KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

(APPROVED BY AICTE, NEW DELHI)

3^{rd} to 8^{th}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	22MATAE31	Fourier Techniques and Probability Theory	Maths	3	0	0	03	3	100	100	200
2	IPCC	22AE32	Mechanics of Materials	AE	3	0	2	05	4	100	100	200
3	IPCC	22AE33	Fluid Mechanics	AE	3	0	2	05	4	100	100	200
4	PCC	22AE34	Aircraft Materials & Processes	AE	3	0	0	03	3	100	100	200
5	ESC	22AE35X	ESC/ETC/PLC	AE	3	0	0	03	3	100	100	200
6	UHV	22AE36	**Social Connect and Responsibility**	AE	0	0	2	02	1	100	--	100
7	AEC/ SEC	22AECAE37X	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					
8	MC	22AE381	National Service Scheme (NSS)	NSS coordinator	0	0	2		0	100	--	100
		22AE382	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept.& Yoga instructor								
		22AE383	Clubs- Social, Cultural & Academic	Coordinators								
9	PCCL	22AEL39	Aircraft Component Modeling Lab	AE	0	0	2	02	1	50	50	100
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)			
22AE351	Aircraft maintenance Repair & Overhaul	22AE353	Introduction to Air Armament
22AE352	Introduction to UAS Technology	22AE354	Cyber Security & Safety
Ability Enhancement Course – III			
22AECAE371	Technical Writing and Presentation	22AECAE373	Introduction to MATLAB & SIMULINK
22AECAE372	*Mathematics I		

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.

*AEC Mathematics I is only for Diploma Students.

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	22AE41	Aircraft Propulsion I	AE	3	0	0	03	3	100	100	200
2	IPCC	22AE42	Aerodynamics	AE	3	0	2	05	4	100	100	200
3	PCC	22AE43	Aircraft Structures I	AE	4	0	0	04	4	100	100	200
4	ESC	22AE44X	ESC/ETC/PLC	AE	3	0	0	03	3	100	100	200
5	AEC/ SEC	22AECAE45X	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					
6	BSC	22AE46	Biology For Engineers		3	0	0	03	3	100	100	200
7	UHV	22AE47	Universal Human Values	AE	1	0	0	01	1	50	50	100
8	MC	22AE481	National Service Scheme (NSS)	NSS coordinator	0	0	2	02	**0**	100	--	100
		22AE482	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept.& Yoga instructor								
		22AE483	Clubs- Social, Cultural & Academic	Coordinators								
9	PCCL	22AEL49	Aircraft Structures Lab	AE	0	0	2	02	1	50	50	100
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

22AECAE451	FEAST Lab	22AECAE452	PYTHON for Aeronautics Lab

22AECAE453	Introduction to SCILAB & SCICOS	22AECAE454	Unmanned Aerial Systems Lab
22AECAE455	*Mathematics II		
Engineering Science Course (ESC/ETC/PLC)			
22AE441	Mechanics	22AE443	Air Traffic Control
22AE442	Introduction to space technology	22AE444	Renewable Energy Sources

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.

*AEC Mathematics II is only for Diploma Students.

KLS Gogte Institute of Technology

3rd Year 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	22AE51	Aviation Planning & Management	AE	3	0	0	03	3	100	100	200
2	IPCC	22AE52	Aircraft Propulsion II	AE	3	0	2	05	4	100	100	200
3	PCC	22AE53	Aircraft Performance	AE	4	0	0	04	4	100	100	200
4	PCCL	22AEL54	Modeling & Analysis Lab	AE	0	0	2	02	1	50	50	100
5	PEC	22AE55x	Professional Elective Course	AE	3	0	0	03	3	100	100	200
6	PROJ	22AE56	Mini Project	AE	0	0	4	04	2	100	-	100
7	AEC	22AE57A	Research Methodology and IPR		2	0	0	02	2	100	100	200
8	AEC	22AECAE57B	Employability Skills -1	Bizotic	1	0	0	01	1	100	-	100
9	MC	22AE58	Environmental Studies		2	0	0	02	2	100	100	200
10	MC	22AE591	National Service Scheme (NSS)	NSS coordinator	0	0	2		0	100	-	100
		22AE592	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
		22AE593	Clubs- Social, Cultural & Academic	Coordinators								
Total									**22**	**950**	**650**	**1600**

Professional Elective Course

22AE551	Finite Element Analysis	22AE553	Gas Dynamics
22AE552	Introduction to Helicopters	22AE554	Electric and hybrid aircraft

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. **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 report, 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 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. **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	22AE61	Avionics	AE	3	0	2	05	4	100	100	200
2	PCC	22AE62	Aircraft Stability & Control	AE	4	0	0	04	4	100	100	200
3	PEC	22AE63X	Professional Elective Course	AE	3	0	0	03	3	100	100	200
4	OEC	22AE64X	Open Elective Course	AE	3	0	0	03	3	100	100	200
5	PROJ	22AE65	Major Project Phase I	AE	0	0	4	04	2	100	--	100
6	PCCL	22AEL66	Simulation Lab	AE	0	0	2	02	1	50	50	100
7	AEC/SDC	22AECAE67	Ability Enhancement Course/Skill Development Course V- **Employability Skills -2**	Bizotic	1	0	0	01	1	100	-	100
8	MC	22AE681	National Service Scheme (NSS)	NSS coordinator	0	0	2		0	100	--	100
		22AE682	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
		22AE683	Clubs- Social, Cultural & Academic	Coordinators								
Total									**18**	**750**	**450**	**1200**

Professional Elective Course			
22AE631	Aircraft Sensors & Instrumentation	22AE633	Computational Fluid Dynamics
22AE632	Mechanics of Composite Materials	22AE634	Gas Turbine Technology
Open Elective Course			
22AE641	Wind Tunnel Techniques	22AE643	Aircraft Systems
22AE642	Introduction to Composites	22AE644	Experimental Aerodynamics
Ability Enhancement Course / Skill Enhancement Course-V			
22AECAE67	Ability Enhancement Course/Skill Development Course V- Employability Skills -2		

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. **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

4th Year 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	22AE71	Flight Vehicle Design	AE	3	0	2	05	4	100	100	200
2	IPCC	22AE72	Vibrations & Aero-elasticity	AE	3	0	2	05	4	100	100	200
3	PCC	22AE73	Guidance Navigation & Control	AE	4	0	0	04	4	100	100	200
4	PEC	22AE74X	**Professional Elective Course**	AE	3	0	0	03	3	100	100	200
5	OEC	22AE75X	**Open Elective Course**	AE	3	0	0	03	3	100	100	200
6	PROJ	22AE76	**Major Project Phase-II**	AE	0	0	10	10	5	100	100	200
7	AEC	22AE77	Indian Knowledge system		1	0	0	01	1	100	-	100
Total									**24**	**700**	**600**	**1300**

Professional Elective Course

22AE741	Fatigue and Fracture	22AE743	Design of UAS
22AE742	Noise, Vibrations & Harshness	22AE744	Aircraft Systems, Testing and Manufacturing Processes

Open Elective Course

22AE751	Integrated Vehicle Health Monitoring	22AE753	Airline and Airport Operations
22AE752	Basics of Flight Simulation	22AE754	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.

IKS (Indian Knowledge system) - VTU in compliance with UGC directive has introduced **IKS (Indian Knowledge system)** in the 6th sem as AEC (1 credit) for 2022 scheme. Hence after discussion it has been decided to introduce the IKS course (as 1 credit) in the 7th sem as an AEC.

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	22AE81X	Professional Elective (Online Courses)	TD-PSB	3	0	0	03	3	100	-	100
2	OEC	22AE82X	Open Elective (Online Courses)	TD: PSB	3	0	0	03	3	100	-	100
3	INT	22AE83	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)

22AE811	Space Flight Mechanics	22AE813	Aerodynamic Design of Axial Flow Compressors & Fans
22AE812	Lighter Than Air Systems	22AE814	Hypersonic Aerodynamics

Open Elective Courses (Online Courses)

22AE821	Digital Marketing	22AE823	Robotics & Automation
22AE822	Artificial Intelligence & Machine Learning	22AE824	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:	22MATAE31	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 = 40Hrs; T = 0Hrs;P = 0Hrs Total = 40Hrs			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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks.

	2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													**CO-PSO Mapping(planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓														
2	✓														
3	✓														
4	✓														
Tick mark the CO, PO and PSO mapping															

Mechanics of Materials

Course Code	**22AE32**	**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.
5	2	8. Torsion of Shaft
		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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks). 2. Remaining 20 marks questions in Part B & C should be descriptive.				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks				

2. Calculations, results, graph, conclusion and Outcome: 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: 15 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	**√**	**√**	**√**					**√**	**√**	**√**			**√**		

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	22AE33	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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive.

Conduct of Lab:

1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 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: 15 marks
5. Viva voce: 10 marks

Eligibility for SEE:

1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE**
2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.**
3. Lab test is COMPULSORY
4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.**
5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	**√**	**√**						**√**	**√**	**√**		**√**	**√**	**√**	**√**

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	22AE34	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,IITKharagpur https://nptel.ac.in/courses/113105057/
2.	**NPTEL:** Online Resources: Lecture by: Prof. JayantaDas,IITKharagpur 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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	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 Chikmath**

Aircraft Component Modeling Lab

Course Code	22AEL39	**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 of Plummer block (Pedestal Bearing)	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Part modelling and Assembly of Drafting of wing assembly	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Part modelling and Assembly of Drafting of fuselage assembly	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Part modelling and Assembly of Drafting of propeller and hub assembly	
Lab Experiment – 9	**Contact Hours = 2 Hours**
Part modelling and Assembly of Drafting of main rotor blade assembly of helicopter	
Lab Experiment – 10	**Contact Hours = 2 Hours**
Part modelling and Assembly of Drafting 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. Conduction of 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	22AE36	**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	Ap	6,9	

	Society at large			
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**	**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															

Aircraft Maintenance, Repair and Overhaul

Course Code	22AE351	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 – II Aircraft 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 VipulMathur 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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE: -Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. -Lack of minimum score in IA test will make the student Not Eligible for SEE. -Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	√											√	√	√	√
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	22AE352	**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 drone components 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 roboticsonceand 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 DronebyDr.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 of Multi 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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	√	√										√		
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	22AE353	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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks

Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	**√**											**√**	**√**	**√**	**√**
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	22AE354	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.	SunitBelapure 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_rt9swsuonce
2.	https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_once
3.	https://www.youtube.com/watch?v=6wi5DI6du-4&list=PL_uaeekrhGzJlB8XQBxU3z__hDwT95xlkonce

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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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			

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**

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	

Technical Writing and Presentation

Course Code	22AECAE371	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 byonce**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**	**PO1 0**	**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	**22AECAE373**	**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.	RudraPratap, 'Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers', Oxford University press, South Asia Edition.
2.	Kumar TyagiAgam, '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**

Ability Enhancement Course 3rd SEMESTER
Mathematics I for Civ/Aero/Mech Stream

Course Code	22AECAE372/ 22DMATC 31	**Course type**	**AEC**	**Credits L-T-P**	1-0-0
Hours/week: L-T-P	1-0-0			**Total credits**	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			**CIE Marks**	50
Flipped Classes content	5 Hours			**SEE Marks**	50

Course learning objectives	
1.	Review basic differentiation and Integration
1.	Get acquainted with different applications of Calculus.
2.	Understand the basic concepts of partial differentiation.
5.	Get familiar with various topics in Linear Algebra.

