulding types; Principles and equipment used in arc welding, gas welding, resistance welding, solid, laser welding, and electronbeam welding, soldering and brazing techniques. Need for NDT,	

Unit – III	**Contact Hours = 8 Hours**
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, fasteners, Different stages of aircraft assembly	

Unit – IV	**Contact Hours = 8 Hours**

Conventional And Unconventional Machining 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,

Unit –V	**Contact Hours = 8 Hours**
Aircraft Composites: Definition and comparison of composites with conventional monolithic materials, Reinforcing fibers and Matrix materials, Fabrication of composites and quality control aspects, Carbon-Carbon Composites production, properties and applications, inter metallic matrix composites, ablative composites based on polymers, ceramic matrix, metal matrix composites based on aluminum, magnesium.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	S. Kalpakjian, Steven R. Schmid, —Manufacturing Engineering and Technology, Pearson Education; Seventh edition (28 March 2018). ISBN-13: 978-9332587908
2.	S. C. Keshu, K. K Ganapathy, —Aircraft production technology and management, Interline Publishing House, Bangalore, 3rd Edition, 1993.
	Reference Books:
1.	S. C. Keshu, K. K Ganapathy, —Aircraft production techniques, Interline Publishing House, Bangalore, 3rd Edition, 1993.
2.	R. K. Jain, —Production technology, Khanna Publishers; 17th edition edition (2004) ISBN-13: 978-8174090997
3.	Douglas F. Horne, —Aircraft production technology, Cambridge University Press, 1st Edition, 1986.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL:** Online Resources: Lecture by: Prof. B S Murty,IIT Kharagpur https://nptel.ac.in/courses/113105057/
2.	**NPTEL:** Online Resources: Lecture by: Prof. Jayanta Das,IIT Kharagpur https://nptel.ac.in/courses/113105081/
3.	**NPTEL:** Online Resources: Lecture by: Prof. R. Velmurugan,IIT Madras https://nptel.ac.in/courses/101106038/

4.	**NPTEL:** Online Resources: Lecture by: Prof. P. M. Mohite, IIT Kanpur https://nptel.ac.in/courses/101104010/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Choose** the various Aircraft Engineering Materials & heat treatment processes.	**Ap**	1	1
2.	**Employ** the knowledge of different types of Casting, Welding and Inspection Techniques	**Ap**	1	1
3.	**Demonstrate** the various Sheet Metal operations and its applications	**Ap**	1	1
4.	**Differentiate** Conventional And Unconventional Machining processes	**Ap**	1	1
5.	**Compare** the various Composites materials in aircraft.	**An**	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	√												√		
2	√												√		
3	√												√		
4	√												√		
5	√												√		
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Acquire the Knowledge about various engineering materials and able to demonstrate various manufacturing processes	Automobile, Mechanical, Product development, Aerospace	Product development Engineer, Process Manufacturing Leader, Manufacturing Engineer Lead – Product Analyst-Manufacturing, Quality Engineer

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. P. M. Banakar	Prof. L Chickmath

Aircraft Component Modeling Lab

Course Code		Course type	PCCL	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1

Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs	**CIE Marks**	50
Flipped Classes content		**SEE Marks**	50

Course learning objectives	
1.	Impart knowledge of Machine component and its conversion into 2D drawing.
2.	Familiarize various thread forms and representation of standard thread components.
3.	Model parts and create assembly using standard CAD packages like CATIA
4.	Familiarize with standard components and their assembly of an aircraft.

Required Knowledge of :

Lab Experiment – I	**Contact Hours = 2 Hours**
Conversion of pictorial views into orthographic Projections of simple machine parts and drafting using software	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Draw various thread forms using drafting tool in software	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Draw various views of threads and its forms using software	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Part modelling and Assembly of Screw jack (Bottle type)	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Part modelling and Assembly ofPlummer block (Pedestal Bearing)	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Part modelling and Assembly ofDrafting of wing assembly	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Part modelling and Assembly ofDrafting of fuselage assembly	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Part modelling and Assembly ofDrafting of propeller and hub assembly	
Lab Experiment – 9	**Contact Hours = 2 Hours**
Part modelling and Assembly ofDrafting of main rotor blade assembly of helicopter	
Lab Experiment – 10	**Contact Hours = 2 Hours**
Part modelling and Assembly ofDrafting of Landing Gear Assembly	

Books	
	Text Books:

1.	N. D. Bhat &V. M. Panchal, 'Machine Drawing', Charotar Publications, 26thEdn. 1991.
2.	K.R. Gopal Krishna, 'Machine drawing' Subhash Publication.,2003
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL course: Introduction to Engineering Drawing by Prof. Robi, P.S, IIT Guwahati. (https://nptel.ac.in/courses/112103019)
2.	NPTEL course: Orthographic projection by Prof. Prof. Avlokita Agrawal, IIT Roorkee. (https://onlinecourses.nptel.ac.in/noc21_ar01/preview)

Course delivery methods		**Assessment methods**	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		5.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify components/assembly drawings either manually or by using standard CAD packages	An	1,2,5,12	1,2,3
2.	Practice with drafted components and their assembly of an aircraft	An	1,2,5,12	1,2,3
3.	Distinguish drawings of machine and aircraft components	An	1,2,5,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments& viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1. Conductionof the experiment:15 marks + Viva voce: 5 marks = 20 marks
2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
3. Lab project/ Open ended experiment: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:

1. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 50 marks of 2/3 hours duration.

2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓			✓							✓	✓	✓	✓
2	✓	✓			✓							✓	✓	✓	✓
3	✓	✓			✓							✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Hand on practice with modelling tool**	**Aerospace, mechanical, automobile , civil**	**Design Engineer , CAD drafters**
2	**Acquire the knowledge of machine drawing and learn to read and understand the drawing in detail**		**CAD technician, Urban designers**

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. P. M. Banakar	**Prof. P P Katti**

SOCIAL CONNECT AND RESPONSIBILITY

Course Code		Course type	UHV	Credits L-T-P	0-0-1
Hours/week: L - T- P	0-0-2			Total credits	1
Total Contact Hours	16 Hours of engagement			CIE Marks	100
Flipped Classes content	--			SEE Marks	--

Course learning objectives	
1.	Bridging the gap between theory and practice through community engagement
2.	Interaction with the community for identification and solution to real life problems faced by the community
3.	Catalyzing acquisition of values and responsibilities for public service to make better citizens

Required Knowledge of: Interpersonal skills, Communication skills

Activities to be planned and conducted by the Department Associations are:

1. **Linking learning with the community through Knowledge Sharing**: In this the students can apply their knowledge and skills to improve the lives of the people. The knowledge available with the students can be shared to the school students of the local community. It can be in the form of engaging the classes, developing projects which can used by the students and teachers, training sessions on MS word, Excel, PPT for students and teachers etc.
2. **Creating Awareness about health and hygiene:** The students can arrange talks on Importance of cleanliness, health, and hygiene by taking help of Doctors, Public Health Organizations, NGOs etc.
3. **Including the Practitioners as teachers:** Arrange the invited talks by experts in agriculture for the farmers in the local community to create awareness about Organic farming, new methods of agriculture such as hydroponics, vertical farming etc.
4. **Environmental Sustainability:** Students can take initiatives to educate the local community regarding protecting our environment through tree plantations, preserving water bodies etc.
5. **Social Innovations for Rural development**

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Gain knowledge about the culture and societal realities	Un	6,9	
2.	Develop sense of responsibility and bond with the local community	Un	6,9	
3.	Make significant contributions to the local community and the Society at large	Ap	6,9	

4	Identify opportunities for contribution to the Socio-economic development	Ev	6,9	

Scheme of Continuous Internal Evaluation (CIE):

• Students must maintain the diary of the activities conducted. • The activities can be conducted in groups/batches. • Faculty members can design the evaluation system wherein weightage can be given to presentation of activities conducted & report writing.	50 marks

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1						✓			✓						
2						✓			✓						
3						✓			✓						
4						✓			✓						
5															
Tick mark the CO, PO and PSO mapping															

Aircraft Maintenance, Repair and Overhaul

Course Code	21 AE 6511	**Course type**	ESC	**Credits L-T-P**	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand the maintenance, repair and overhaul process.
2.	Learn different departments merged to function as maintenance team.
3.	Recognize different types of checks and servicing on aircraft.
4.	Study assembly and rigging process of aircraft components.
5.	Learn safety measures of aircrafts and inspection process.

Pre-requisites: Elements of Aeronautics

Unit – I Introduction to Aircraft Maintenance Engineering	**Contact Hours = 8 Hours**
Aircraft design philosophy—Safe life and fail-safe principles. Stages of aircraft design and development. Necessity for development of an aircraft maintenance program. History leading to development of FAA, ICAO and DGCA. Introduction to Indian Aircraft act 1934 and Aircraft rules 1937.Rules and Regulation of Civil Aviation. Overview of Maintenance, Repair and Overhaul of aircraft. Zones of aircraft, soft life components, Hard Time Components, consumables. Definition of common terms used in Aircraft MRO. **Flipped Class content**: Various sections of CAR as per DGCA, various parts of Indian aircraft rules	

Unit – IIAircraft Maintenance philosophy, Checks and allied departments	**Contact Hours = 8 Hours**
Aircraft Maintenance philosophy: Flying Hours based, Calendar based, landing based, on condition etc. Maintenance sections: Daily Servicing Section or line maintenance team and Technical servicing section. Type of daily servicing—First Line or O Level (FFS, TRS &TRS), Second Line or I Level, Third Line and Fourth Line or D level. Checks: A-type, B-type, C-type and D-type servicing.Allied Maintenance Allied Departments: Planning (Maintenance Control Center), Logistics, Quality, Ground Equipment maintenance team. **Flipped Class Content**: Aviation certification requirements.	

Unit – III Layout of work place and actions prior to servicing	Contact Hours = 8 Hours
Typical layout of an aircraft servicing hangar – Clean room, Tool Crib, Aircraft servicing bay, Hydraulic Bay, Avionics servicing bay, Battery Charging room, Tyre Bay, painting bay, Refueling Bay, specialist power supply bay, Technical library, Servicing crew rest room and Marshalling crew section. Aircraft Jacking, Airplane Rigging and weighing, Balancing of control surfaces. Helicopter flight controls. Tracking and balancing of main rotor. **Flipped Class content**: Aircraft Health monitoring.	

Unit – IV Review of Aircraft systems and trouble shooting	Contact Hours = 8 Hours
Overview of Aircraft systems--- Electrical system, Instrumentation system, Control system, Fuel system, Hydraulic system, Pneumatic system and Environment control system. Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs) Trouble shooting procedure for aircraft systems and aircraft documentation. **Flipped Class content**: Aircraft documentation.	

Unit – VSafety precautions in Aircraft MRO	Contact Hours = 8 Hours
Precautions against Human Error Servicing, Precaution against fire and use of inspection lamps, Safety precautions against electrical shock due to static electricity, precautions against loose articles in aircraft servicing, Precautions in Monsoon seasons, Safety precaution against radar radiations. Practices in Hazardous materials storage and handling, Aircraft furnishing practices. Defect investigation of components. **Flipped Class content**: Quality checks on aircraft Fuel and Hydraulic fluid.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Kroes, Watkins, Delp, “Aircraft Maintenance and Repair”, Mcgraw-Hill, New York 1992.
2.	Brimm D.J. Bogges H.E., “Aircraft Maintenance”, Pitman Publishing Corp. New York, 1940.
3.	Friend, C.H., Aircraft maintenance Management . Longman, 1992
4.	
	Reference Books:
1.	Kinnison, H.A , Aviation Maintenance Management, Mc Graw – Hill – 2004
2.	Mc Kinley, J.L. Bent, R.D ., Maintenance and Repair of Aerospace Vehicles, Northrop Institute of Technology, Mc Graw Hill, 1967.

	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Lectures by Vipul Mathur of IIT Kanpur https://elearn.nptel.ac.in/shop/nptel/advance-aircraft-maintenance/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the maintenance, repair and overhaul process.	Un	1,12	1,2,3
2.	**Discuss** different departments merged to function as maintenance team.	Un	1,9,12	1,2,3
3.	**Demonstrate** different types of checks and servicing on aircraft.	Ap	1,12	1,2,3
4.	**Illustrate** assembly and rigging process of aircraft components.	Ap	1,12	1,2,3
5.	**Elucidate** safety measures of aircrafts and inspection process.	An	1,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25 = 50	5* 4 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass:** Score should be > 35 &, however overall score of CIE + SEE should be > 40%

3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√											√	√	√	√
2	√								√			√	√	√	√
3	√											√	√	√	√
4	√											√	√	√	√
5	√											√	√	√	√
Please Tick at appropriate place															

Sl. No.	Skill & Competence enhanced after undergoing the course	Applicable sectors & domains	Job roles students can take up after undergoing the course
1	**Basic knowledge about aircraft servicing, repair and overhaul.**	**Civil Aviation and Defense**	**Aircraft maintenance engineer in MRO industry or airlines.**

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. P S Joshi	**Prof. P M Banakar**

Introduction to UAS technology

Course Code		Course type	ETC	Credits L-T-P	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Learn about the various types of Drones and its applications.
2.	Understand about the various components of drone design.
3.	understand different types of sensors used in drone technology
4.	Classify different microcontrollers and flight controllers.

Pre-requisites : Engineering Mechanics , Fundamentals of Flight

Unit – I: Introduction	**Contact Hours = 06 Hours**
Introduction, Types of Drones , Components of UAVs-Types of motors used for Drones –Several type of Speed Controllers, Flight Control Board, Radio Transmitter and receiver , Battery propellers,Power distribution board, Additional Equipment, UAV Materials and Launching Systems.	

Unit – II: Multi rotor Aerodynamics and Flight Mechanics	**Contact Hours = 10 Hours**
Lift and Thrust Pitch and roll, yaw, Translational Lift, Climbing, Hovering and Descent. Quad copter modeling representation-Frames –kinematic modeling –Euler angles, Quaternions and dynamic modeling.	

Unit – III: Drone Control Systems	**Contact Hours = 8 Hours**
Choosing a Flight control System-MultiWii, Dronecode, APM/ArduPilot,PX4/Pixhawk, DJI/Naza,KK2 and CC3D/Open Pilot. Sensors dedicated to flight control –IMU,INS,GPS, Magnetometer and barometer, Ground control systems sense and avoid technology.	

Unit – IV: Drone Design and optimization	**Contact Hours = 8 Hours**
Design considerations for drone airframe and propulsion systems, Selecting and assembling dronecomponents such as motors, batteries, flight controllers, and cameras, Basic wiring and soldering techniques. Case study: Improve the Hubsan X4 and Build the X4Wii.	

Unit –V: Safety and Regulations	Contact Hours = 8 Hours
DGCA Rules and Regulations, Drone license, Digital Sky Platform Maintenance procedure, Drone commercial applications, Drone technology- Entrepreneurship, Tool for social inclusion and Future of Drones.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	3	2	2	2

Books	
	Text Books:
1.	YasminaBestaouiSebbane, "A First Course in Aerial robotics and Drones ", PHI, `1st edition, 2022, ISBN-0367631385.
2.	David Mcgriffy, Make: Drones: Teach an Arduino to Fly ,1st edition,2016,ISBN-13:978-1680451715.
	Reference Books:
1.	E. Tooley, Practical Drones: Building, Programming, and Applications, Apress, 2021.
2.	S. K. Kopparthy, Drone Technology: Theory and Practice, Springer, 2020.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.udemy.com/course/make_a_drone/: Make an Open Source Droneby Dr.Peter.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the fundamental concepts and Regulations of Drone Technology, basic equations ofMulti rotor dynamics.	Un	1	1
2.	**Derive** and **explain** various Drone Performance Parameters for various Applications.	Ap	1, 2	1
3.	**Explain** various types of Flight Control Systems to **determine** the suitable flight control system for the application.	An	1, 2	1

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass:** Score should be > 35&, however overall score of CIE + SEE should be > 40%
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**√**	**√**											**√**		
2	**√**	**√**											**√**		
3	**√**	**√**											**√**		
Please Tick at appropriate place															

Sl. No.	**Skill & Competence enhanced after undergoing the course**	**Applicable sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Mathematical Modelling of Dynamic systems.**	**UAV system modelling and simulation**	**UAV System Engineer**
2	**Controller design (Root locus Method)**	**UAV , Space vehicles and aircraft**	**Flight Control Engineer**

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. Anil Kumar Nakkala	**Dr.K V Kulkarni**

Introduction to Air Armament

Course Code		**Course type**	**ETC**	**Credits L-T-P**	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand basic working of air armament
2.	Understand basics of War heads and fuses
3.	Understand ballistics of projectiles
4.	Understand procedure for certification of indigenously developed air armament stores.

Pre-requisites : Chemistry and elements of Aeronautics

Unit – I Introduction to Air Armament	**Contact Hours = 8 Hours**
Introduction to air armament stores—Aircraft Guns, Bombs, Missiles and Rockets. Classification of air armament and their working principle of operation.	

Unit – II warheads and Fuses	**Contact Hours = 8 Hours**
Introduction to blast loads, Detonators, Intermediary and high explosives. Construction and classification of warheads. Working principle of Blast, Fragmentation and shaped charge warheads.. Types of fuses and their principle of working	

Unit – III Internal Ballistics	**Contact Hours = 8 Hours**
Basics of Ballistics of any projectile, Difference between precision, accuracy and CEP. Burning of propellants, Vielle's mode and rate of burnings, form function, Resalls' Energy Equation.	

Unit – IV External ballistics	**Contact Hours = 8 Hours**
Aerodynamic force system. Normal equations. Numerical methods of trajectory computation, Meteorological corrections. Angular motion of the Centre of mass. Drift and deflection, Dispersion of fire.	

Unit –V Certification of Air Armament stores	**Contact Hours = 8 Hours**
Definition, Process of development, Development Phase, Production Phase, Indigenization, Flight Testing by user services.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Text Book of Ballistic & Gunnery, Vol I & II, HMSO Publication,1987,. 2., 3. 4.
2.	Ballistics Theory and Design of Guns & Ammunition, DE Carlucci & SS Jacobson, CRC Press. 2007
3.	Modern Exterior Ballistics, ,Robert L McCoy, Schiffer Publishing.
	Reference Books:
1.	2001Military Ballistics: A Basic Manual (Brassey's New Battlefield Weapons Systems and Technology Series into 21st Century), CL Farrar, DW Leeming, GM Moss, Brassey's (UK) Ltd. 1999,

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the importance and utilization of Air Armament	Un	1,12	1,2,3
2.	**Discuss** the functioning of Warheads and Fuses	Un	1,12	1,2,3
3.	**Illustrate** concepts of Internal Ballistics	Un	1,12	1,2,3
4.	**Demonstrate** External ballistics with aerodynamics as backdrop	Un	1,12	1,2,3
5	**Elucidate** procedure for certification of Air Armament	Un	1,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks

Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√											√	√	√	√
2	√											√	√	√	√
3	√											√	√	√	√
4	√											√	√	√	√
5	√											√	√	√	√
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1			
2			
3			

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. P S Joshi	**Prof. I V Patil**

Cyber Security & Safety

Course Code		**Course type**	**ETC**	**Credits L-T-P**	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To familiarize cybercrime terminologies and perspectives
2.	To understand Cyber Offenses and Botnets
3.	To gain knowledge on tools and methods used in cybercrimes
4.	To understand phishing and computer forensics•

Pre-requisites :

Unit – I	**Contact Hours = 8 Hours**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives Textbook:1 Chapter 1 (1.1 to 1.5, 1.7-1.9)	

Unit – II	**Contact Hours = 8 Hours**
Cyber Offenses: How Criminals Plan Them:Introduction, How criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercaafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector. Textbook:1 Chapter 2 (2.1 to 2.7)	

Unit – III	**Contact Hours = 8 Hours**
Tools and Methods used in Cybercrime: Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyways, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attackes, Attacks on Wireless networks. Textbook:1 Chapter 4 (4.1 to 4.9, 4.12)	

Unit – IV	**Contact Hours = 8 Hours**
Phishing and Identity Theft: Introduction, methods of phishing, phishing,phising techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft Textbook:1 Chapter 5 (5.1. to 5.3)	

Unit –V	Contact Hours = 8 Hours
Understnading Computer Forensics: Introdcution, Historical Background of Cyberforensics, Digital Foresics Science, Need for Computer Foresics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics. Textbook:1 Chapter 7 (7.1. to 7.5, 7.7 to 7.9)	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, First Edition (Reprinted 2018)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.youtube.com/watch?v=yC_hFm0BX28&list=PLxApjaSnQGi6Jm7LLSxvmNQjS_rt9swsu
2.	https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_
3.	https://www.youtube.com/watch?v=6wi5DI6du-4&list=PL_uaeekrhGzJlB8XQBxU3z__hDwT95xlk