Required Knowledge of: Basic Trigonometry, Calculus, Algebra

Unit– I: Basic Differentiation, Integration **ContactHours =5Hours**
Rate of change, increasing/decreasing functions, tangents and normals, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations). Integration of a variety of functions by substitution, by partial fractions and by parts, Basic properties of definite integrals and evaluation of definite integrals.

Unit–II: Calculus **Contact Hours =5Hours**
Introduction to limits, continuity and differentiation: Polar Curves, angle between radius vector and tangent, angle between polar curves, Radius of curvature (Cartesian and polar form only).

Unit – III: Partial Differentiation **ContactHours =5Hours**
Definition and simple problems. Total Differentiation-Problems. Partial Differentiation of Composite functions – Problems. Maxima and minima of function of two variables. Jacobians.

Unit– IV: Linear Algebra **ContactHours =5Hours**
Rank of a matrix by elementary transformation, consistency of system of linear equations-Gauss Jordan method and Gauss-Seidal method. Eigen value and Eigen vectors – Rayleigh's Power method.

Flipped Classroom Details

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

Books	
	Text Books:
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006.
3.	B. V.Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.
	Reference Books:
1.	Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
2	Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.

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)

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.	**Review** basics of Differentiation and Integration	L1	1	1
2.	**Review** basic concepts of Calculus.	L1	1	1
3.	**Understand** multivariable Calculus.	L2	1	1
4.	**Understand** basic Linear Algebra.	L1	1	1

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	√														

Scheme of Continuous Internal Evaluation (CIE): Theory course (Non-Integrated)

Components	Addition of CIE components	Total Marks
WrittenTest	30	50
Two Open Book Assignments	20	

Scheme of Semester End Examination (SEE):Theory course(Non-Integrated)

Components	Total Marks
Written exams	50

Syllabus of IV Semester

Aircraft Propulsion - I

Course Code	**22AE41**	**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. BhaskarRoy , 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)
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 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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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**	**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 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	22AE42	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"McGrawHill, NewYork, 2004. ISBN-978-3-662-57095-1
4.	PopeA. and Goin, KL. "High Speed Wind Tunnel Testing", John Wiley &SonsInc. New York, ISBN-0-471-55774-9once
	E-resources (NPTEL/SWAYAM)
1.	**NPTEL:** Online Resources: Lectureby: ProfProf.JobKurianIITMadras https://nptel.ac.in/courses/101106040/,
2.	**NPTEL:** Online Resources: Lectureby: Prof.K P Sinha Mahapatra,IITKharagpur. 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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive.

Conduct of Lab:
1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 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: 15 marks
5. Viva voce: 10 marks

Eligibility for SEE:
1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE**
2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.**
3. Lab test is COMPULSORY
4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.**
5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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

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															

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	**22AE43**	**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 Ghoshonce |once 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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE 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 ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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**	**PO1 0**	**PO1 1**	**PO1 2**	**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	22AEL49	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. AnupGhosh, 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**	**PO1 0**	**PO1 1**	**PO1 2**	**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	22AE46	**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 = 30Hrs			**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. SelfhealingBioconcrete (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.once
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.once
8.	Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C UdayashankarLambert Academic Publishing, 2019.once
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/biologyonce
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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks.

	3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	√						√								
Tick mark the CO, PO and PSO mapping															

UNIVERSAL HUMAN VALUES

Course Code	22AE47	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 = 16Hrs; T = 0Hrs;P = 0Hrs Total = 16Hrs			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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	The pattern of the **question paper is MCQ** (multiplechoice questions).

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						✓									
2								✓							
Tick mark the CO, PO and PSO mapping															

Applied Mechanics

Course Code	22AE441	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,TATAMcGraw 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 TATAMcGraw Hill, New Delhi,1991
2.	R.G.Takwale and P.S.Puranik, Introduction to Classical Mechanics TATAMcGraw 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

Scheme of Continuous Internal Evaluation (CIE):

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**	

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	22AE442	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 arocket in a gravitational field; simplified vertical trajectory; burn-out velocity and burn-outheight; step-rockets; ideal mission velocity and losses; effect of launch angle; factors causingdispersion 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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 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	✓	✓											✓		
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	**22AE443**	**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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	22AE444	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 conversion systems.
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; Solarpondelectric powerplant.

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-Horizontalaxis-single, double and muliblade system. Vertical axis-Savoniusand darrieustypes.

BiomassEnergy: Introduction; Photo synthesis 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 associated with OTEC.

Unit –V	**Contact Hours = 8 Hours**
Green Energy: Introduction, Fuel cells: Classification of fuel cells – H_2; Operating principles, Zero energy Concepts. 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.	NonconventionalEnergysources,GDRai,KhannaPublication,FourthEdition,
2.	EnergyTechnology,S.RaoandDr.B.B.Parulekar,KhannaPublication.Solarenergy,SubhasPSukhatme,TataMcGrawHill, 2nd Edition,1996.
	Reference Books:
1.	PrinciplesofEnergyconversion,A.W.CulpJr.,,McGrawHill,1996
2.	Non-ConventionEnergyResources,ShobhNathSingh,Pearson,2018
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc18_ge09/preview
2.	E-bookURL: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	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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		

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													✓	✓	✓

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	22AECAE451	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 PKatti

Introduction to the SCILAB and SCICOS LAB

Course Code	**22AECAE453**	**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 = 0Hrs;P = 20Hrs Total = 20Hrs			**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 solvecomputational 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 usingSCICOS**

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**	**PO1 0**	**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	22AECAE452	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",1stEdition, 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,	Ev	1,2,5,8,9,10	1,2

	including thrust measurement, engine performance analysis, and intake and inlet analysis, using Python programming to simulate and analyze engine behavior and assess efficiency.			

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 PKatti	**Prof. D A Ponnaswami**

Unmanned Aerial Systems Lab

Course Code	**22AECAE454**	**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 = 0Hrs; T = 0Hrs;P = 20Hrs Total = 20Hrs			**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.	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 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	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
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**

Ability Enhancement Course 4th SEMESTER

Mathematics II for Civil /Aero/Mech stream

CourseCode	22AECCV/ME/AE441	**Course type**	**AEC**	**CreditsL-T-P**	1-0-0
Hours/week:L-T-P	1-0-0			**Totalcredits**	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			**CIEMarks**	50
Flipped Classes content	5 Hours			**SEEMarks**	50

Course learning objectives	
1.	Learn differential equations of first and second order.
2.	Learn to use numerical method to extract values by interpolation and extrapolation.
3.	Learn to use numerical methods to obtain roots of differential equations.
4.	Learn and use various concepts in vector differentiation and vector Integration.

Required Knowledge of: Basic vector algebra, Calculus.

Unit– I: Differential Equations	**Contact Hours = 5 Hours**
Bernoulli and Exact (excluding reducible). Orthogonal trajectory. Linear differential equations of higher order with constant coefficients. Problems on second order only.	

Unit–II: Numerical Methods I	**Contact Hours =5Hours**
Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems. Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.	

Unit – III: Numerical Methods II	**Contact Hours =5 Hours**
Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems. Numerical solution of ordinary differential equations of first order and first degree – Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order.	

Unit– IV: Vector Differentiation and Integration	**Contact Hours =5Hours**
Scalar and Vector point function, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields, scalar potential and its applications (Directional Derivative, Angle between surfaces). Line Integral, Surface Integral, Volume Integral, Green's Theorem, Stoke's Theorem, Gauss Divergence Theorem (all theorems statement only) and problems.	

Flipped Classroom Details

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

Books	
	Text Books:
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition,once2006.
3.	B. V.Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.
	Reference Books:
1.	Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
2	Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.

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)

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.	**Understand** Differential Equations	L1	1	
2.	**Understand** numerical methods to interpolate and extrapolate.	L1	1	
3.	**Understand** numerical methods to solve differential equations	L2	1	
4.	**Understand** vector differentiation and Integration**.**	L2	1	

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	√														

Scheme of Continuous Internal Evaluation (CIE): Theory course (Non-Integrated)

Components	AdditionofCIEcomponents	Total Marks
Written Test	30	50
Two Open Book Assignments	20	

Scheme of Semester End Examination (SEE):Theory course(Non-Integrated)

Components	Total Marks
Written exams	50

Syllabus of V Semester

Aviation Planning & Management

Course Code	22AE51	Course type	HSMS	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.	Gain the knowledge of airport and its systems
2.	Understand the components of airport
3.	Learn the management of airport operations and finance
4.	Impart the knowledge of airport capacity and delay

Pre-requisites : NIL

Unit – I	Contact Hours = 8 Hours
Introduction: Airport management on an international level; The national plan of integrated airport systems; The nation's airport system plan; The rules that govern airport management; Organizations that influence airport regulatory policies; A historical and legislative perspective :Introduction the Formative period of aviation and airports.	

Unit – II	Contact Hours = 8 Hours
The components of an airport. The airfield. Navigational aids(NAVAIDS) located on airfields; Air traffic control and surveillance facilities located on the airfield; Weather reporting facilities located on airfields; Security infrastructure on airfields; Airspace and Current and future enhancements to air traffic control; Airport terminals and ground access, Runways and its operations.	

Unit – III	Contact Hours = 8 Hours
Airport operations management: Introduction, pavement management, aircraft rescue and firefighting (ARFF); Snow and ice control, safety inspection programs. Bird and wildlife hazard management; Airport security: Security at commercial service airports, security at general aviation airports; The future of airport security	

Unit – IV	Contact Hours = 8 Hours
Airport financial accounting, revenue strategies at commercial airports, pricing of airport facilities andservices ,variation in the sources of operating revenues, rise in airport financial burdens	

Unit – V	Contact Hours = 8 Hours

Defining capacity, factors affecting capacity and delay, estimating capacity, analytical estimates of delay: The queuing diagram; The future of airport management: Introduction, restructuring of commercial air carriers, new large aircraft, small aircraft transportation systems.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	A historical and legislative perspective: Introduction the formative period of aviation and airports.
2	Current and future enhancements to air traffic control; Airport terminals and ground access, Runways and its operations.
3	The future of airport security
4	Rise in airport financial burdens
5	Factors affecting capacity and delay

	Books
	Text Books:
1.	Alexander T Wells,Ed.D Seth Young,—Airport P lanningandManagement,6th Edition,2011.
2.	NormanJ. Ashford,H.P. Martin Stanton, CliftonA. Moore, Pierre Coutu,—Airport Operations, McGrawHill,3rdEdition,2013.
3.	Alexander T Wells, Ed.D SethYoung,—AirportplanningandManagement,6th Edition,2011.
	Reference Books:
1.	RobertM.Horonjeff,FrancisX.McKelvey,WilliamJSproule,SethYoung,"Planningand DesignofAirports", fifthedition,McGrawHillProfessional, 2010.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	**NPTEL:** OnlineResources :Lectureby: ManojKumar Mondal, IITKharagpur https://swayam.gov.in/nd1_noc20_ge08/preview
2.	**NPTEL:** OnlineResources: Lectureby:Prof. MukeshKumar Barua, IITRoorkee https://nptel.ac.in/courses/110/107/110107081/
3.	**NPTEL:** Online Resources: Lecture by: Prof. Rajat Agrawal and Vinay Sharma, IITRoorkee https://nptel.ac.in/courses/110/107/110107094/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Identify** the capacity of the airport and delay factors	Un	1,2	1
2.	**Recognize** the airport and its operations	Ap	1,2	1
3.	**Explain** the different airport systems and their components	Ap	1,2	1
4.	**Illustrate** the management skills in airport operations and Finance	An	1,2,3,5,8,9,10	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√		
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	**All-round basic knowledgeabout airport operations**	**Aerospace**	**Project Manager,** **Executive Officer,** **Airport Engineer,** **Operational Manager**

I.V. Patil
Name & Signature of Faculty members involved in designing the syllabus

P M Banakar
Name & Signature of Faculty members verifying/approving the syllabus

Aircraft Propulsion –II

Course Code	22AE52	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.	Familiarize students with the preliminary design and analysis of turbomachinery components found in conventional aircraft engines: compressors and turbines.
2.	Explore the concept and procedures for compressor-turbine (gas generator) matching and provide understanding of off-design performance of an engine based on compressor and turbine maps.
3.	Familiarize students with the preliminary design and analysis of main combustor found in conventional aircraft engines.
4.	Introduce students to advanced propulsion architectures for hypersonic aircraft, and for enhanced cycle efficiency or reduced fuel-consumption in subsonic or transonic aircraft

Required Knowledge of : Aircraft Propulsion - I

Unit – I	Contact Hours = 8 Hours
Aircraft Propulsion Review: Air breathing propulsion systems like Turbojet, turboprop, Turbo fan, Turboshaft, Ramjet, Scramjet and Air augmented rockets, Engine architectures, Performance characteristics	

Unit – II	Contact Hours = 8 Hours
Turbomachinery Design and Analysis : Axial architectures, Euler equations and cascade nomenclature, Mean line design of compressors and compressor performance ,Cascade flow angles and velocity triangles, Single-stage compressor characteristics, Blade design considerations, Multistage compressors , Mean line design of turbines and turbine performance, Overview, Euler equations and maps, Degree of reaction, Stage inlet swirl, solidity, losses , Blade and disk stresses, Compressor and turbine design point procedures	

Unit – III	Contact Hours = 8 Hours
Engine Off-Design Performance : Gas turbine matching requirements and map scaling, Gas generator matching for off-design performance, Engine off-design performance, Engine transient response	

Unit – IV	Contact Hours = 8 Hours
Combustor Design: Overview: requirements and rationale for typical features, Inlet diffuser sizing & losses, combustor length scaling, Fuel atomization and evaporation, Ignition, Aerodynamics and swirl ,Controlling emissions, Heat transfer and liner cooling	

Unit – V	Contact Hours = 8 Hours
Advanced Propulsion Architectures: Ramjets, Scramjets, Pressure gain combustion approaches, Electric and hybrid electric propulsion	

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.Study the performance of propeller at different speeds and measure the thrust force
2	3	1.Study the pressure distribution on a cascade unit at different incidence angle of an axial compressor blade, 2.Study the pressure distribution on a cascade unit at different incidence angle of a turbine blade 3.Calculation of the Mechanical efficiency of axial compressor- power required, power Available, Compression Ratio
3		
4	4	1.Experimentally determination of the burning velocity of premixed flame by measuring the cone angle 2.Determine the natural and forced heat transfer coefficient 3.Study the pressure distribution on a cascade unit at different incidence angle of an axial compressor blade, 4.Calculation of the Mechanical efficiency of axial compressor- power required, power Available, Compression Ratio
5	2	1.velocity profile or decaying velocity of free jet of different sizes, 2.Performance studies on two dimensional diffusers for stable flow

Unit No.	Self-Study Topics
1	Engine architectures
2	Compressor and turbine design point procedures,
3	Engine transient response
4	Heat transfer and liner cooling
5	Ramjets, scramjets

Books	
	Text Books:
1.	Philip Hill and Carl Peterson, Mechanics and Thermodynamics of Propulsion, 2nd Edition, , Addison-Wesley, 1992.
2.	S. Farokhi, Wiley , Aircraft Propulsion, , 2009.
	Reference Books:
1.	A. Lefebvre and D. Balla, Gas Turbine Combustion, 3rd Edition, l, CRC Press, 2010.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc20_ae13/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Lab Test
3.	Flipped Classes	3.	Semester End Examination
4.	Practice session/Demonstrations in Labs	4.	
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.	Provide preliminary design parameters for compressors and turbines and characterize their performance based on a mean line approach.	An	1,2	1
2.	Evaluate the operation and performance of a jet engine based on compressor and turbine maps for different operating conditions.	An	1,2	1
3.	Provide preliminary design parameters and define key design issues, constraints and architectures for main combustors in jet engines.	An	1,2	1
4.	Describe the advantages and drawbacks of various advanced propulsion architectures.	Un	1	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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive.

Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 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: 15 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√		
3	√	√											√		
4	√	√											√		
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	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
3	Knowledge of Gas Turbine engines and their functioning	Maintenance	Repair Industrialization Engineer
4	Familiar with gas turbine principles, different modules and functionalities of major parts	Engineering & Manufacturing	Aero Engine Component Design Engineer

P M Banakar
Name & Signature of Faculty members involved in designing the syllabus

Sidyant Kumar
Name & Signature of Faculty members verifying/approving the syllabus

Aircraft Performance

Course Code	22AE53	Course type	HSMS	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.	Understand the parameters affecting the performance of the Aircraft.
2.	Study lift, drag and other performance parameters of airplane and Understand the thrust requirements of an aircraft.
3.	Recognize the difference between Study and accelerated flight performance.

Pre-requisites : Elements of Aeronautics, Aerodynamics

Unit – I	Contact Hours = 10 Hours

Overview of aerodynamics, mission profile, International standard Atmosphere, four forces of flight, General equation of motion, Power available and power required curves. Thrust available and Thrust required curves. Conditions for power required and thrust required minimum. Thrust available and maximum velocity, Stall phenomena. Power available and maximum velocity, Altitude effects on power available and power required; thrust available and thrust required.

Unit – II	Contact Hours = 10 Hours

Level Flight, Climb & Glide Performance: Equation of motion for Rate of climb- analytical approach -Absolute ceiling, Service ceiling, Time to climb – analytical approach, climb performance graph (hodograph diagram); maximum climb angle and rate of climb Gliding flight, Range during glide, minimum rate of sink and shallowest angle of glide. Effect of wind on climb and decent performance.

Flipped Class Content: Cruise techniques: constant angle of attack, constant Mach number, constant Mach number methods

Unit – III	Contact Hours = 10 Hours

Thrust– to–weight ratio, Wing loading, Drag polar and lift-to–drag ratio. Minimum velocity. Aerodynamic relations associated with lift- to-drag ratio.

Range And Endurance: Propeller driven Airplane: Physical consideration, Quantitative formulation, Breguet equation for Range and Endurance, Conditions for maximum range and endurance. Tail wind and head wind effects on Range and Endurance Performance.

Flipped Class Content: Energy height and specific excess power.

Unit – IV	Contact Hours = 10 Hours

Level turn, load factor, Constraints on load factor, Minimum turn radius, Maximum turn rate. Pull-up and Pull-down maneuvers: (Turning rate, turn radius). Performance in accelerated climb from energy point of view, Energy height. Limitations of pull up and push over. Spin phenomena. Maneuver performance of supersonic flights. **Flipped Class content**: Limiting case for large load factor. The V-n diagram.

Unit – V	**Contact Hours = 10 Hours**
Calculation of Ground roll, Calculation of distance while airborne to clear obstacle, Balanced field length. Landing Performance and Accelerated Climb-Calculation of approach distance, Calculation of flare distance, Calculation of ground roll, ground effects. Acceleration in climb. **Flipped Class content**: accelerating climb, turning flight.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Applications of ISA
2	Accelerated climb
3	Role of Aircraft performance parameters in Aircraft Design
4	Energy methods
5	STOL Aircrafts

	Books
	Text Books:
1.	Anderson, J.D. Jr., ―Aircraft Performance and Design‖, International edition McGraw Hill, 1stEdition, 1999, ISBN: 0-07-001971-1.
2.	Eshelby, M.E., ―Aircraft Performance theory and Practice‖, AIAA Education Series, AIAA, 2ndEdition, 2000, ISBN: 1-56347-398-4.
	Reference Books:
1.	Shevel, R.S., ―Fundamentals of Flight‖, Pearson Education, 2nd Edition, 1989, ISBN: 81-297-0514-1.
2.	McCormick, B. W., Aerodynamics, Aeronautics, and Flight Dynamics, 2nd ed., Wiley (1994).
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/101104007/ Lectures by Prof. A K Ghosh, IIT Kanpur.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Describe** the influence of atmosphere, Aerodynamics and aircraft configuration on aircraft performance.	Un	1	1
2.	**Calculate t**he Performance parameters of a fixed-wing aircraft with either a jet or a propeller-driven propulsion system in straight and level flight and **analyze** the various types of cruise techniques.	AP	1,2	1
3.	**Analyze** the factors effecting the accelerated Flight performance of the aircraft.	An	1,2,3	1
4.	**Describe** the influence of atmosphere, Aerodynamics and aircraft configuration on aircraft performance.	Un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√	√										√	√	
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	Basic knowledge of Aircraft performance Parameters.	Aircraft design	Aircraft Design Engineer
2	Analysis of Accelerated flight performance	Aircraft & Cruise missile Design	Design Trainee (HAL)

A K Nakkala
Name & Signature of Faculty members
involved in designing the syllabus

P P Katti
Name & Signature of Faculty members
verifying/approving the syllabus

Modelling & Analysis Lab

Course Code	22AEL54	**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.	Apply the knowledge of FEM to construct finite element models using the library of finite elements available in the software
2.	Choose suitable number of finite elements for the given domain to form meshes
3.	Apply the knowledge of CFD to construct model of fluid flow
4.	Analyze the boundary conditions for the given problem and generating results

Required Knowledge of : Finite Elements Analysis, Aerodynamics

Lab Experiment – I	**Contact Hours = 2 Hours**
Structural Modeling of Sandwich Beam having square Cross-Section and Analyze forStresses	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Structural Modeling and Stress Analysis of a Fuselage Bulk Head.	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Structural Modeling of a Three Dimensional Wing and analyze the modal frequency.	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Structural Modeling and Stress Analysis of a wing with double engine at certain distancefrom fixed end	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Structural modeling and stress analysis of a tapered I section spar	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Flow analysis of Symmetric Aerofoil of Inviscid flow	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Flow analysis of Cambered Aerofoil of viscid flow	
Lab Experiment – 8	**Contact Hours = 2 Hours**

Flow Analysis of Symmetric Aerofoil of compressible flow (Supersonic Flows)	
Lab Experiment – 9	**Contact Hours = 2 Hours**
2-D Convergent- Divergent Nozzle and Analyses of Flow for Adiabatic Conditions.	
Lab Experiment – 10	**Contact Hours = 2 Hours**
Fluid Structure Interaction model on Flat plate.	