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the cybercrime terminologies	RE	1,2,3,4,5	1,2,3
2.	Describe Cyber offenses and Botnets	UN	1,2,3,4,5	1,2,3
3.	Illustrate Tools and Methods used on Cybercrime	UN	1,2,3,4,5	1,2,3

4.	Explain Phishing and Identity Theft	RE	1,2,3,4,5	1,2,3
5.	Justify the need of computer forensics	EV	1,2,3,4,5	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓	✓	✓	✓								✓	✓	✓
2	✓	✓	✓	✓	✓								✓	✓	✓
3	✓	✓	✓	✓	✓								✓	✓	✓
4	✓	✓	✓	✓	✓								✓	✓	✓
5	✓	✓	✓	✓	✓								✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Network Security Engineer	Information Technology (IT) and Technology Services	Security Analyst:
2	Security Operations Center (SOC) Analyst	Finance and Banking	Network Security Engineer
3	Incident Responder	Government and Defense	Incident Responder

4	Cybersecurity Consultant	E-commerce and Retail	Security Operations Center (SOC) Analyst
5	Compliance Officer	Telecommunications	Cybersecurity Consultant
6	Security Auditor	Consulting and Advisory Services	Compliance Officer
7	Ethical Hacker/Penetration Tester	Legal and Compliance	Security Auditor
8	Risk Analyst	Information Technology (IT) and Technology Services	

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. P Katti	**Prof. A K Nakkala**

Technical Writing and Presentation

Course Code		Course type	AEC	Credits L-T-P	0 - 0- 1
Hours/week: L-T-P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0Hrs; T = 0 Hrs;P = 20 Hrs Total = 20Hrs			CIE Marks	50
Flipped Classes content	0 Hours			SEE Marks	50

Course learning objectives	
1.	Learn to use written communication in your work and personal experience
2.	Teach you the skills needed to successfully communicate in a modern world through written materials.
3.	Understanding the characteristics of technical writing and the importance of purpose for written communication in technical fields.
4.	Learn how to write effective technical and business documents that are grammatically correct.

Required Knowledge of :Basic English Language

List of Experiments

No. of Experiments	Topic(s) related to Experiment
1	Introduction to the technical writing, Formal email/message writing.
2	Writing using various tools Microsoft Word/Google docs etc.
3	Effective use of various presentation tools: PowerPoint/Google slides
4	Basics of Microsoft Excel/Google Spreadsheet
5	Event report writing.
6	Technical project/Internship report writing.
7	Research paper writing.
8	Proposals writing.
9	Technical catalogue writing.
10	Final year project report writing.

No.	Self-Study Topics
I	Literature survey on any related technical topic
II	Write Statement of Purpose (SOP)
III	Presentation on technical content
IV	Use of excel to plot and evaluate problems from various subjects.

Books

	Text Books:
1.	McMurrey David A, 'Handbook for Technical Writing', New Delhi Cengage, 2012.
2.	Raman &Meenakshi, 'Technical Communication', New York Oxford University Press, 2010.
	Reference Books:
1.	Sheeham& Richard Johnson, 'Writing Proposals', Noida Pearson, 2008.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL course: Effective Writing by** Prof.Binod Mishra, IIT Roorkee https://onlinecourses.nptel.ac.in/noc20_hs06/preview
2.	**NPTEL course: Technical English for engineers by Prof. Aysha Iqbal, IIT Madras** https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-hs27/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Demonstrate** technical writing skills	Ap	1, 5, 8, 9, 10, 12	3
2.	**Use** various tools required for technical writing	Ap	1, 5, 8, 9, 10, 12	3
3.	**Create**and **Present** technical contents	Cr	1, 2, 5, 8, 9, 10, 12	3

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab:

1. Conducting the experiment and journal: 10 marks
2. Calculations, results, graph, conclusion and Outcome: 10 marks
3. Viva voce: 5 marks

Journal Submission

1. Students will submit the journal at the end of the semester

Open Ended Experiment/Quiz

1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)			Total
Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (planned)													CO-PSO Mapping(planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√				√			√	√	√		√			√
2	√				√			√	√	√		√			√
3	√	√			√			√	√	√		√			√
Mention the levels: 1, 2, 3															

Sl. No.	Skill & Competence enhanced after undergoing the course	Applicable sectors & domains	Job roles students can take up after undergoing the course
1	**Technical writing**	**All engineering branches**	**All engineering branches**
2	**Professional communications**	**All industries**	**All industries**
3	**Technical content presentation**	**All higher educations**	**All higher educations**

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Dr. Kamlesh Kulkarni	**Prof. A K Nakkala**

Introduction to the MATLAB & SIMULINK

Course Code		Course type	AEC	Credits L-T-P	0 - 0- 1
Hours/week: L-T-P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0Hrs; T = 0 Hrs;P = 20 Hrs Total = 20Hrs			CIE Marks	50
Flipped Classes content	0 Hours			SEE Marks	50

Course learning objectives	
1.	Learn basics of MATLAB programming
2.	Will be able to use MATLAB to solve computational problems
3.	Learn the basics of Simulink.
4.	Model a simple system in Simulink.

Required Knowledge of : Engineering Mathematics

List of Experiments

No. of Experiments	Topic(s) related to Experiment
1	**Basics of MATLAB programming**
2	**Array operations in MATLAB**
3	**Loops and execution control**
4	**Working with files: Scripts and Functions**
5	**Plotting and program output**
6	**Differentiation and numerical integration**
7	**Introduction to the block diagram in SIMULINK**
8	**Plotting various graphs using SIMULINK**
9	**Solving differential equations using SIMULINK**
10	**Mass-Spring-Damper model for different inputs using SIMULINK**

Unit No.	Self-Study Topics
I	Solving step bars subjected to axial load problems using MATLAB
II	Solving Bernoulli's equation using MATLAB
III	Plotting Mohr's stress circle using MATLAB
IV	Solving differential equations for real life problems using SIMULINK
V	Solving Euler Angles using SIMULINK

Books	
	Text Books:
1.	Rudra Pratap, 'Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers', Oxford University press, South Asia Edition.
2.	Kumar Tyagi Agam, 'MATLAB and SIMULINK for Engineers', **Oxford University Press** India, 2012 Edition
	Reference Books:
1.	B. H. Hahn & D. T. Valentine, 'Essential MATLAB for Engineers and Scientists', Elsevier Publications, 4th Edition
2.	Modelling & Simulation using MATLAB SIMULINK, ' Shailendra Jain, Newdelhi Willey, 2011 Edition
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL course: Matlab Programming for Numerical Computation, by Prof. NiketKaisare, IIT Madras.** https://onlinecourses.nptel.ac.in/noc20_ge05/preview
2.	**MATHWORKSWeb Page: Getting started with SIMULINK** https://in.mathworks.com/help/simulink/getting-started-with-simulink.html

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Explain basic steps involved in MATLAB programming	Un	1, 5	1
2.	Explain processes involved in SIMULINK	Un	1, 5	1
3.	Write & Execute appropriate codes to solve various mathematical problems	Ev	1, 2, 3, 5, 8, 9, 10, 12	1, 2, 3
4.	Construct & Run a physical model using SIMULINK	Ap	1, 2, 3, 5, 8, 9, 10, 12	1, 2, 3
5.	Debug a code to identify errors involved	Ap	1, 2, 5, 8, 9, 10, 12	1, 2, 3

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab:

1. Conducting the experiment and journal: 10 marks

2. Calculations, results, graph, conclusion and Outcome: 10 marks 3. Viva voce: 5 marks
Journal Submission 1. Students will submit the journal at the end of the semester
Open Ended Experiment/Quiz 1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)			Total
Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√				√								√		
2	√				√								√		
3	√	√	√		√			√	√	√		√	√	√	√
4	√	√	√		√			√	√	√		√	√	√	√
5	√	√	√		√			√	√	√		√	√	√	√
Mention the levels: 1, 2, 3															

Sl. No.	**Skill & Competence enhanced after undergoing the course**	**Applicable sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Programming skills**	**Aerospace Industry**	**Stress Analyst**
2	**Plotting skills**	**Aircraft structural industries**	**Fluid flow Analyst**
3	**Loop execution**	**Fluid flow analysis industries**	**CFD Analyst**
4	**Solving various mathematical equations**	**Aircraft Propulsion industries**	**Programmer**

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Dr. Kamlesh Kulkarni	**Prof.A K Nakkala**

Syllabus of IV Semester

Aircraft Propulsion - I

Course Code		**Course type**	**PCC**	**Credits L-T-P**	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand the basic principle and theory of aircraft propulsion.
2.	Understand the purpose of a centrifugal, axial compressors, axial and radial turbines
3.	Acquire knowledge of importance of nozzles & inlets and combustion chamber

Pre-requisites : Engineering Thermodynamics

Unit – I	**Contact Hours = 8 Hours**
Introduction: Review of thermodynamic principles, Principles of aircraft propulsion, Types of power plants, Working principles of internal combustion engine, Two – stroke and four – stroke piston engines, Gas- turbine engines, Cycle analysis of reciprocating engines and jet engines , advantages and disadvantages.	

Unit – II	**Contact Hours = 8 Hours**
Propeller Theories & Jet propulsion: Types of propeller, Propeller thrust: momentum theory, Blade element theories, propeller blade design, propeller selection. 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.	

Unit – III	**Contact Hours = 8 Hours**
Inlets & Nozzles: Internal flow and Stall in Subsonic inlets, Boundary layer separation. Major features of external flow near a subsonic inlet. Relation between minimum area ratio and eternal deceleration ratio. Diffuser performance. **Supersonic inlets:** Supersonic inlets, starting problem in supersonic inlets, Shock swallowing by area variation, External deceleration. Modes of inlet operation. **Nozzles:** Theory of flow in isentropic nozzles, Convergent nozzles and nozzle choking, Nozzle throat conditions. Nozzle efficiency, Losses in nozzles. Over-expanded and under-expanded nozzles, Ejector and variable area nozzles, Thrust reversal.	

Unit – IV	**Contact Hours = 8 Hours**

Centrifugal compressors: Principle of operation of centrifugal compressors. Work done and pressure rise -Velocity diagrams, Diffuser vane design considerations. performance characteristics. Concept of Prewhirl, Rotating stall. **Axial flow compressors:** Elementary theory of axial flow compressor, Velocity triangles, Degree of reaction, three dimensional flow. Air angle distribution for free vortex and constant reaction designs, Compressor blade design. Axial compressor performance characteristics.