Books	
	Text Books:
1.	Chandrupatla T. R., "Finite Elements in engineering", PHI, 3rd edition, 2002, ISBN-13: 978 - 8120321069
2.	Anderson J D Jr "Computational Fluid Dynamics – The basics and applications", (1995), Mcgraw-Hill,New York
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.ansys.com/en-in/applications

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.	**Understand** the knowledge of various software used in industries	Un	1,2,3,5,9,12	1,2,3
2.	**Analyze** the various engineering field problems	An	1,2,3,5,9,12	1,2,3
3.	**Execute** the various field problems using software	An	1,2,3,5,9,12	1,2,3
4.	**Compare** the result values of field problem	An	1,2,3,5,9,12	1,2,3
5.	**Analyze** the results based on the experimental/ analytical values	An	1,2,3,5,9,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

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

Conduct of Lab:

1. Conduction of the experiment: 15 marks + Viva voce: 5 marks

2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks 3. Lab project/ Open ended expt: 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.	Minimum marks required in SEE to pass: 20 out of 50		
4.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
5.	Viva-voce shall be conducted for individual student and not in a group.		

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	✓	✓	✓		✓				✓			✓	✓	✓	✓
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	Design Modelling	Design and Analysis	Design Engineering

2	FEM and CFD Mesh generation		Analysis Engineers
3	Analysis of FEA and CFD problems		

D A Ponnaswami
Name & Signature of Faculty members
involved in designing the syllabus

A K Nakkala
Name & Signature of Faculty members
verifying/approving the syllabus

Finite Element Analysis

Course Code	22AE551	**Course type**	HSMS	**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 different types of elements and related field problems
2.	Derive and interpret the governing equation of finite element analysis
3.	Acquire the knowledge of implementing different loading and boundary conditions
4.	Apply the knowledge of FEA to structural problems

Pre-requisites : Mechanics of Materials

Unit – I	**Contact Hours = 8 Hours**
Brief history of FEA; Introduction to FEA; Processes involved in FEA (flow chart); Applications, advantages and limitations of FEA; Discretization of the domain, Finite elements, nodes and shape functions, types of elements based on geometry, and shape functions; Overview of basic elasticity, Plane stress, plane strain conditions, various energies associated with the elastic body. Matrix operations.	

Unit – II	**Contact Hours = 8 Hours**
Elemental equation of 1D elements for various problems. Determination of interpolation/shape functions for various 1D elements. Principal of minimum total potential energy applied to obtain elemental equation to evaluate deformations, stresses and strains of 1D bars. Shape functions, their properties and variations; General process of FEA applied to the solution of structural problems. Implementation of boundary conditions by elimination method and penalty approach. Elemental equation for 2d truss analysis. Elemental equation for heat conduction of 1D problems and associated boundary conditions.	

Unit – III	**Contact Hours = 8 Hours**
Concept of 1D elements applied to the analysis of stepped and tapered bars subjected to axial loads. 2D truss problems using 1D elements. Heat conduction problems of Insulated fins, infinite plates, walls, un-insulated fins using 1D finite elements.	

Unit – IV	**Contact Hours = 8 Hours**
Two dimensional elements: Triangular, rectangular elements; Linear, quadratic and cubic elements; interpolation functions for all 2D elements using Lagrange equations, concept of global and local/natural coordinate systems applied to determine shape functions of various elements. Three dimensional elements: Introduction to tetrahedral, brick, pyramidal, and wedge elements; Shape functions of linear brick element.	

Convergence requirements of shape functions and finite elements.

Unit – V	**Contact Hours = 8 Hours**
Two dimensional elements applied for the solution of plane stress and plane strain problems; Numericals using 2D elements. Serendipity elements; Axisymmetric elements; iso-parametric, sub-parametric and super-parametric elements and their formulations; Jacobian matrix and its importance.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Matrix operations.
2	Elemental equation for heat conduction of 1D problems
3	un-insulated fins using 1D finite elements.
4	Convergence requirements of shape functions and finite elements.
5	Jacobian matrix and its importance.

	Books
	Text Books:
1.	Chandrupatla T. R.and A. Belagundu, “Finite Elements in engineering”, PHI, 3rd edition, 2002, ISBN-13:978- 8120321069.
2.	Bhavikatti, Finite element Analysis, New Age International,3rd edition,2015,ISBN-13:978- 8122436716.
3.	S. S. Rao, “The Finite Element Method in Engineering”, Elsevier Science & Technology Books, 4th Edition, 2004, ISBN: 0750678283.
	Reference Books:
1.	Zienkiewicz. O.C. - "The Finite Element Method", Elsevier,7th edition,2013,ISBN-13:978- 9351071587.
2.	J N Reddy, “Introduction to the Finite Element Method”, McGraw Hill, 3rd Edition, 2006, ISBN-007-124473-5.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/105106051/: Finite element analysis course at IIT Madras by Dr. B N Rao.
2.	https://nptel.ac.in/courses/112104193/: Finite element analysis course at IIT Kanpur by Prof. Nachiketa Tiwari.

Course delivery methods	Assessment methods

1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Explain** the fundamental concepts of finite element methods, basic equations of Stress-strain relations and energy concepts.	Un	1	1
2.	**Derive** and **explain** various elemental equations for various finite elements	Ap	1, 2	1
3.	**Explain** various types of finite elements and the process to **determine** their shape functions.	Ap	1, 2	1
4.	**Evaluate** and **Analyze** various structural problems using concept of finite element analysis	Ev	1, 2, 3, 4, 5, 8, 9, 10, 12	1, 2, 3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks.

	2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√		
3	√	√											√		
4	√	√	√	√	√			√	√	√		√	√	√	√
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	Discretization of domain	Aircraft Structural analysis and Design	Stress Analyst
2	Application of loads	UAV design and Analysis	Structural Designer
3	Implementation of boundary conditions	Aerospace system design and analysis	Structure Analyst
4	Primary and secondary variables calculations	Mechanical system design and analysis	-

Shakthi Prasad M
Name & Signature of Faculty members
involved in designing the syllabus

Lokamanya Chikmath
Name & Signature of Faculty members
verifying/approving the syllabus

Introduction to Helicopters

Course Code	22AE552	**Course type**	PEC	**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.	Apply the basic concepts of helicopter dynamics
2.	Compute the critical speed by using various methods.
3.	Distinguish the turbo rotor system stability by using transfer matrix and finite element formulation.

Pre-requisites : : Introduction to Aeronautical Engineering, Aerodynamics

Unit – I	**Contact Hours = 8 Hours**
Introduction: History of helicopter flight. Fundamentals of Rotor Aerodynamics; Momentum theory analysis in hovering flight. Disk loading, power loading, thrust and power coefficients. **Blade Element Analysis:**Blade element analysis in hovering and forward flight. Rotating blade motion. Types of rotors. Concept of blade flapping, lagging and coning angle. Equilibrium about the flapping hinge, lead/lag hinge, and drag hinge.	

Unit – II	**Contact Hours = 8 Hours**
Basic Helicopter Performance: Forces acting on helicopters in forward flight. Methods of achieving translatory flight. Controlling cyclic pitch: Swash-plate system. Lateral tilt with and without conning. Lateral and longitudinal asymmetry of lift in forward flight. Forward flight performance- total power required, effects of gross weight, effect of density altitude. Speed for minimum power, and speed for maximum range.	

Unit – III	**Contact Hours = 8 Hours**
Rotor Airfoil Aerodynamics: Rotor airfoil requirements, effects of Reynolds number and Mach number. Airfoil shape definition, Airfoil pressure distribution. Pitching moment. Maximum lift and stall characteristics, high angle of attack range. **Rotor Wakes and Blade Tip Vortices:** Flow visualization techniques, Characteristics of rotor wake in hover, and forward flight. Other characteristics of rotor wake.	

Unit – IV	**Contact Hours = 8 Hours**
Helicopter Stability and Control: Introductory concepts of stability. Forward speed disturbance, vertical speed disturbance, pitching angular velocity disturbance, side-slip disturbance, yawing disturbance. Static stability of helicopters: longitudinal, lateral directional and directional. Dynamic stability aspects. Main rotor and tail rotor control. **Flight Testing-**General handing flight test requirements and, basis of limitations.	

Unit – V	Contact Hours = 8 Hours
Standards, and Specifications: Scope of requirements. General and operational requirements. Military derivatives of civil rotorcraft. Structural strength and design for operation on specified surfaces. Rotorcraft vibration classification. **Conceptual Design of Helicopters:** Overall design requirements. Design of main rotors-rotor diameter, tip speed, rotor solidity, blade twist and aerofoil selection, Fuselage design, Empennage design, Design of tail rotors, High speed rotorcraft.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	History of helicopter flight ,Fundamentals of Rotor Aerodynamics
2	Forces acting on helicopters in forward flight
3	Flow visualization techniques
4	Flight and Ground Handling Qualities
5	Scope of requirements, Overall design requirements.

Books	
	Text Books:
1.	J. Gordon Leishman, Principles of Helicopter Aerodynamics, Cambridge University Press, 2002.
2.	George H. Saunders, Dynamics of Helicopter Flight, John Wiley & Sons, Inc., NY,1975. VISVESV
3.	
	Reference Books:
1.	W Z Stepniewski and C N Keys, Rotary Wing Aerodynamics, Dover Publications, Inc, New York, 1984.
2.	John, M. Seddon and Simon Newman, Basic Helicopter Aerodynamics, Wiley, 2011.
3.	Gareth D. Padfield, Helicopter Flight Dynamics, 2nd Edition, Wiley, 2011.
4.	ARS Bramwell, George Done, and David Balmford, Helicopter Dynamics, 2nd Edition, Butterworth-Heinemann Publication, 2001.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/101104017
2.	http://acl.digimat.in/nptel/courses/video/101104017/101104017.html

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Problems on Disk loading, power loading, thrust and power coefficients	Ap	1	1
2.	Helicopter Performance.	Re	1	1
3.	Flow visualization techniques	un	1	1
4.	General handing flight test requirements	un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive
-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE.
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√												√		
3	√												√		
4	√												√		
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 Knowledge about Helicopters	Rotor dynamics	Design &Development of Helicopter
2	Helicopter Aerodyanamics	Aerodynamics of Rotors	Aerodynamicist
3	General and operational requirements	Maintenance	Service Engineer

Shakthi Prasad M
Name & Signature of Faculty members
involved in designing the syllabus

D A Ponnaswami
Name & Signature of Faculty members
verifying/approving the syllabus

Gas Dynamics

Course Code	22AE553	**Course type**	PEC	**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.	Understanding of shock wave and θ-B-M relations of oblique shock wave
2.	Study of supersonic flow over convex and concave corner
3.	Understanding the method of characteristics for the design of the nozzle
4.	Introduction to Moving Shock wave

Pre-requisites : Fundamental of Aerodynamics, Thermodynamics, Fluid mechanics

Unit – I	**Contact Hours = 8 Hours**
Introduction to compressible flow, A brief review of thermodynamics and fluid mechanics, Integral forms of conservation equations, Differential conservation equations, Acoustic speed and Mach number, Governing equations for compressible flows.	

Unit – II	**Contact Hours = 8 Hours**
One dimensional flow concept, Isentropic flows, Stagnation/Total conditions, Characteristics speeds of gas dynamics, Dynamic pressure and pressure coefficients, Normal shock waves, Rankine-Hugonoit equations, Introduction to Rayleigh flow, Introduction to Fanno flow, Crocco's theorem.	

Unit – III	**Contact Hours = 8 Hours**
Oblique shock wave and its governing equations, θ-B-M relations, Shock Polar, Supersonic flow over wedges and cones, Mach line, Attached and Detached shock, Reflections and interaction of oblique shock waves, Expansion waves, Prandtl-Meyer flow and its governing equations, Supersonic flow over convex and concave corners, Approximation of continuous expansion waves by discrete waves.	

Unit – IV	**Contact Hours = 8 Hours**
Quasi one-dimensional flows Governing equations, Area velocity relations, Isentropic flow through variable-area ducts, Convergent-divergent (or De Laval) nozzles, Over-expanded and under-expanded nozzles, Optimization of the nozzle using the method of characteristics, other losses in the nozzle, Diffusers, losses in a diffuser.	

Unit – V	**Contact Hours = 8 Hours**

Moving normal shock waves, Reflected shock waves, Physical features of wave propagation, Elements of acoustic theory, Incident and reflected waves, Shock tube relations, Piston analogy, Incident and reflected expansion waves, Finite compression waves, Shock tube relations.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Method of characteristic for design of nozzle
2	Dynamic pressure and pressure coefficients
3	Approximation of continuous expansion waves by discrete waves.
4	Diffusers, losses in a diffuser
5	Finite compression waves

Books	
	Text Books:
1.	John D Anderson, Modern Compressible Flows, McGraw-Hill Higher Education
2.	Radhakrishnan, E. Gas dynamics, PHI Edition
	Reference Books:
1.	P.Murugaperumai, Gas Dynamics and Jet Propulsion, SciTech Publication, Chennai
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Gas Dynamics, V.D.Kulkarni; https://archive.nptel.ac.in/courses/112/103/112103021/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Defining one dimensional flow	Re	1	1
2.	Understanding θ-B-M relations	Un	1	1
3.	Design of nozzle using method of characteristics	Ap, An	2	2
4.	Discussion on moving shock wave	An	3	3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓	✓					✓					✓	✓	✓	
3	✓	✓										✓	✓	✓	
4	✓	✓	✓		✓							✓	✓	✓	
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	**Compressible flow phenomenon**	**Gas turbines and Aerospace propulsion**	**Propulsion Engineering**

Sidyant Kumar
Name & Signature of Faculty members
involved in designing the syllabus

D A Ponnaswami
Name & Signature of Faculty members
verifying/approving the syllabus

Electric and Hybrid aircraft

Course Code	22AE554	Course type	PEC	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.	Understanding the fundamentals of DC circuits and its applications in aircraft systems.
2.	Understanding the relationships among current, voltage and power in AC circuits and their role in aircraft systems.
3.	Understanding performance of hybrid vehicle

Pre-requisites :

Unit – I	Contact Hours = 8 Hours
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Construction and working Principle of DC Machines, Single phase Transformers, Alternators and single phase induction motors, Application of Electrical machines in Aircraft systems.	

Unit – II	Contact Hours = 8 Hours
DC CIRCUITS 6 Hours Basic circuit elements and sources, Ohms law, Kirchhoff's laws, Series and parallel connection of circuit elements, Power, Work, Energy, Capacitance, Energy stored in a capacitor, DC circuits in Aircraft systems	

Unit – III	Contact Hours = 8 Hours
Alternating voltages and current, Sinusoidal waveform, Cycle and frequency, RMS value, Alternating current through Resistance, Inductance and Capacitance, Power factor, Active and Reactive power, AC circuits in Aircraft systems, Construction and working Principle of DC Machines, Single phase Transformers, Alternators and single phase induction motors, Application of Electrical machines in Aircraft systems.	

Unit – IV	Contact Hours = 8 Hours
Aircraft Applications—Part I: Electric Propulsion, Electric Taxiing , Battery Electric Propulsion—Small General Aviation , Urban Air Transportation, Fuel Cell Electric Propulsion—Commuter Aircraft, Battery Electric Propulsion—Regional Aircraft, Battery Electric Propulsion—Short-Range Aircraft, Electric Taxiing—Short-Range Aircraft , Operation, System Configurations and Performance, Nose Landing Gear Actuation, Main Landing Gear Actuation	

Unit – V	Contact Hours = 8 Hours

Aircraft Applications—Part II: Hybrid-Electric Propulsion, Fuel Cell Parallel HEP: Commuter Aircraft, Battery Series HEP: Commuter Aircraft, Battery Parallel HEP: Short-Range Aircraft, Battery Series HEP: Short-Range Aircraft, Battery Distributed HEP: Commuter Aircraft, Battery Distributed HEP: Regional Aircraft

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Application of Electrical machines in Aircraft systems.
2	DC circuits in Aircraft systems
3	AC circuits in Aircraft systems.
4	Basic vehicle dynamics
5	Components of road load

Books	
	Text Books:
1.	Mike Tooley and David Wyatt, 'Aircraft Electrical and Electronic Systems Principles, Operation and Maintenance', Elsevier, 2009.
2.	Theraja B.L., 'Fundamentals of Electrical Engineering and Electronics', S. Chand Publishing, 2012.
3.	John M. Miller MD FACR. 2. Propulsion Systems for Hybrid Vehicles (Energy Engineering). 2nd Edition - 31 July 2010. ISBN-13: 978-1849191470 ISBN-10: 1849191476.
4.	Pascal Thalin, Ravi Rajamani, Jean-Charles Maré, Sven Taubert, Fundamentals of Electric Aircraft R-462, SAE International with a Product Code of R-462, ISBN of 978-0-7680-9322-3,
	Reference Books:
1.	Thomas L Floyd, 'Electronic Devices', Sixth Edition, Pearson Education, 2003.
1.	Sedha R.S., 'Applied Electronics', S. Chand and Co., 2006.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL Online course materials on Semiconductor Devices and Circuits: https://nptel.ac.in/courses/108108112/
2.	NPTEL Online course materials on Electrical Machines-I: https://nptel.ac.in/courses/108105017/
3.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Discuss the fundamentals of DC circuits and its applications in aircraft systems.	Un	1	1
2.	Explain the relationships among current, voltage and power in AC circuits and their role in aircraft systems.	Un	1	1
3.	Explain the construction, working principle of electrical machines and their applications in aircraft systems.	Un	1	1
4.	Discuss the hybrid vehicle performance	Un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√												√		
3	√												√		
4	√												√		
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	Discuss about electric and hybrid propulsion	Aerospace, Automobile , Electrical	Electric propulsion system engineer

P M Banakar
Name & Signature of Faculty members
involved in designing the syllabus

I V Patil
Name & Signature of Faculty members
verifying/approving the syllabus

Research Methodology and IPR

Course Code	22AE57A	Course type	AEC	Credits L-T-P	2-0-0
Hours/week: L-T-P	2-0-0			Total credits	2
Total Contact Hours	L = 30 Hrs; Total = 30 Hrs			CIE Marks	100
Flipped Classes content	05 Hours			SEE Marks	100

Course learning objectives	
1.	Understand the basic concepts of research and its methodologies
2.	Identify and select the appropriate research.
3.	Understand the basic concepts & types of hypothesis.
4.	Create the awareness about Intellectual Property Rights for the protection of inventions.

Required Knowledge of : --

Unit – I	Contact Hours = 5 Hours
Research Methodology: Introduction Meaning, Objectives, types, Research Approaches. Significance of Research, Research Methods versus Methodology, Research and scientific method, research Process, Criteria of good research, Problems encountered by researchers.	

Unit – II	Contact Hours = 6 Hours
Research Problem: Defining a research problem, Selecting a research problem, necessity and techniques involved in defining the research problem. **Data Collection Methods:** Collection of Primary Data, Observation Method, Interview Method, Questionnaires, Schedules, Collection of Secondary Data, Case study method.	

Unit – III	Contact Hours = 9 Hours
Processing and Analysis of Data Processing operations, Elements/ types of analysis, Statistics in research- measures of central tendency or statistical averages, measures of dispersion, measures of asymmetry (skewness), measures of relationship. **Testing of hypothesis 1** Definition, basic concepts, procedure, flow diagram, measuring the power of hypothesis tests, tests of hypothesis. **Chi-square test** Chi-square as a test for comparing variance, steps involved in applying chi-square test.	

Unit – IV	Contact Hours = 5 Hours

Intellectual Property Rights – IPR- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs- Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures. Research ethics, Plagiarism, Prior art search.

Unit – V	**Contact Hours = 5 Hours**
Interpretation and Report Writing: Meaning of interpretation, Why interpretation, Technique of interpretation, Precaution in interpretation, Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing research report.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics [Mention if applicable else NIL]
1	Significance of Research Methodology.
2	Limitations of test of hypothesis.
3	Other measures-Index numbers, Time series analysis.

	Books
	Text Books:
1.	C R. Kothari, **"Research Methodology"**, New Age International Publishers, 2nd edition, 2007.
2.	Dr. B.L. Wadhera, **"Intellectual Property Rights"**, Universal Law Publishing Co. Ltd.. 2002
	Reference Books:
1.	Panneer Selvam, **"Research Methodology"**, PHI Learning Pvt. Ltd., 2007.
	E-resources (NPTEL/SWAYAM.. Any Other)-
1.	https://onlinecourses.swayam2.ac.in/cec20_ge37

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignments (OA)
3.	Flipped Classes	3.	Case studies
4.		4.	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 and select an appropriate methodology for	**Un**	**1,2,9,10**	**1**

	research.			
2.	Analyze and interpret data collected	**Ap**	**1,2,9,10**	**1**
3.	Analyze the significance of hypothesis testing	**An**	**1,2,9,10**	**1**
4.	Discuss the significance of Intellectual Property Rights & report writing	**Ap**	**1,2,3,9,10,12**	**1,2,3**

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:
1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Employability Skills I

Course Code	**22AECAE57B**	**Course type**	**AEC**	**Credits L-T-P**		1– 0 - 0
Hours/week: L - T- P	1 – 0 – 0			**Total credits**		1
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 0 Hrs Total = 30 Hrs			**CIE Marks**		100

Course learning objectives	
1.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
2.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
3.	In essence, they are essential for individual success in the workplace, their company's success, and their personal life also

Pre-requisites :

Unit – I	**Contact Hours = 6 Hours**
Quantitative Aptitude**:** Number System (2 Hours), HCF, LCM and Decimal Fractions (1 Hour), Simplification (1 Hour) ***Logical Reasoning*****:** Blood Relations (1 Hour), Direction Sense Test (1 Hour)	

Unit – II	**Contact Hours = 6 Hours**
Quantitative Aptitude**:** Percentages (2 Hours), Profit, Loss and Discounts (2 Hours) ***Verbal Ability:*** Change of Speech and Voice (2 Hours)	

Unit – III	**Contact Hours = 6 Hours**
Quantitative Aptitude**:** Simple and Compound Interest (2 Hours) ***Logical Reasoning*****:** Number and Letter Series (2 Hours) ***Verbal Ability:*** Sentence Correction (2 Hours)	

Unit – IV	**Contact Hours = 6 Hours**
Quantitative Aptitude**:** Averages (2 Hours) ***Logical Reasoning*****:** Coding and Decoding (1 Hour), Analogy (1 Hour) ***Soft Skills*****:** Body Language (1 Hour), Grooming and Etiquette (1 Hour)	

Unit – V	**Contact Hours = 6 Hours**
Quantitative Aptitude: Alligations and Mixtures (2 Hours) ***Verbal Ability*****:** Sentence Completion (2 Hours) ***Soft Skills*****:** Group Discussion and Mock GDs (2 Hours)	

Books	
	Text Books:

	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
1.	The Aptitude Triad , BIZOTIC
2.	How to prepare for Quantitative Aptitude for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 4th Edition, 2018.
3.	How to prepare for Logical Reasoning for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.
4.	How to prepare for Verbal Ability and Reading Comprehension for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.
5.	How to prepare for Data Interpretation for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 5th Edition, 2018.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes
		3.	Assignments
		4.	Seminar

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.	Clear the Aptitude round of recruiters during placements	L2	10, 12	
2.	Perform confidently during the GD and Interview process	L2	10, 12	
3.	Develop behaviors that are appropriate for a professional	L2	10, 12	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two Assignments	Total Marks
Marks	30+30 = 60	20	10+10 =20	100
- Writing 2 IA tests are compulsory **-Student should score minimum 40% of 100 marks to pass the course.**				

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										✓		✓			
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	Logical Thinking	IT Industry	Software Engineer
2	Problem Solving	Automotive	Developer
3	Communication Skills	Education Sector	Project Manager

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Environmental Studies

Course Code	**22AE58**	**Course type**	**MC**	**Credits L-T-P**	**2-0-0**
Hours/week: L-T-P	**2-0-0**			**Total credits**	**2**
Total Contact Hours	**L = 30 Hrs; Total = 30 Hrs**			**CIE Marks**	**100**
Flipped Classes content	**5 Hours**			**SEE Marks**	**100**

Course learning objectives	
1.	To understand the scope of Environmental Engineering.
2.	Identify the Environmental impact due to Human activities.
3.	Identify the renewable and non-renewable sources of energy.
4.	To understand the concept of Disaster Management.
5.	Identify the various Legal aspects in Environmental Protection.