Unit –V	**Contact Hours = 8 Hours**
Combustion chambers and Turbines: Classification of combustion chambers, important factors affecting combustion chamber design, Combustion process, Combustion chamber performance Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders **Axial Flow Turbines:** Introduction, Turbine stage, Multi-staging of turbine, Exit flow conditions, Turbine cooling, Heat transfer in turbine cooling. **Radial turbine:** Introduction, Thermodynamics of radial turbines, Losses and efficiency	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Bhaskar Roy, “Aircraft propulsion”, Elsevier (2011), ISBN-13: 9788131214213
2.	V. Ganesan, “Gas Turbines”, Tata McGraw-Hill, 2010, New Delhi, India, ISBN: 0070681929.
	Reference Books:
1.	Hill, P.G. & Peterson, C.R., “Mechanics & Thermodynamics of Propulsion” Addison – Wesley Longman INC, 1999, ISBN-13: 978-0201146592.
2.	Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H., “Gas Turbine Theory”, Longman, 1989, ISBN 13: 9780582236325.
3.	Irwin E. Treager, “Gas Turbine Engine Technology” GLENCOE Aviation Technology Series, 7th Edition, Tata McGraw Hill Publishing Co. Ltd. Print 2003, ISBN-13: 978-0028018287
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL:** Online Resources: Lecture by: Prof. Bhaskar Roy , Prof. A M Pradeep, IIT Bombay https://nptel.ac.in/courses/101101002/
2.	**NPTEL:** Online Resources: Lecture by: Prof. Vinayak N. Kulkarni , IIT Guwahati https://swayam.gov.in/nd1_noc19_me76/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
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4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply the basic principle and theory of aircraft propulsion.	**Ap**	1,2	1
2.	Explain the functions of centrifugal, axial compressors, axial and radial turbines	**Ap**	1,2	1
3.	Analyse the performance of nozzles & inlets and combustion chamber	**An**	1,2	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

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1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**√**	**√**											**√**		

2	√	√										√		
3	√	√										√		
4	√	√										√		
5	√	√										√		
Tick mark the CO, PO and PSO mapping														

Sl. No.	Skill & Competence enhanced after undergoing the course	Applicable sectors & domains	Job roles students can take up after undergoing the course
1	Able to understand working of aircraft engine	Aerospace propulsion	Gas turbine engines related jobs
2	Acquire knowledge about each component of engines	Technical publication	Aero Engine Technical Publication Engineer
4	Knowledge of Gas Turbine engines and their functioning	Maintenance	Repair Industrialization Engineer
5	Familiar with gas turbine principles, different modules and functionalities of major parts	Engineering & Manufacturing	Aero Engine Component Design Engineer

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. P M Banakar	Prof. I V Patil

Aerodynamics

Course Code		**Course type**	IPCC	**Credits L-T-P**	3 – 0 - 1
Hours/week: L - T- P	3 – 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the basic concepts of control volume approaches & flow properties
2.	To understand the governing equations used in aerodynamics
3.	Acquire knowledge on 2D Inviscid Incompressible Flows
4.	To understand various Lift theorems. Lift and Drag of the Aircraft
5.	Acquire knowledge on wind tunnel equipment & its measuring techniques

Required Knowledge of: Fluid Mechanics, Physics and Mathematics

Unit – I:	**Contact Hours = 8 Hours**
Fundamental Principles of Aerodynamics: Introduction, Flow similarities, Types of Flow, Control volume approach to continuity, momentum and energy equations. Path lines, Streamlines, and Streak lines, Angular velocity, Vorticity, Circulation, and Stream function, Velocity potential and Relationship between them.	

Unit – II:	**Contact Hours = 8 Hours**
Incompressible flow over 2D bodies: Non-lifting flow over a two-dimensional circular cylinder, vortex flow. Lifting flow over a two-dimensional circular cylinder, Generation of lift.aerodynamic forces and moments, center of pressure, pressure coefficient, types of drags, calculation of airfoil lift and drag from measured surface pressure distributions.	

Unit – III:	**Contact Hours = 8 Hours**
Incompressible Flow over Finite wings: Induced Downwash and Drag, Kelvin's circulation theorem and the starting vortex, vortex sheet, vortex filaments, Kutta condition, Prandtl's Classical Lifting line theory, Delta wing, Airplane Lift and Drag.	

Unit – IV:	**Contact Hours = 8 Hours**
Introduction to Compressible flows: Inviscid, Compressible flow, Shock waves, speed of sound, Normal shock wave, oblique shock wave and expansion waves, shock wave boundary layer interaction, flow through nozzles, diffusers and wind tunnels.	

Unit – V:	**Contact Hours = 8 Hours**
Introduction to Aerodynamic Testing: Principles of wind tunnel flow simulation, open and closed-circuit wind tunnels, Major features of low speed, transonic and supersonic wind tunnels, smoke and tuft flow visualization techniques-Surface oil film & Particle Image Velocimetry, Pressure and	

Aerodynamic load measurements on a model, total drag determination of two-dimensional bodies using wake survey at low speeds.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	2	1. Smoke flow visualization studies on a two-dimensional body at low speeds for studying path line and streamlines. 2. Tuft flow visualization on a flat plate at different angles of attack at low speeds.
2	2	3. Surface pressure distributions on a two-dimensional circular cylinder at low speeds and calculation of pressure drag. 4. Surface pressure distributions on a two-dimensional symmetric airfoil at different incidences at low speeds.
3	2	5. Calculation of total drag of a two-dimensional Flat plate and cylinder at low speeds using pitot-static probe wake survey. 6. Calculation of total drag of a two-dimensional symmetric and cambered airfoil at low speeds using pitot-static probe wake survey.
5	2	7. Calibration of a subsonic wind tunnel by inclined manometer. 8. Study of the characteristics of three-dimensional body involving measurement of lift, drag, pitching moment using force balance method.

Unit No.	**Self-Study Topics**
1	Mach number & Mach number regimes
2	Pitot-tube measurement of airspeed based on Bernoulli's equation
3	Airfoil geometry and wing plan-form geometry selection, Kutta-Joukowski theorem
4	Estimation of Skin friction drag for laminar and turbulent flow
5	Types of visualization techniques used for subsonic aerodynamic analysis

Books	
	Text Books:
1.	Anderson,Jr.J.D."FundamentalsofAerodynamics",McGraw-HillEducation/Asia;5th edition (16 May 2011).ISBN-13: 978-0071289085
2.	HoughtonE.LandCarpenterP.W."AerodynamicsforEngineeringStudents,Elsevier; Sixth edition (2012)ISBN-13: 978-9382291176
	Reference Books:
1.	PopeA.andHarper,JJ."LowSpeedWindTunneltesting",JohnWileyInc.New

	York, 1966, ISBN: 978-0-471-55774-6
2.	Anderson,Jr.J.D."IntroductiontoFlight",TataMcGraw-HillPublishingCo.Ltd., New Delhi, 2007. (Special Indian Edition), ISBN-10-0071263187
3.	Schlichting, H. "Boundary Layer Theory"McGraw Hill, NewYork, 2004. ISBN-978-3-662-57095-1
4.	PopeA. and Goin, KL. "High Speed Wind Tunnel Testing", John Wiley &SonsInc. New York, ISBN-0-471-55774-9
	E-resources (NPTEL/SWAYAM)
1.	**NPTEL:** Online Resources: Lectureby: ProfProf.Job KurianIIT Madras https://nptel.ac.in/courses/101106040/,
2.	**NPTEL:** Online Resources: Lectureby: Prof.K P Sinha Mahapatra,IIT Kharagpur. https://nptel.ac.in/courses/101105059/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Describe the control volume approach and apply vorticity, circulation concepts to Aerodynamic applications	AP	1,2,8,9,10,12	1,2
2.	Analyze the 2-dimensional incompressible flow over various bodies and understand related theories.	AP	1,2,8,9,10,12	1,2
3.	Apply finite wing theory for incompressible flow.	AP	1,8,9,10,12	1,2
4.	Interpret generation of various shock waves generated in compressible flow.	AN	1,2,12	1,2
5.	Demonstrate different techniques in experimental Aerodynamic analysis.	AN	1,2,8,9,10,12	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper					

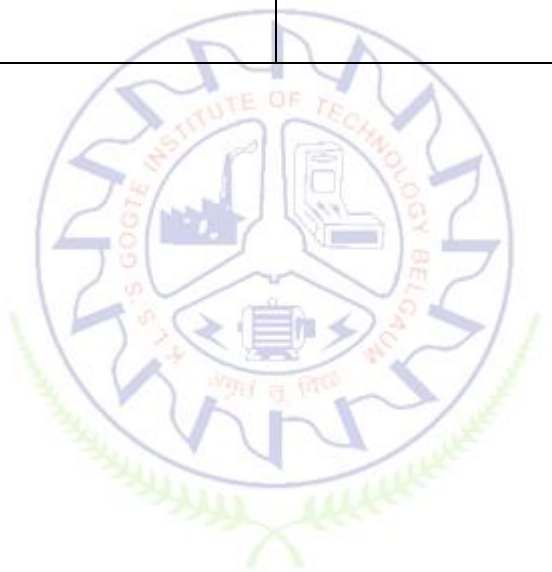
2. All questions descriptive
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks
Lab test: (Batchwise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√						√	√	√		√	√	√	
2	√	√						√	√	√		√	√	√	
3	√							√	√	√		√	√	√	
4	√	√										√	√	√	
5	√	√						√	√	√		√	√		
Mention the levels: 1, 2, 3															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Basics of Aerodynamics	Aircraft manufacturing sector	Aerodynamics Engineer
2	Use of governing equation both Theory and CFD	Aerodynamics analysis sector	Fluid flow Analysis Engineer

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. D A Ponnaswami	Prof. A K Nakkala



Aircraft Structures I

Course Code		**Course type**	**PCC**	**Credits L-T-P**	4 - 0- 0
Hours/week: L-T-P	4 - 0 – 0			**Total credits**	4
Total Contact Hours	L = 50 Hrs; T = 0 Hrs;P = 0 Hrs Total = 50 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Explain basic concept of stress, strain, transformation of stress/strain and strength of materials.
2.	Teach the concepts and calculation of Torsion of thin wall structures
3.	Shear flow in thin wall structure due to shear load
4.	To understand Fracture, Fatigue and buckling Analysis of aircraft

Required Knowledge of : Engineering Mechanics, Engineering Mathematics, Mechanics of Materials

Unit – I	**Contact Hours = 10 Hours**
Loads on Aircraft, Types of loads, Concept of allowable stress and factor of safety, Introduction to thin wall structure, sectional properties of thin wall structures, idealized structures, unsymmetrical bending, position of neutral axis	

Unit – II	**Contact Hours = 10 Hours**
Torsion of thin wall structures (Open, Closed, Combined), Introduction to shear center, center of twist and shear flow, Breadt- Batho equations, Torsional constants, angle of twist, torsion of idealized structure.	