Required Knowledge of : Nil

Unit – I	**Contact Hours = 6 Hours**
Definition of Environment, Ecology and Ecosystem, Structure and functions of ecosystem, balanced ecosystem, Introduction to Environmental Impact Assessment Natural Resources: Material Cycles – Oxygen, Carbon, Nitrogen and Hydrological cycle. Importance of water quality, Water borne diseases, Water induced diseases, Significance of Fluoride in drinking water.	

Unit – II	**Contact Hours = 6 Hours**
Energy – Different types of energy, Conventional and Non – Conventional sources – Advantages and Limitations of Wind Mills, Hydro Electric, Fossil fuel, Nuclear, Solar, Biomass and Biogas, Geothermal energy.	

Unit – III	**Contact Hours = 6 Hours**
Disasters – Natural Disasters: Meaning and nature of natural disasters, their types and effects (Floods, drought, cyclone, earthquakes, Tsunami). Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution and marine pollution.	

Unit – IV	**Contact Hours = 6 Hours**
Disaster Management: International strategy for disaster reduction. Concept of disaster management and national disaster management framework.	

Unit – V	Contact Hours = 6 Hours
Environmental Protection: Role of Government, Legal aspects, Initiatives by Non – Governmental Organizations (NGO), Environmental Education, Women Education. E-waste and solid waste management rules.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics [Mention if applicable else NIL]

Books	
	Text Books:
1.	Benny Joseph, **"Environmental Studies"**, Tata McGraw – Hill Publishing Company Limited (2005).
2.	Sanjay K. Sharma, **"Environment Engineering and Disaster Management"**, USP (2011).
3.	Harsh K. Gupta, **"Disaster Management"**, Universities Press (India) Pvt. Ltd (2003).
4.	Ranjit Daniels R.J. and Jagdish Krishnaswamy, **"Environmental Studies"**, Wiley India Private Ltd., New Delhi (2009).
	Reference Books:
1.	Meenakshi P., **"Elements of Environmental Science and Engineering"**, Prentice Hall of India Private Limited, New Delhi (2006).
2.	Tyler Miller Jr. G., **"Environmental Science – Working with the Earth"**, Tenth Edition, Thomson Brooks/Cole (2004).
	E-resources (NPTEL/SWAYAM.. Any Other)-
1.	–
2.	–

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	4.	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 the importance of the Environment and different sources of energy and energy crises.	Un	**6,7**	**1**

2.	Understand various environmental disasters and its management.	Ap	**6,7**	**1**
3.	Understand the various Legislations related to Environment.	Un	**6,7**	**1**

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

IA Test:

1. 10 marks questions in Part A of IA question paper should also include an OBE related question (max 2 marks).
2. Remaining 20 marks questions in Part B & C should be descriptive

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.

Eligibility for SEE:

-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.

-Lack of minimum score in IA test will make the student Not Eligible for SEE.

-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

ANNEXURE-I

Syllabus of VI Semester

Avionics

Course Code	22AE61	**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 provide a comprehensive understanding of integrated modular avionics architectures, fly-by-wire flight control features, control laws, and redundancy mechanisms.
2.	To understand the basic aircraft instruments, cockpit layout, and functionality of various display systems
3.	To grasp the principles, operation, and applications of radar systems, Doppler effect, antenna theory and GPS, Data Transfer.

Required Knowledge of : Elements of Aeronautics

Unit – I	**Contact Hours = 8 Hours**
Definition and scope of avionics, Integrated modular avionics architectures, Bus Bar, split bus bar system, special purpose cables, Electrical diagram and identification scheme. Fly by wire Flight Control Features and Advantages, Control Laws, Redundancy and failure survival.	

Unit – II	**Contact Hours = 8 Hours**
Basic Aircraft Instruments and Cockpit Layout, Working of: Airspeed, Altitude, Vertical Speed, Attitude Indicator, Indicated Air Speed, Calibrated Airspeed, True Airspeed, Mach Number. Display Systems: Primary Flight Display (PFD), Multi-Function Displays (MFD), Head-Up Display (HUD) Systems, and Helmet Mounted Displays (HMD), Cockpit Voice Recorder (CVR) Systems, HOTAS.	

Unit – III	**Contact Hours = 8 Hours**
Introduction, Principles of Radars, the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radars, Range Performance of Radars, Minimum Detectable Signal, Noise. Continuous Wave and Frequency Modulated Radar: The Doppler Effect, The CW Radar, Isolation Between Transmitter And Receiver, Sign of The Radial Velocity, Applications of CW Radars, Frequency Modulated CW Radar(FM-CW), MTI and Pulse Doppler Radars: Introduction, Description Of Operation, Block Diagram of Simple CW Radar , Pulse Radar Using Doppler Information	

Unit – IV	**Contact Hours = 8 Hours**
Aerials and Propagation : Antenna theory, various types of antenna for medium wave, short wave, VHF and UHF frequencies, propagation at microwave frequencies, atmospheric attentnation, effects of precipitation, reflection, Refraction and Diffraction phenomenon, clutter signals.	

Unit – V	Contact Hours = 8 Hours
Attitude heading reference system, GPS-Global positioning system: basic principle, solution of navigation equations, MIL-STD-1553B, ARINC 429. Introduction to Microcontroller: Pin diagram, Architecture & Application.	

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	Lead Lag compensator
3	2 3 4 5	To determine the Velocity of the object moving in the RADAR range Time and Frequency measurement with the help of moving pendulum Determine the rotation per minute of a moving objects To study the effect of different types material on RADAR receiving or detection.
4	7 8	Measurement of Guide Wavelength, Free Space Wavelength and SWR using Measuring Line Measurement of Directivity & Gain of Antennas : yagi ,patch, Dipole Antenna
5	9 10	Measurement of Latitude and Longitude Analysis of Elevation ,Azimuth, SNR

Unit No.	Self-Study Topics
1	Aircraft Electrical systems ,logics gates
2	Types of communication cables used in aircraft
5	Programming in microcontroller

Books	
	Text Books:
1.	R.P.G. Collinson., "Introduction to Avionics Systems", Springer,3rd edition, 2011, ISBN-13: 978-9400707078
2.	Ian Moir, Allan Seabridge, Aircraft Systems: Mechanics, Electrical and Avionics Subsystems Integration, Wiley, 3rd Edition, 2012.
	Reference Books:
1.	Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989, ISBN-13: 978-0582018815.
2.	Spitzer, C.R., "Digital Avionic Systems", McGraw-Hill Inc., US, 2nd edition, 1992, ISBN-13: 978-

	0070603332.
3.	Mike Tooley and David Wyatt, Aircraft Communications and Navigation Systems, Butterworth Heinemann, 2007.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.youtube.com/@AviationTheory
2.	https://nptel.ac.in/courses/105107194

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Lab Test
3.	Flipped Classes	3.	Semester End Examination
4.	Practice session/Demonstrations in Labs	4.	
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.	Analyze avionics fundamentals and integrated architectures while applying fly-by-wire concepts, control laws, redundancy, autopilot systems, and stability augmentation in aircraft operations.	AN	1,2,9	1,2,3
2.	Analyze aircraft instrumentation, layout, display systems & Microprocessor	UN	1,2,9	1,2,3
3.	Analyze aircraft communication & navigation systems	AN	1,2,9	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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 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				
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: 15 marks				

5. Viva voce: 10 marks
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√	√	√
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	Understanding of avionics systems, modular architectures, bus bars, special cables, electrical diagrams, and circuit controls	Aerospace, Defense, Aviation, Electronics	Avionics Technician, Electrical Engineer, Systems Engineer
2	Knowledge of fly-by-wire concepts, control laws, redundancy, failures, autopilot systems, and stability augmentation	Aerospace, Aviation, Defense	Avionics Engineer, Flight Control Engineer, Systems Analyst
3	Familiarity with aircraft instruments, cockpit layout, system architecture, sensors, display systems, and voice recorders	Aerospace, Aviation, Defense	Avionics Systems Engineer, Cockpit Design Engineer, Instrumentation Engineer
4	Understanding of aircraft communication, radar, navigation systems, INS, landing systems, and GPS integration principles	Aerospace, Aviation, Defense	Communication Systems Engineer, Navigation Systems Engineer, Radar Systems Specialist
5	Comprehension of air data laws, sensors, computing, MIL-STD-1553B, ARINC 429 standards, and their application in aviation	Aerospace, Defense, Aviation	Avionics Standards Specialist, Data Systems Engineer, Standards Compliance Engineer

P P Katti
Name & Signature of Faculty members
involved in designing the syllabus

A K Nakkala
Name & Signature of Faculty members
verifying/approving the syllabus

Aircraft Stability & Control

Course Code	22AE62	**Course type**	PEC	**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.	Understand the basic principles of aircraft stability like equilibrium, stability and control
2.	Study the aerodynamic forces and moments acting on an aircraft during the flight.
3.	Understanding how disturbances can induce unwanted aircraft motions and how pilots can mitigate these effects.
4.	Analyze and design control systems using Classical control techniques.

Pre-requisites : Theory of Machines ,Engineering Mechanics

Unit – I	**Contact Hours = 8 Hours**

Review of system dynamics, Coordinate systems, Euler angles and transformations,Degree of freedom of a system, equilibrium condition - Static and dynamic stability - Need for stability in airplanes - Purpose of controls.
Flipped Class content: Application of Eigen values and Vectors

Unit – II	**Contact Hours = 10 Hours**

Contribution of wing and tail and elevator to pitching moments - Effect of fuselage and nacelles - Effects of centre of gravity location - Power effects - Stabilizer setting and centre of gravity location – Elevator power– Elevator to trim. Trim gradients. Control fixed static stability – Control fixed neutral point. Stability Margins-Stick Free neutral point.
Flipped Class content: Manuever point and Margin.

Unit – III	**Contact Hours = 10 Hours**

Definition of directional and roll stability, static directional stability rudder fixed, estimation of dihedral effect, wing sweep, flaps and power, balancing the aileron, contribution of airframe components, directional control, rudder power, requirements for directional control, rudder lock, Dorsal fin, in operation condition.
Flipped Class content: stick-free directional stability

Unit – IV	**Contact Hours = 10 Hours**

Dynamic longitudinal stability, types of modes of motion, airplane equation for longitudinal motion, derivation of rigid body equation, orientation of position of plane, small disturbance theory, factors affecting period and damping of oscillations, effects of wind shear, flying qualities in pitch, cooper Harper scale, aileron step function response, Dutch roll and spiral instability, Auto-rotation and spin. Spin and Stall recovery procedures.
Flipped Class content: Roll-pitch-yaw inertial coupling.

Unit – V	Contact Hours = 10 Hours
Time Response of feedback control systems, Stability analysis- Routh stability criterion, Introduction to Root-Locus Techniques, Correlation between time and frequency response, Bode Plots. Introduction to Stability Augmented System. **Flipped Class content:** Pitch Attitude hold Autopilot.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Reference Frames, Eigen values and Vectors and Differential Equations
2	Ground effect on Stability margins
3	Weather cocking effect, adverse yaw effects.
4	Cooper-Harper Scale, Flight Handling Qualities.
5	Altitude hold Autopilot

Books	
	Text Books:
1.	Bernard Etkin, "Dynamics of flight stability and control", John Wiley and Sons, Second edition, 1982.
2.	Nelson R. C., "Flight Stability and Automatic Control", McGraw Hill Education; 2 edition (1 July 2017), ISBN-13: 978-0070661103.
3.	Nandan K. Sinha and N. Ananthkrishnan "Advanced Flight Dynamics with Elements of Flight Control" CRC Press 2017.
	Reference Books:
1.	Bandu N. Pamadi, "Performance Stability, Dynamics and Control of Airplanes", AIAA, 2004.
2.	Barnes W. McMormick, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley & Sons, Inc. 1995.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL: Online Resources: Lecture by: Prof. E G Tulapurkara, IIT Madras https://nptel.ac.in/courses/101106043/
2.	NPTEL: Online Resources: Lecture by: Prof. A K Ghosh, IIT Kanpur https://nptel.ac.in/courses/101104062/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Explain the importance of System dynamics and Describe the necessity of stability for dynamic systems like Aircraft.	Un	1	1
2.	Apply the rigid body dynamics to aircraft for representing aircraft in mathematical model.	Ap	1,2	1
3.	Estimate the longitudinal and directional parameters with the help of the linearized equations of aircraft motion.	An	1,2	1,2
4.	Analyze the different type of modes in longitudinal, lateral and directional motion of aircraft, and recovery from those modes by using recovery control systems.	An	1,2,3,5	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Aassignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. **-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.** **-Lack of minimum score in IA test will make the student Not Eligible for SEE** **-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√		
3	√	√											√	√	
4	√	√	√		√			√	√	√		√	√	√	
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	Discretization of domain	Aircraft Structural analysis and Design	Stress Analyst
2	Application of loads	UAV design and Analysis	Structural Designer
3	Implementation of boundary conditions	Aerospace system design and analysis	Structure Analyst
4	Primary and secondary variables calculations	Mechanical system design and analysis	-

A K Nakkala
Name & Signature of Faculty members
involved in designing the syllabus

P P Katti
Name & Signature of Faculty members
verifying/approving the syllabus

Aircraft Sensors and Instrumentation

Course Code	22AE631	**Course type**	PEC	**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.	The working principle, construction, operation, characteristics and features of sensors and transducers
2.	Specifications of various sensors and transducers.
3.	Applications of sensors and transducers for measurement

Pre-requisites : Physics

Unit – I	**Contact Hours = 8 Hours**
Need of sensors and transducers, transducers definition, classification, performance characteristics and selection criteria. Displacement Measurement: resistive-potentiometers, inductive-LVDT and RVDT, capacitive, piezoelectric, ultrasonic, Hall Effect, optical and proximity sensors. Speed Measurement: Tachometer, Magnetic pickups, Encoders, Photoelectric pickups, Stroboscopes, Shaft speed measurement. Vibration Measurement: Piezoelectric, Seismic, Potentiometric, and LVDT.	

Unit – II	**Contact Hours = 8 Hours**
Elastic elements, strain gauges, load cells, piezoelectric, vibrating string, strain gauge torque meter, inductive torque meter, magneto-restrictive transducers, and torsion bar dynamometers. units and their relations, manometers and their types, elastic sensors, piezoelectric secondary transducers, differential pressure sensors, capacitive (delta cell), high-pressure gauges, vacuum gauges, dead weight tester and vacuum gauge tester	

Unit – III	**Contact Hours = 8 Hours**
Temperature scales, units and their relations, classification of temperature sensors, bimetallic thermometer, Resistance temperature detectors (RTD), types of RTD, lead wire compensation, thermistors, Thermocouples, thermocouple tables, cold junction compensation techniques, thermopiles, thermo well, pyrometers, temperature IC sensor LM35, design of signal conditioning circuits for RTD and Thermocouple.	

Unit – IV	**Contact Hours = 8 Hours**
Units, Newtonian and non-Newtonian fluids, Reynolds's number, laminar and turbulent flows, velocity profile, Bernoulli's equation for incompressible flow, head type flow meters (orifice, venture meter and Pitot tube), variable area type, turbine, electromagnetic, ultrasonic, vortex shedding, anemometers, and mass flow meter: Coriolis flow meter	

Unit – V	**Contact Hours = 8 Hours**

Level Measurement: Float, Bubbler, DP cell, Ultrasonic, Capacitive, radioactive type, radar, solid level detectors. Viscosity: Saybolt, Searle's rotating cylinder, Cone and plate, Falling and rolling ball, Rotameter. Density: Chain-balanced float type, Hydrometer (Buoyancy type), U tube type, Hydrostatic Head (Air bubbler, DP Cell). Humidity: resistive and capacitive type sensors Miscellaneous Sensors: pH sensors, Conductivity sensors.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Design of sensors
2	Piezoresistive pressure sensor
3	Piezoelectric accelerometer
4	Capactive Accelerometer
5	Nano sensors

	Books
	Text Books:
1.	Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill, 2nd Ed.
2.	Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi, 2nd Ed.
3.	Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co, 2nd Ed.
4.	Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt. Ltd, 07th Ed.
	Reference Books:
1.	Measurement Systems by E.O. Doebelin, McGraw Hill, 06th Ed.
2.	Process Measurement & Analysis by B.G. Liptak, CRC press, 04th Ed.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.youtube.com/watch?v=qbKnW42ZM5c

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Understand the working principle, construction, operation, characteristics and features of sensors and transducers.	UN	1,2	1,2,3

2.	Examine the performance specifications of various sensors and transducers.	AN	1,2,3	1,2,3
3.	Select sensors and transducers for measurement applications.	AP	1,2,3	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. **-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.** **-Lack of minimum score in IA test will make the student Not Eligible for SEE** **-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√	√	√
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	Understanding the working principle, construction, operation, characteristics, features, specifications, and applications of sensors and transducers.	Aerospace, Automotive, Electronics, Manufacturing, Medical Devices, Robotics, IoT, Renewable Energy	Sensor Engineer, Instrumentation Engineer, Automation Engineer, Control Systems Engineer, Robotics Engineer, IoT Specialist, Test and Measurement Engineer, Product Development Engineer.

P P Katti
Name & Signature of Faculty members
involved in designing the syllabus

A K Nakkala
Name & Signature of Faculty members
verifying/approving the syllabus

Mechanics of Composite Materials

Course Code	22AE632	**Course type**	PEC	**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.	Describe what are composite materials and their differences with respect to conventional materials such as metals.
2.	Advantages of composites, processing of composites, reinforcement of composites
3.	Micro and macro behavior of laminates
4.	Predict strength and failure of lamina and laminates under mechanical loads

Pre-requisites : Mechanics of materials

Unit – I	**Contact Hours = 8 Hours**
Introduction to composite materials: Definition and classification of composite materials: Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC), Carbon-Carbon Composites (CCC). Reinforcements and matrix materials. Introduction to laminate, special cases of laminates: Symmetric laminates, Cross-ply laminates, angle ply laminates, antisymmetric laminates, balanced Laminate	

Unit – II	**Contact Hours = 8 Hours**
Manufacturing Techniques of Composites: **Fiber Reinforced Plastic (FRP) Processing:** Layup and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding. **Fabrication Process for Metal Matrix Composites (MMC's):** Powder metallurgy technique, liquid metallurgy technique, special fabrication techniques	

Unit – III	**Contact Hours = 8 Hours**
Micromechanics of Composites: Density, mechanical Properties: Prediction of elastic constants, micromechanical approach, Halpin-Tsai Equations, transverse stresses. Thermal properties: expression for thermal expansion coefficients of composites, expression for thermal conductivity of composites, Mechanics of load transfer from matrix to fiber: load transfer in particulate composites	

Unit – IV	**Contact Hours = 8 Hours**
Macromechanics of Composites: Elastic constants of an isotropic material, elastic constants of a lamina, relationship between engineering constants and reduced stiffnesses and compliances, Variation of lamina Properties with orientation, analysis of laminated composites, stresses and strains in laminate composites, inter-laminar stresses and edge effects, numerical problems.	

Unit – V	Contact Hours = 8 Hours
Failure and Repair: Fracture modes in composites; single and multiple fracture, debonding, fiber pullout and delamination fracture, strength of an orthotropic lamina, failure theories: maximum stress theory, maximum strain theory, Tsai-Hill criterion, Tsi -Wu tensor theory, comparison of failure theories, repair and recycling of composites	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Advanced fabrication techniques of composites
2	Modelling and analysis of laminates using FEA tool
3	Classical laminate plate theory
4	Application of composites in aerospace vehicles

	Books
	Text Books:
1.	Robert M. Jones, Mechanics of Composite Materials, CRC Press, Taylor & Francis Group, 2nd Ed, 1999.
2.	Autar K. Kaw, Mechanics of Composite materials, CRC Press, Taylor & Francis Group, 2nd Ed, 2005
3.	Krishan K. Chawla, Composite Materials, Springer, 3rd Ed, 2019
	Reference Books:
1.	Madhijit Mukhopadhay, Mechanics of Composite Materials & Structures, Universities Press, 2004
2.	Michael W, Hyer, Stress Analysis of Fiber Reinforced Composite Materials, Mc-Graw Hill International, 2009
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Mr. Vinay Goyal, Mechanics of Composite Materials, Aerospace Technical Fellow, Joint Professor UCLA and USC https://www.youtube.com/watch?v=Y7MeN9oSmik&list=PLREHQnoFMsHAuaShRdNQ1-tsE_r8qS6dh
2.	Prof. Nachiketa Tiwari, Introduction to Composites, IIT Kanpur https://archive.nptel.ac.in/courses/112/104/112104229/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.	Un	1,2,7	1
2.	Apply the concept of linear elasticity with emphasis on the difference between isotropic and anisotropic material behaviour.	Ap	1,2,3	1
3.	Predict the failure strength of a laminated composite plate	Ap	1,5,9	3
4.	Design, analysis, optimization and test simulation of advanced composite structures and components.	An	1,4,5,9, 12	3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√	√										√		√
3	√				√				√				√		√
4	√			√	√				√			√	√		√
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	Characteristic behavior of composites	Materials and Metallurgy	Analyst Engineer
2	Advantages of composites over conventional materials	Materials and Metallurgy	Stress Engineer
3	Application of composites in different engineering fields	Aerospace, Mechanical and Marine Engineering	Stress Engineer, MRO Lead

Lokamanya Chikmath
Name & Signature of Faculty members
involved in designing the syllabus

Shakthi Prasad M
Name & Signature of Faculty members
verifying/approving the syllabus

Computational Fluid Dynamics

Course Code	22AE633	**Course type**	PEC	**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.	Know the basic of computational techniques in field of engineering
2.	Acquire the knowledge of Discretization and Mathematical modeling
3.	Know the basics of Finite difference method schemes
4.	Understand the various types of grids and its uses.
5.	Understand the various models and its applications.