Unit – III	**Contact Hours = 10 Hours**
Shear flow in thin wall structure due to shear load (Open, Closed, Combined), Calculation for position of shear center for open and closed structure, shear of idealized structure Analysis of tapered shear beams, Wagner beam.	

Unit – IV	**Contact Hours = 10 Hours**
Energy Methods Strain energy due to tension, shear, torsion and bending, Castigliano's theorem, Maxwell's Reciprocal theorem, Principle of super position, Unit load method, Stress due to impact load, tension due to impact, bending due to impact, torsion due to sudden applied torque	

Unit –V	**Contact Hours = 10 Hours**

Fatigue and fracture: Introduction, Strain energy release rate, Stress intensity factor, Crack tip opening displacement, Crack growth rate, Miner's rule, Elber correction, Goodman and Soldberg equations, Fatigue Life cycles

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**01**	**02**	**02**	**02**	**03**

Unit No.	**Self-Study Topics**
I	Loads acting on major components of aircraft, aircraft structural layout, Aircraft materials
II	Vertical and horizontal shear stresses, distribution of shear stress over rectangular, circular & I sections
III	Shear Flow Distribution, Tension field beams- complete diagonal tension
IV	Strain energy produced by bending and twisting, experimental determination of critical load for a flat plate
V	Fracture, Fatigue and buckling Analysis of aircraft

Books	
	Text Books:
1.	T H G Megson, Aircraft Structures for Engineering Students, Elsevier aerospace engineering series fifth edition.
2.	Ferdinand Beer & Russell Johnston, "Mechanics of Materials", McGraw Hill Education India Private Limited; Seventh edition, 2017.
3.	L Srinath, Advanced Mechanics of Solids McGraw Hill Education India Private Limited; third edition.
	Reference Books:
1.	Timoshenko S.,"Engineering-Mechanics", McGraw-Hill Education, 5th Edition, ISBN: 9781259062667, 9781259062667
2.	S.S.Bhavikatti , "Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL course: Aircraft Structures – I By Prof. Anup Ghosh | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc20_ae08
2.	NPTEL course: Mechanics of Materials by Dr. U Saravanan, IIT Madras. https://nptel.ac.in/courses/105106172/
3.	NPTEL course: Mechanics of Solids by Prof. Priyanka Ghosh, IIT Kanpur. https://onlinecourses.nptel.ac.in/noc22_ce46/preview

Course delivery methods	**Assessment methods**

1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)
Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

	At the end of the course, the student will be able to	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply the concepts of thin wall structure for different analysis	AP	1,2	1,2
2.	Evaluate the response of the various structures in terms of deformation, stress, strain, and shear flow under different loading condition	AN	1, 2, 5,8,9,10	1,2
3.	Apply the concept of energy method to solve for the structural response of various structures	AN	1, 2, 5,8,9,10	1,2
4.	Explain the phenomenon of fatigue and fracture fatigue life cycle related to aero structure	AN	1, 2, 5,8,9,10	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**√**	**√**											**√**	**√**	
2	**√**	**√**			**√**			**√**	**√**	**√**			**√**	**√**	

3	**√**	**√**			**√**			**√**	**√**	**√**			**√**	**√**	
4	**√**	**√**			**√**			**√**	**√**	**√**			**√**	**√**	

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. L Chikmath	**Prof. K V Kulkarni**

Aircraft Structures Lab

Course Code		**Course type**	**PCCL**	**Credits L-T-P**	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			**Total credits**	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			**CIE Marks**	50
Flipped Classes content	0 Hours			**SEE Marks**	50

Course learning objectives	
1.	Explain basic concept of stress, strain, transformation of stress/strain and strength of materials.
2.	Teach the concepts and calculation of Torsion of thin wall structures
3.	Shear flow in thin wall structure due to shear load
4.	To understand Fracture, Fatigue and buckling Analysis of aircraft

Required Knowledge of: Engineering Mechanics, Engineering Mathematics, Mechanics of Materials

List of Experiments:

No. of Experiments	**Topic(s) related to Experiment**
1	Determination of shear centre for thin-walled open section
2	Determination of Flexural Stiffness (EI) of a laminated (Bi - Metal) composite beam
3	Wagner Beam experiment
4	Verification of Castigliano's Load Theorem
5	Verification of Maxwell's Reciprocal Theorem
6	Verification of Principle of Super Position
7	Verification of Unit Load Method using Beam Apparatus
8	Fatigue Analysis of a beam
9	Non-destructive testing

Sl. No	**Self-Study Topics**
I	Loads acting on major components of aircraft, aircraft structural layout, Aircraft materials
II	Vertical and horizontal shear stresses, distribution of shear stress over rectangular, circular & I sections
III	Shear Flow Distribution, Tension field beams- complete diagonal tension
IV	Strain energy produced by bending and twisting, experimental determination of critical load for a flat plate
V	Fracture, Fatigue and buckling Analysis of aircraft

Books	
	Text Books:
1.	T H G Megson, Aircraft Structures for Engineering Students, Elsevier aerospace engineering series fifth edition.
2.	Ferdinand Beer & Russell Johnston, "Mechanics of Materials", McGraw Hill Education India Private Limited; Seventh edition, 2017.
3.	L Srinath, Advanced Mechanics of Solids McGraw Hill Education India Private Limited; third edition.
	Reference Books:
1.	Timoshenko S.,"Engineering-Mechanics", McGraw-Hill Education, 5th Edition, ISBN: 9781259062667, 9781259062667
2.	S.S.Bhavikatti , "Strength of Materials", Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL course: Aircraft Structures – I By Prof. Anup Ghosh, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc20_ae08
2.	NPTEL course: Mechanics of Materials by Dr. U Saravanan, IIT Madras. https://nptel.ac.in/courses/105106172/
3.	NPTEL course: Mechanics of Solids by Prof. Priyanka Ghosh, IIT Kanpur. https://onlinecourses.nptel.ac.in/noc22_ce46/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)
Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply the concepts of thin wall structure for different analysis	AP	1,2	1,2
2.	Evaluate the response of the various structures in terms of deformation, stress, strain, and shear flow under different loading condition	AN	1, 2, 5,8,9,10	1,2
3.	Apply the concept of energy method to solve for the structural response of various structures	AN	1, 2, 5,8,9,10	1,2

4.	Explain the phenomenon of fatigue and fracture fatigue life cycle related to aero structure	AN	1, 2, 5,8,9,10	1,2

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab:

1. Conducting the experiment and journal: 10 marks
2. Calculations, results, graph, conclusion and Outcome: 10 marks
3. Viva voce: 5 marks

Journal Submission

1. Students will submit the journal at the end of the semester

Open Ended Experiment/Quiz

1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)			Total
Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√											√	√	
2	√	√			√			√	√	√			√	√	
3	√	√			√			√	√	√			√	√	
4	√	√			√			√	√	√			√	√	

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. L Chikmath	**Prof. K V Kulkarni**

BIOLOGY FOR ENGINEERS

Course Code	22XXXX	**Course type**	BSC	**Credits L-T-P**	3-0-0
Hours/week: L - T- P	3-0-0			**Total credits**	3
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 0 Hrs Total = 30 Hrs			**CIE Marks**	100
Flipped Classes content	-			**SEE Marks**	100

Course learning objectives	
1.	To familiarize the students with the basic biological concepts and their engineering applications.
2.	To enable the students with an understanding of biodesign principles to create novel devices and structures
3.	To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems
4.	To motivate the students develop the interdisciplinary vision of biological engineering

Module-1	**Contact Hours = 6 Hours**
BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).	

Module-2	**Contact Hours = 6 Hours**
HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1 (QUALITATIVE): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).	

Module-3	**Contact Hours = 6 Hours**
HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2 (QUALITATIVE): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis)	

Module-4	**Contact Hours = 6 Hours**
NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction	

reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs)

Module-5	**Contact Hours = 6 Hours**
TRENDS IN BIOENGINEERING (QUALITATIVE): Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Self healing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic)	

Books	
Text Books:	
1.	Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022 S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
2.	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi
3.	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4.	Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5.	Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6.	Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
7.	Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
8.	Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
9.	3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
10.	Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
11.	Blood Substitutes, Robert Winslow, Elsevier, 2005
E-resources (NPTEL/SWAYAM.. Any Other)- mention links	
1	VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
2	https://nptel.ac.in/courses/121106008
3	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
4	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring 2009
5	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
6	https://www.coursera.org/courses?query=biology
7	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
8	https://www.classcentral.com/subject/biology
9	https://www.futurelearn.com/courses/biology-basic-concepts

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)

3.		3.	Open Assignment/Seminar
4.		4.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Elucidate the basic biological concepts via relevant industrial applications and case studies.	Un	1	
2.	Evaluate the principles of design and development, for exploring novel bioengineering projects.	Un	1	
3.	Corroborate the concepts of biomimetics for specific requirements.	Un	1	
4.	Think critically towards exploring innovative biobased solutions for socially relevant problems	Ap	1, 7	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Open Assignment	Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OA - Open Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√														
2	√														
3	√														
4	√						√								
Tick mark the CO, PO and PSO mapping															

UNIVERSAL HUMAN VALUES

Course Code		Course type	UHV	Credits L-T-P	1 – 0 - 0
Hours/week: L - T- P	1– 0 – 0			Total credits	1
Total Contact Hours	L = 16 Hrs; T = 0 Hrs; P = 0 Hrs Total = 16 Hrs			CIE Marks	50
				SEE Marks	50

Course objectives

1. To provide understanding of basic human values
2. To communicate the need of education for quality life

Knowledge required : English Language, Social Studies

Unit – I Human Values	8 Hours
Objectives, Morals , Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage ,Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality, Yoga for Professional Excellence and Stress Management.	

Unit – II Value Education	8 Hours
Introduction, Understanding Value Education, Basic Guidelines for Value Education, The content of Value Education, Education for Fulfilling Life, Skill Education, Priority of Values over Skills. The Process of Value Education.	

Activities include - Illustrative case studies and Surveys related to Human values.

	Books
1.	Nagarazan R.S., Professional Ethics and Human Values, New Age International Publishers Pvt.Ltd. 2006
2	P.R.Gaur, R.Sangal, G.P.Bagaria: A Foundation Course in Human Values and Professional ethics.

Course delivery methods		Assessment methods	
1.	Lecture	1.	IA. test
2.	Presentation	2.	Activity
3.	Expert talks	3.	Quiz

		4.	SEE

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and practice the human values	Un	6	
2.	Understand the human values, work ethics, respect others and stress management.	Un, Ap	8	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Quiz	Activities (Case study & Survey)	Total Marks
Marks	15+15 = 30	10	10	50
Minimum score to be eligible for SEE: 20 OUT OF 50				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 50 marks of 1 hour duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	The pattern of the **question paper is MCQ** (multiple choice questions).

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						✓									
2								✓							
Tick mark the CO, PO and PSO mapping															

Mechanics

Course Code	22MATM/A41	Course type	Theory	Credits L-T-P	3 - 0- 0
Hours/week: L-T-P	3 - 0 - 0			Total credits	3
Total Contact Hours	L = 40 Hrs; Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To Understand the concepts of plane statics and equilibrium of system of particle.
2.	To Demonstrate fundamental laws of Newtonian mechanics and conservation principles to practical problems
3.	To Explain the motion of a particle in resting medium and general motion under a central force.
4.	To Illustrate the motion of a rigid body rotating about a fixed axis and its practical applications
5.	To Demonstrate motion of a rotating frame and motion of a particle relative to a rotating frame.

Required Knowledge of : Differentiation, Integration, Basic Statistics

Unit – I	Contact Hours = 8 Hours
Plane Statics: Introduction, Equilibrium of a particle, The triangle of forces, The polygon of forces, Lamy's theorem, equilibrium of system of particles, External and Internal forces, Necessary conditions for equilibrium(forces), Moment of vector about a line, The theorem of Varignon, Necessary conditions for equilibrium(moments), Equipollent system of forces, Couples, Moment of a couple, reduction of a general plane force system, Work potential energy, The principle of virtual work.	

Unit – II	Contact Hours = 8 Hours
Applications in Plane Statics: Mass center, Theorems of Pappus, Gravitation, Friction, Laws of static and kinetic friction, Flexible cables, General formula for all flexible cables hanging freely, The suspension bridge, The common catenary.	

Unit – III	Contact Hours = 8 Hours
Plane Kinematics: Kinematics of a particle, Tangential and Normal components of velocity and acceleration, Radial and transverse components, The hodograph.	

Unit – IV	Contact Hours = 8 Hours
Plane Dynamics: Equations of motion of a particle, Principle of angular momentum for a particle and system, Principle of energy for a particle and system, Principle of linear momentum for a system, D'Alembert's principle , Hamilton's principle, Some techniques of calculus of variation, Derivation of Lagrange's equation from Hamilton's principle	

Unit –V	Contact Hours = 8 Hours

Applications in Plane Dynamics: Motion in resisting medium , motion of particles of varying mass , Central orbits, Kepler's law of motion ,Moment of inertia; theorem of parallel axes, Theorem of perpendicular axes, Kinectic energy and angular momentum, Konig's theorem, Rigid body rotating about a fixed axis, The component pendulum, Cylinder rolling down an inclined plane. quaternions and limitations of Euler's equations.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	J.L.Synge and B.A.Griffith Principles of mechanics,2nd Edition,TATA McGraw Hill,New Delhi,1949
2.	H.Goldstein,C.P. Poole and J.L.stafko,classical mechanics 3rd Edition Addison Wesely Publishing Company ,1980
	Reference Books:
1.	N.C.Rana and P.C.Joag ,classical mechanics TATA McGraw Hill, New Delhi,1991
2.	R.G.Takwale and P.S.Puranik, Introduction to Classical Mechanics TATA McGraw Hill,New Delhi,2000
3.	N.P Bali and Manish Goyal:"A textbook of Engineering Mathematics"Laxmi Publications, 10th Ed., 2022 onwards
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/111106111
2	https://nptel.ac.in/courses/111104025
3	https://nptel.ac.in/courses/117105085
4	https://nptel.ac.in/courses/111105042

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)
3.	Flipped Classes	3.	Course Seminar
4.	Practice session/Demonstrations in Labs	4.	Quizzes
5.	Virtual Labs (if present)	5.	Semester End Examination

Course Outcome (COs)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain the concepts of plane statics**	**Un**	**1**	
2.	**Apply fundamental laws of Newtonian mechanics and conservation principles to practical problems**	**Un, Ap**	**1**	
3.	**Explain the motion of a particle in resting medium and general motion under a central force.**	**Un, Ap**	**1**	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/Python	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for CIE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and eachQuestion Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓														
2	✓														
3	✓														
Tick mark the CO, PO and PSO mapping															

Introduction to space technology

Course Code		**Course type**	**ESC**	**Credits L-T-P**	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Introduction of system design concepts used in space exploration.
2.	Present the mission design parameters from the early principles of mechanics.
3.	Introduction of the fundamentals of orbital mechanics.
4.	To introduce subsystems of a space vehicles
5.	To introduce communication systems for space vehicles

Pre-requisites :

Unit – I	**Contact Hours = 8 Hours**
Earth environment, launch environment, atmosphere, space and upper atmosphere; earth-bound orbits, lunar and deep space missions, advanced missions, launch vehicle selection, launching and deployment	

Unit – II	**Contact Hours = 8 Hours**
Mass ratio and propellant mass fraction; equation of motion of an ideal rocket; motion of a rocket in a gravitational field; simplified vertical trajectory; burn-out velocity and burn-out height; step-rockets; ideal mission velocity and losses; effect of launch angle; factors causing dispersion of rockets in flight; dispersion of finned rockets; stability of flight.	

Unit – III	**Contact Hours = 8 Hours**
Orbits and trajectories, Kepler's laws, orbital velocity and periods, eccentric elliptical orbits; effect of injection conditions, effect of earth’s rotation, perturbation analysis; parking orbit, transfer trajectory, impulsive shot; rendezvous; recent interplanetary missions	

Unit – IV	**Contact Hours = 8 Hours**

Entry flight mechanics, entry heating, entry vehicle design, aero-assisted orbit transfer; concepts and terminology of attitude determination, rotational dynamics, rigid body dynamics, disturbance torques, passive attitude control, active control, attitude determination, system design considerations

Unit –V	**Contact Hours = 8 Hours**
Design drivers and concepts, mass properties, structural loads; power sources, design drivers and practice, command subsystems, redundancy and autonomy, radio communications, tracking	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

Books	
	Text Books:
1.	M.D. Griffin and J.R. French, Space Vehicle Design. 2nd Edition, AIAA Education Series (2004).
	Reference Books:
1.	J.W. Cornelisse, H.F.R. Schöyer, and K.F. Wakkar. Rocket Propulsion and Spacecraft Dynamics. 1st Edition, Pitman (1979).
2.	E. Stuhlinger and G. Mesmer. Space Science and Engineering. 1st Edition, McGraw-Hill, New York (1965).
	W.N. Hess. Space Science. 1st Edition, Blackie and Son (1965)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/101106046
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to(Highlight the **action verb** representing the learning level.)			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**

1.	Explain the criteria of launch vehicle and it's selection	3	1,2	1
2.	Interpret and discuss about the orbital mechanics	3	1,2	1
3.	Estimate and illustrate about the space vehicles	3	1,2	1
4.	Demonstrate the flight vehicle design	3	1,2	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓											✓		
2	✓	✓											✓		
3	✓	✓											✓		
4	✓	✓											✓		
5	✓	✓											✓		
Tick mark the CO, PO and PSO mapping															

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. I V Patil	**Prof. P S Joshi**

Air Traffic Control

Course Code		**Course type**	**ESC**	**Credits L-T-P**	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand Air traffic control systems.
2.	Learn Flight information system.
3.	Identify the Aerodrome systems.
4.	Compare the Navigation systems

Pre-requisites : Elements of Aeronautics

Unit – I	**Contact Hours = 8 Hours**
Objectives of air traffic control systems - Parts of ATC services, Visual flight rules (VFR) & Instrument flight rules (IFR) operations, Classification of Air traffic services (ATS) air spaces, Various kinds of separation, Altimeter setting, procedures, Establishment, designation and Identification of units providing ATS, Division of responsibility of control.	

Unit – II	**Contact Hours = 8 Hours**
Air traffic system: Area control service, assignment of cruising levels, minimum flight altitude, ATS routes and significant points, area navigation (RNAV) and required navigation performance (RNP), Vertical, lateral and longitudinal separations based on time / distance, ATC clearances, Flight plans, position report	

Unit – III	**Contact Hours = 8 Hours**
Flight Information systems: Radar service, Basic radar terminology, Identification procedures using primary / secondary radar, performance checks, use of radar in area and approach control services, assurance control and coordination between radar / non radar control, emergencies, Flight information and advisory service, Alerting service, Co-ordination and emergency procedures, Rules of the air.	

Unit – IV	Contact Hours = 8 Hours
Aerodrome Data: Aerodrome data, Aerodrome reference code, Aerodrome reference point, Aerodrome elevation, Aerodrome reference temperature, Instrument runway, physical characteristics; length of primary / secondary runway, Width of runways, Minimum distance between parallel runways etc. obstacles restriction.	

Unit – V	Contact Hours = 8 Hours
Navigation and Other services: Visual aids for navigation Wind direction indicator, Landing direction indicator, Location and characteristics of signal area, Markings, general requirements, Various markings, Lights, general requirements, Aerodrome beacon, identification beacon, Simple approach lighting system and various lighting systems, visual approach slope indicator (VASI) & precision approach path indicator (PAPI), Visual aids for denoting obstacles; object to be marked and lighter, Emergency and other services	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	AIP (India) Vol. I & II, "The English Book Store", 17-1, Connaught Circus, New Delhi.
2.	Aircraft Manual (India) Volume I", 1st Edition, The English Book Store, 17-1 Connaught Circus, New Delhi
3.	
4.	
	Reference Books:
1.	"PANS RAC ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-72-air-traffic-control-fall-2006/
2.	https://www.atc-network.com/atc-courses

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Illustrate basic concepts of Air Traffic Control.	2	1,2	1,2,3
2.	Compare the various air traffic systems.	2	1,2	1,2,3
3.	Describe flight information systems and subsystems.	2	1,2	1,2,3
4.	Quantify Aerodrome Data.	2	1,2	1,2,3
5.	Recognize Navigation and other services of aircraft systems.	2	1,2	1,2,3

Scheme of Continuous Internal Evaluation (CIE): **Theory course**

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass:** Score should be > 35 &, however overall score of CIE + SEE should be > 40%
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

Levels	**Target**
1 (Low)	**50 % of the total marks is scored by 60% of the students. (% can be varied)**
2 (Medium)	**50 % of the total marks is scored by 60% -70% of the students. (% can be varied)**
3 (High)	**50 % of the total marks is scored by 70% of the students. (% can be varied)**

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓										✓	✓	✓	✓
2	✓	✓										✓	✓	✓	✓
3	✓	✓										✓	✓	✓	✓
4	✓	✓										✓	✓	✓	✓

5	✓	✓										✓	✓	✓	✓
Please Tick at appropriate place															

Sl. No.	Skill & Competence enhanced after undergoing the course	Applicable sectors & domains	Job roles students can take up after undergoing the course
1	Acquire knowledge about air traffic control, Airport data and flight information.	Airlines	Aircraft Maintainance Engineer
2		Aviation	Airport Instructor
3		Airport Authority of India	Air Traffic controller
4			

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. I V Patil	Prof. Dharmendra A P

RENEWABLE ENERGY SOURCES

Course Code		Course type	ETC	Credits L-T-P	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To understand energy scenario, energy sources and their utilization.
2.	To explore society's present needs and future energy demands.
3.	To Study the principles of renewable energy conversionsystems.
4.	To exposed to energy conservation methods.

Pre-requisites :NIL

Unit – I	Contact Hours = 8 Hours

Introduction: Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).

Unit – II	Contact Hours = 8 Hours

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder.Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant.

Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.

Unit – III	Contact Hours = 8 Hours

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and muliblade system. Vertical axis- Savonius and darrieus types.

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft) .

Unit – IV	Contact Hours = 8 Hours

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power,harnessing tidal energy, advantages and limitations. **Ocean Thermal Energy Conversion:** Principle of working, OTEC power stations in the world, problems associatedwith OTEC.

Unit –V	**Contact Hours = 8 Hours**
Green Energy: Introduction, Fuel cells: Classification of fuel cells – H_2; Operating principles, ZeroenergyConcepts.Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only),hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**2**	**2**	**2**	**2**	**2**

Books	
	Text Books:
1.	Nonconventional Energy sources, G D Rai, Khanna Publication, Fourth Edition,
2.	Energy Technology, S.Rao and Dr. B.B. Parulekar, Khanna Publication.Solarenergy, SubhasPSukhatme,TataMcGrawHill, 2nd Edition,1996.
	Reference Books:
1.	Principles of Energy conversion, A. W. Culp Jr.,, McGraw Hill, 1996
2.	Non-Convention EnergyResources, Shobh Nath Singh, Pearson, 2018
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc18_ge09/preview
2.	E-book URL: https://www.pdfdrive.com/renewable-energy-sources-and-their-applications-e33423592.html

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	Analyze the social implications of renewable energy and its role in sustainable development.	AN	1	1,2,3
2.	Assess the advantages, disadvantages, and applications of solar photovoltaic systems for electric power generation.	AN	1	1,2,3
3.	Evaluate the major problems associated with wind power and analyze the different types and components of wind energy conversion systems.	AN	1	1,2,3
4.	Evaluate the advantages, limitations, and operational principles of tidal power and ocean thermal energy conversion (OTEC) systems.	EV	1	1,2,3
5.	Assess the benefits, applications, and challenges associated with hydrogen energy as a green energy source.	EV	1	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	✓												✓	✓	✓
2	✓												✓	✓	✓
3	✓												✓	✓	✓
4	✓												✓	✓	✓
5	✓												✓	✓	✓
Tick mark the CO, PO and PSO mapping													✓	✓	✓

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Technical Knowledge	**Energy Generation**	
2	System Design and Integration		
3	Renewable Energy Policy and Regulations		
4	Project Development and Management		
5.	Energy Efficiency and Conservation		
6	Environmental Impact Assessment		

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. P P Katti	**Prof. D A Ponnaswami**

FEAST Lab

Course Code		Course type	AEC	Credits L-T-P	0 - 0- 1
Hours/week: L-T-P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0Hrs; T = 0 Hrs;P = 20 Hrs Total = 20Hrs			CIE Marks	50
Flipped Classes content	0 Hours			SEE Marks	50

Course learning objectives	
1.	Learn basics of FEAST
2.	Will be able to use FEAST for the structural problems
3.	Learn to cater the linear and nonlinear capabilities.
4.	

Required Knowledge of :

List of Experiments

No. of Experiments	Topic(s) related to Experiment
1	Introduction to Feast Software
2	Static analysis of a simply supported beam.
3	Free vibration analysis of a cantilever beam.
4	Buckling analysis of a single shell.
5	Frequency response analysis of a Base Excited Cylindrical Column
6	Random response analysis of Rectangular Cantilever Plate
7	Transient response analysis of Beam with Sinusoidal Load
8	Heat transfer transient analysis of Rectangular Plate Convective BC
9	Static analysis of planar truss
10	Frequency analysis of Cantilever Plate Subject Harmonic Pressure load

Unit No.	Self-Study Topics
I	Static analysis of Simply Supported Beam with Uniformly Distributed Load
II	Static analysis of Hanging Plate
III	Transient analysis of Simply Supported Rectangular Plate

Books	
	Text Books:
1.	

2.	
	Reference Books:
1.	
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://feast.vssc.gov.in/index.php
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain basic steps involved in Feast software	Un	1,2,5,11,12	1,2,3
2.	Explain processes involved in feast	Un	1,2,5,11,12	1,2,3
3.	Solving the cater the linear and nonlinear capabilities.	Ev	1,2,5,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab:

1. Conducting the experiment and journal: 10 marks
2. Calculations, results, graph, conclusion and Outcome: 10 marks
3. Viva voce: 5 marks

Journal Submission

1. Students will submit the journal at the end of the semester

Open Ended Experiment/Quiz

1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)			Total
Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (planned)													CO-PSO Mapping(planned)		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	✓	✓			✓						✓	✓	✓	✓	✓
2	✓	✓			✓						✓	✓	✓	✓	✓
3	✓	✓			✓						✓	✓	✓	✓	✓
4															
5															
Mention the levels: 1, 2, 3															

Sl. No.	Skill & Competence enhanced after undergoing the course	Applicable sectors & domains	Job roles students can take up after undergoing the course
1			
2			
3			
4			

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. I V Patil	Prof. P P Katti

Introduction to the SCILAB and SCICOS LAB

Course Code	22AECXX3	Course type	AEC	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	0 Hours			SEE Marks	50

Course learning objectives	
1.	Learn basics of SciLab programming
2.	Will be able to use SciLab to solve computational problems
3.	Learn the basics of SCICOS
4.	Model a simple system in SCICOS.

Required Knowledge of : Engineering Mathematics

List of Experiments

No. of Experiments	Topic(s) related to Experiment
1	Basics of SciLab programming
2	Array operations in SCILAB
3	Loops and execution control
4	Working with files: Scripts and Functions
5	Plotting and program output
6	Differentiation and numerical integration
7	Introduction to the block diagram in SCICOS
8	Plotting various graphs using SCICOS
9	Solving differential equations using SCICOS
10	Mass-Spring-Damper model for different inputs using SCICOS

Unit No.	Self-Study Topics
I	Solving step bars subjected to axial load problems using SCILAB
II	Solving Bernoulli's equation using SCILAB
III	Plotting Mohr's stress circle using SCILAB
IV	Solving differential equations for real life problems using SCICOS
V	Solving Euler Angles using SCICOS

Books	
	Text Books:
1.	Anil Kumar Verma, 'SCILAB: A Begineer's Approach', Cengage Learning India Pvt. Ltd, First Edition (1 January 2018).
2.	Stephen L.Campbell, 'Modelling and Simulation in SCILAB/Scicos with Scicos lab 4.4', **Springer**, 2010 Edition.
	Reference Books:
1.	Ramachandran Hema & Nair Achuthsankar S, 'SCILAB (A Free Software to MATLAB)', & S Chand Company, 2011 Edition.
2.	Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists, Apress; 1st ed. edition (13 December 2017)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL course: Scilab, by Prof Kannan Moudgalya, IIT Bombay.** https://onlinecourses.swayam2.ac.in/aic20_sp38/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Explain basic steps involved in MATLAB programming	Un	1, 5	1
2.	Explain processes involved in SIMULINK	Un	1, 5	1
3.	Write & Execute appropriate codes to solve various mathematical problems	Ev	1, 2, 3, 5, 8, 9, 10, 12	1, 2, 3
4.	Construct & Run a physical model using SIMULINK	Ap	1, 2, 3, 5, 8, 9, 10, 12	1, 2, 3
5.	Debug a code to identify errors involved	Ap	1, 2, 5, 8, 9, 10, 12	1, 2, 3

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab:

1. Conducting the experiment and journal: 10 marks
2. Calculations, results, graph, conclusion and Outcome: 10 marks
3. Viva voce: 5 marks

Journal Submission

1. Students will submit the journal at the end of the semester
Open Ended Experiment/Quiz 1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)			Total
Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√				√								√		
2	√				√								√		
3	√	√	√		√			√	√	√		√	√	√	√
4	√	√	√		√			√	√	√		√	√	√	√
5	√	√	√		√			√	√	√		√	√	√	√
Mention the levels: 1, 2, 3															

Sl. No.	**Skill & Competence enhanced after undergoing the course**	**Applicable sectors & domains**	**Job roles students can take up after undergoing the course**
1	**Programming skills**	**Aerospace Industry**	**Stress Analyst**
2	**Plotting skills**	**Aircraft structural industries**	**Fluid flow Analyst**
3	**Loop execution**	**Fluid flow analysis industries**	**CFD Analyst**
4	**Solving various mathematical equations**	**Aircraft Propulsion industries**	**Programmer**

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. A K Nakkala	**Dr. Kamlesh Kulkarni**

Python for Aeronautics

Course Code		Course type	AEC	Credits L-T-P	0 – 0 - 1
Hours/week: L-T-P	0 – 0 – 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	10 Hours			SEE Marks	50

Course learning objectives	
1.	Understand the principles and techniques used in structural analysis, including static load testing, fatigue testing, and buckling analysis.
2.	Apply Python programming skills to develop programs that calculate stress, strain, deformation, fatigue life, and buckling behavior of aircraft structures under various loading conditions.
3.	Gain knowledge of aerodynamics and airfoil performance analysis, including lift, drag, and moment coefficients, and their dependence on angles of attack.
4.	Utilize Python programming to analyze wind tunnel data, calculate flow properties, and visualize flow patterns using contour plots or streamlines
5.	Learn the principles of propulsion systems, including thrust measurement, engine performance analysis, combustor analysis, intake and inlet analysis, and apply Python programming to simulate and analyze the behavior of aircraft engines.

Course learning objectives	
1.	Learn the syntax and semantics of the Python programming language.
2.	Illustrate the process of structuring the data using lists, tuples
3.	Appraise the need for working with various documents like Excel, PDF, Word and Others.
4.	Demonstrate the use of built-in functions to navigate the file system.
5.	Implement the Object Oriented Programming concepts in Python.

Pre-requisites : Basic PYTHON

LIST OF EXPERIMENTS:

No. of Experiments	Topic(s) related to Experiment
1	Static Load Testing: Experiment: Apply loads to an aircraft structure to measure stress, strain, and deformation. Python Program: Develop a program to calculate stress, strain, and deformation of a given structure under applied loads using basic structural analysis equations.
2	Fatigue Testing: Experiment: Perform cyclic loading on aircraft components to study fatigue behavior and determine fatigue life. Python Program: Write a program to

	simulate fatigue loading using a load spectrum or input data, calculate fatigue life using fatigue analysis methods such as Miner's rule or Rainflow counting algorithm.
3	Buckling Analysis: Experiment: Investigate the buckling behavior of aircraft structures under compression loads. Python Program: Develop a program to perform buckling analysis using finite element methods or analytical formulas, calculate critical buckling loads, and visualize the buckling modes.
4	Airfoil Performance Analysis: Experiment: Measure lift and drag characteristics of different airfoils at various angles of attack. Python Program: Develop a program to calculate lift, drag, and moment coefficients based on airfoil properties and flow conditions using potential flow theory or thin airfoil theory
5	Wind Tunnel Testing: Experiment: Conduct wind tunnel experiments to study aerodynamic forces and flow patterns around aircraft models. Python Program: Write a program to analyze wind tunnel data, calculate flow properties (velocity, pressure, etc.), and visualize flow patterns using contour plots or streamlines
6	Boundary Layer Analysis: Experiment: Investigate the behavior of the boundary layer and its impact on aerodynamic performance. Python Program: Develop a program to solve the boundary layer equations numerically, calculate boundary layer thickness, drag, and separation points, and visualize the boundary layer profiles
7	Thrust Measurement: Experiment: Measure the thrust produced by different propulsion systems, such as jet engines or propellers. Python Program: Develop a program to calculate thrust based on engine parameters (e.g., mass flow rate, velocity) using thrust equations and performance models, and compare the performance of different propulsion systems
8	Engine Performance Analysis: Experiment: Analyze the performance characteristics of aircraft engines under different operating conditions. Python Program: Write a program to simulate the thermodynamic cycle of an engine (e.g., Brayton cycle for gas turbines), calculate key performance parameters (e.g., specific fuel consumption, thermal efficiency), and plot performance maps.
9	Combustor Analysis: Experiment: Study the combustion process in aircraft engines, including flame stabilization, emissions, and flame dynamics. Python Program: Develop a program to simulate the combustion process using chemical kinetics models, calculate important combustion parameters (e.g., flame temperature, emissions), and visualize the flame structure.
10	Intake and Inlet Analysis: Experiment: Study the airflow behavior and pressure recovery in aircraft engine intakes and inlets. Python Program: Write a program to analyze the intake/inlet flow using numerical methods (e.g., method of characteristics), calculate important parameters (e.g., total pressure recovery, distortion), and visualize the flow patterns.

Sl. No	**Self-Study Topics**
I	Static Load Testing
II	Fatigue Testing:

III	Buckling Analysis
IV	Engine Performance Analysis:
V	Combustor Analysis:

Books	
	Text Books:
1.	Al Sweigart,"Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 18, except 12) for lambda functions use this link: https://www.learnbyexample.org/python-lambda-function/
2.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2 nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above link)
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.learnbyexample.org/python/
2.	https://www.learnpython.org/
3.	https://pythontutor.com/visualize.html#mode=edit

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply principles of structural analysis and utilize Python programming to assess the behavior of aircraft structures under different loading conditions, including static loads, fatigue loads, and buckling loads.	Ap	1,2	1,2
2.	Analyze and interpret aerodynamic characteristics of airfoils and wings, including lift, drag, and moment coefficients, and utilize Python programming to optimize aerodynamic performance and evaluate flow patterns.	An	1,2,5,8,9,10	1,2

3.	Evaluate the performance of aircraft propulsion systems, including thrust measurement, engine performance analysis, and intake and inlet analysis, using Python programming to simulate and analyze engine behavior and assess efficiency.	Ev	1,2,5,8,9,10	1,2

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab: 1. Conducting the experiment and journal: 10 marks 2. Calculations, results, graph, conclusion and Outcome: 10 marks 3. Viva voce: 5 marks
Journal Submission 1. Students will submit the journal at the end of the semester
Open Ended Experiment/Quiz 1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)			Total
Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√											√	√	
2	√	√			√			√	√	√			√	√	
3	√	√			√			√	√	√			√	√	
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Programming Fundamentals	Web Development:	Python Developer/Programmer.
2	Python Language Proficiency:	Data Science and Analytics	Data Analyst
3	Problem Solving.	Scientific Computing	Data Scientist

4	Debugging and Troubleshooting:	Machine Learning and Artificial Intelligence	Data Engineer
5	Data Structures and Algorithms	Finance and Trading	Web Developer
6	Software Development Practices	Automation and Scripting	DevOps Engineer
7	Collaboration and Teamwork:	Internet of Things (IoT)	Software Engineer
8	Analytical Thinking	Game Development	Researcher/Scientist

Name & Sign of faculty members involved in designing the syllabus	**Name & Sign of faculty members verifying/approving the syllabus**
Prof. P P Katti	**Prof. D A Ponnaswami**

Unmanned Aerial Systems Lab

Course Code	22AECXX3	Course type	SEC	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	0 Hours			SEE Marks	50

Course learning objectives	
1.	Understand different drone parts and their contribution for successful flight operation
2.	Learn various electrical parts/Flight controllers of the drones.
3.	Learn the basics of Unmanned Aerial systems.
4.	Model a simple quadcopter in CAD software.

Required Knowledge of : Engineering Mathematics

List of Experiments

No. of Experiments	Topic(s) related to Experiment
1	**Basics and Demonstration of open source Ground control Stations.**
2	**Demonstration of Various Flight Control Systems**
3	**Establish Ground Control Points using open source Ground control Stations.**
4	**Configure, test and perform communication of FCB with motor, GPS, ESC and sensors.**
5	**Fabrication of wings of an unmanned aerial vehicles using 3D printing/Hotwire cutting process.**
6	**Fabrication of motor mount using FDM / 3D printer.**
7	**Hands on Training on Assembling and Manual Flying of UAV.**
8	**Hands on Training on Autonomous Flying of UAV.**

Unit No.	Self-Study Topics
I	Identify different types of ports and connectors
II	Measurements of propellers thrust using open source softwares.
III	Case study: Classify different microcontrollers and flight controllers for the required task.
IV	Develop wings and other components profiles using CAD software.
V	Projects related to optimization of Endurance of the UAV.

Books	
	Text Books:
1.	Yasmina Bestaoui Sebbane, “A First Course in Aerial robotics and Drones ”, PHI, `1st edition, 2022, ISBN- .0367631385
2.	David Mcgriffy, Make: Drones: Teach an Arduino to Fly ,1st edition,2016,ISBN-13:978-

	1680451715.
	Reference Books:
1.	E. Tooley, Practical Drones: Building, Programming, and Applications, Apress, 2021.
2.	S. K. Kopparthy, Drone Technology: Theory and Practice, Springer, 2020.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**https://www.udemy.com/course/make_a_drone/: Make an Open Source Drone by Dr.Peter.**

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Apply fundamental engineering knowledge to Identify the UAS technology's systems and component parts.	Un	1,2, 5	1,2
2.	Select the Suitable flight controller and important components for the required Task.	Un	1, 2, 3, 5, 8, 9, 10, 12	1,2
4.	Develop innovative design and collaboration skills as they plan and execute UAV missions, analyze data for the desired mission.	Ap	1, 2, 3, 5, 8, 9, 10, 12	1, 2, 3

Scheme of Continuous Internal Evaluation (CIE):

LAB (50 marks)			Total
Conduction	Journal Submission	Open Ended Experiment	
25 marks	15 marks	10	50 marks

Conduct of Lab:

1. Conducting the experiment and journal: 10 marks
2. Calculations, results, graph, conclusion and Outcome: 10 marks
3. Viva voce: 5 marks

Journal Submission

1. Students will submit the journal at the end of the semester

Open Ended Experiment/Quiz

1. Students will perform one open ended experiment or appear for quiz at the end of the semester

Scheme of Semester End Examination (SEE):

LAB SEE (50 marks)	Total

Initial Write-up	Conduction of Experiment	Written and Oral Viva	
15 marks	25 marks	5 marks + 5 Marks	50 marks

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√			√								√		
2	√	√	√		√			√	√	√		√	√	√	
3	√	√	√		√			√	√	√		√	√	√	√
Mention the levels: 1, 2, 3															

Sl. No.	Skill & Competence enhanced after undergoing the course	Applicable sectors & domains	Job roles students can take up after undergoing the course
1	**Selection of Flight Controller design and Programming skills**	**UAV Industry, Aircraft and Space sector**	**Flight control Engineer.**
2	**Optimizing the UAVs performance parameters**	**UAV Industry**	**UAV Design Engineer, System engineer**
3	**Manual and Autonomous Flying of UAVs**	**UAV Industry**	**Drone pilot**

Name & Sign of faculty members involved in designing the syllabus	Name & Sign of faculty members verifying/approving the syllabus
Prof. A K Nakkala	**Dr. K V Kulkarni**