Pre-requisites : Basic Mathematics, Physics, Fluid Mechanics Basics

Unit – I	**Contact Hours = 8 Hours**
CFD Applications. Continuity Momentum, and Energy Equations-Derivation in Differential forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions.	

Unit – II	**Contact Hours = 8 Hours**
Classification of partial differential equations. Cramer Rule and Eigen value methods for classification. Hyperbolic, parabolic, and elliptic forms of equations. Case studies: steady in viscid supersonic flow, unsteady in viscid flow, steady boundary layerflow,andunsteadythermalconduction,steadysubsonicinviscidflow	

Unit – III	**Contact Hours = 8 Hours**
Finite differences methods, and difference equations. Explicit and implicit approaches. Explicit versus Implicit Scheme. Errors and stability analysis. Time marching and space marching.	

Unit – IV	**Contact Hours = 8 Hours**
Need for grid generation and Body-fitted coordinate system. Structured Grids-essential features. Importance, Structured Vs. Unstructured Grids, Major Tasks of generation, Analytical Transformation, Grid Quality, Concept of Multi-blocking, Adaptive grids, Surface grid generation	

Unit – V	**Contact Hours = 8 Hours**

Representation of the pressure - Gradient term and continuity equation–Staggered grid-Momentum equations-Pressure and velocity corrections-Pressure Correction equation-Numerical procedure for SIMPLE algorithm–Boundary conditions for the pressure correction method.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Comments on governing equations. Physical boundary conditions.
2	Steady in viscid supersonic flow, unsteady in viscid flow
3	Time marching and space marching.
4	Surface grid generation
5	Boundary conditions for the pressure correction method.

Books	
	Text Books:
1.	Ferziger, J. H. and Peric, M. (2003). Computational Methods for Fluid Dynamics. Third Edition, Springer-Verlag, Berlin.
2.	Versteeg, H. K. and Malalasekara, W. (2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method. Second Edition (Indian Reprint) Pearson Education.
	Reference Books:
1.	Anderson, D.A., Tannehill, J.C. and Pletcher, R.H. (1997). Computational Fluid Mechanics and Heat Transfer. Taylor & Francis.
2.	
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/112/107/112107079/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Understand the need of CFD and its applications	Un	1	1,2
2.	Apply mathematical knowledge to modeling of physical problems.	Ap	1,2	1,2
3.	Evaluate the effects of different approaches and boundary	Ap	1,2	1,2

	conditions			
4.	Acquire the knowledge of grids and its uses	An	1,2,5,9,10	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. **-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.** **-Lack of minimum score in IA test will make the student Not Eligible for SEE** **-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√	√	
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	Computational method basics	CFD	CFD Flow analysis Engineer
2	Computational flow analysis	Automobile sector	
3	Multidisciplinary projects handling knowldge	Aeronautical Sector	

I V Patil
Name & Signature of Faculty members
involved in designing the syllabus

D A Ponnaswami
Name & Signature of Faculty members
verifying/approving the syllabus

Gas Turbine Technology

Course Code	22AE634	Course type	PEC	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 to concepts of Gas turbines
2.	Explain the concepts of the engine performance
3.	Explain and evaluate the concepts underpinning the design of gas turbine combustors and reheat systems for gas turbines
4.	Evaluate the concepts of the combustion and turbines in gas turbines.
5.	Understand the concept of overhauling in gas turbines

Pre-requisites : Thermodynamics

Unit – I	Contact Hours = 8 Hours
Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; The relationship between force, work, power, energy, velocity, acceleration; Constructional arrangement and operation of turbojet, turbofan, turbo shaft, turboprop.	

Unit – II	Contact Hours = 8 Hours
Materials and Manufacturing: Criteria for selection of materials. Heat ranges of metals, high temperature strength. Surface finishing. Powder metallurgy. Use of composites and Ceramics. Super alloys for Turbines. Systems: Fuel systems and components. Sensors and Controls. FADEC interface with engine. Typical fuel system. Oil system components. Typical oil system. Starting systems. Typical starting characteristics. Various gas turbine starters.	

Unit – III	Contact Hours = 8 Hours
Axial and centrifugal types; Constructional features and operating principles and applications; Fan balancing; Operation: Causes and effects of compressor stall and surge; Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades Compressor ratio	

Unit – IV	Contact Hours = 8 Hours
Nozzle guide vanes; Causes and effects of turbine blade stress and creep. Constructional features and principles of operation; Convergent, divergent and variable area nozzles; Engine noise reduction; Thrust reversers.	

Unit – V	Contact Hours = 8 Hours
Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components Operation of engine start systems and components; Ignition systems and components; Maintenance safety requirements. Exhaust Gas Temperature/Inter stage Turbine Temperature; Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure and flow; Engine speed; Vibration measurement and indication; Torque; Power.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Potential energy, kinetic energy, Newton's laws of motion
2	Criteria for selection of materials. Heat ranges of metals
3	Causes and effects of turbine blade stress and creep
4	Nozzle guide vanes; Causes and effects of turbine blade stress and creep
5	Exhaust Gas Temperature/Inter stage Turbine Temperature

Books	
	Text Books:
1.	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
2.	P.P Walsh and P. Peletcher, 'Gas Turbine Performance' Blackwell Science, 1998, ISBN0632047843.
	Reference Books:
1.	J P Holman, 'Experimental methods for Engineers ', Tata Mc Graw Hill,7th edition,2007, ISBN13: 978-0070647763
2.	Michael J.Kores, and Thomas W.Wild ,' Aircraft Power Plant', GLENCOE Aviation Technology Series, 7th Edition, Tata Mc Graw Hill Publishing Co.Ltd.2002
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL: Online Resources: Lecture by: Prof. PranabMondal, IIT Guwahati https://nptel.ac.in/courses/112103262/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Identify** the types of engines and describe their applications	3	1,2	1,2,3
2.	**Evaluate** the performance of the engine.	3	1,2	1,2,3
3.	**Evaluate** the performance of specific engine components	3	1,2	1,2,3
4.	**Test** the engine using several types of engine testing methods.	3	1,2	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓												✓	✓	✓
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 of jet engine and its components	Aerospace	Lead Engineer
2	Gain the knowledge about the engine overhauling	Thermal	Maintenance engineer

I V Patil
Name & Signature of Faculty members
involved in designing the syllabus

P M Banakar
Name & Signature of Faculty members
verifying/approving the syllabus

Wind Tunnel Techniques

Course Code	22AE641	**Course type**	OEC	**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 the basic concept of Wind tunnel and its principles
2.	Understand the various types of wind tunnels and its operational functions
3.	Analyze the flow through calibration and measurement techniques.
4.	Learn the advanced types of wind tunnel.

Pre-requisites : Basic knowledge of Fluid Mechanics & Aerodynamics

Unit – I	**Contact Hours = 8 Hours**
Introduction to Wind Tunnels & Principles of Model Testing, Wind Tunnels and its functional parts, Non-dimensional numbers, Scale effect, Geometric Kinematic and Dynamic similarities. Types of wind tunnels – continuous and intermittent – closed circuit and open circuit – applications.	

Unit – II	**Contact Hours = 8 Hours**
Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation of wind tunnels – Turbulence- Wind tunnel balance –principles, types and classifications	

Unit – III	**Contact Hours = 8 Hours**
Forces, moments and Reference Frames – Balances – Internal and External - Requirements and Specifications, Intrusive and Non-intrusive methods, Pitot – static tube characteristics – Velocity measurements – Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques – Pressure transducers – Temperature measurements.	

Unit – IV	**Contact Hours = 8 Hours**
Intake tests, store carriage and separation tests, Unsteady force and pressure measurements, Non-Intrusive Flow Diagnostics, Laser – Doppler Anemometry. Particle Image Velocimetry. Laser Induced Fluorescence.	

Unit – V	**Contact Hours = 8 Hours**

Introduction, general considerations, general design procedure, main design criteria, wind tunnel component specification, design of various components of wind tunnel – test chamber, contraction, settling chamber, diffuser, power plant, turning vane, fan and drive system, safety net design

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Closed circuit and open circuit
2	Wind tunnel balance –principles
3	Hot-wire anemometry
4	Laser Induced Fluorescence.
5	Safety net design

Books	
	Text Books:
1.	Rae,W.H. and Pope,A.,"LowSpeed WindTunnelTesting",WileyIndiaPvtLtd;Third edition(16March2010)ISBN-13:978-8126525683
2.	Pope,A.,andGoin,L.,"HighSpeedWindTunnelTesting",KriegerPubCo(June1,1978),ISBN-13:978-0882757278
3.	Pope, J B Barlow —low speed wind tunnel testing — 3 edition j.w publication
	Reference Books:
1.	J P Holman, 'Experimental methods for Engineers ', Tata Mc Graw Hill,7th edition,2007, ISBN13: 978-0070647763
2.	Michael J.Kores, and Thomas W.Wild ,' Aircraft Power Plant', GLENCOE Aviation Technology Series, 7th Edition, Tata Mc Graw Hill Publishing Co.Ltd.2002
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/101106040

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Understand** the concepts of aerodynamics and types of wind tunnels	Un	1	1

2.	**Examine** the wind tunnel through the calibrations and its functions used in wind tunnels	**An**	1	1
3.	**Distinguish** the different approaches of measurements in **Understand**ing the function of Wind tunnel.	**Ap**	1	1
4.	**Apply** the concept of aerodynamics in designing the wind tunnels.	**Ap**	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓												✓		
3	✓												✓		
4	✓												✓		
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	Understanding basic principle of operations of wind tunnel.	Aeronautical sector	Experimental aerodynamics Engineer
2	Measurement equipment used	Automobile sector	Wind tunnel designer
3	Designing fundamental basics		Aerodynamics Engineer

D A Ponnaswami
Name & Signature of Faculty members
involved in designing the syllabus

Sidyant Kumar
Name & Signature of Faculty members
verifying/approving the syllabus

Introduction to Composites

Course Code	22AE642	**Course type**	OEC	**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.	Explain the advantages of using composite materials as an alternative to conventional materials for specific applications
2.	Describe the advanced fabrication and processing for producing composite parts.
3.	Evaluate the micro- and macro-mechanical behaviour of composite laminates

Pre-requisites : Mechanics of Materials, Aircraft Materials

Unit – I	**Contact Hours = 8 Hours**
Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fiber composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites	

Unit – II	**Contact Hours = 8 Hours**
Manufacturing Methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.	

Unit – III	**Contact Hours = 8 Hours**
Mechanical Properties -Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.	

Unit – IV	**Contact Hours = 8 Hours**
Laminates: Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Antisymmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle ply Laminate. Orthotropic Laminate, Laminate Moduli, Hygrothermal Stresses.	

Unit – V	**Contact Hours = 8 Hours**

Inspection & Quality Control: Destructive & Non-Destructive Testing, ultrasonic testing – A-B-C scan **Applications of Composites Materials**: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Definitions, Composites, Reinforcements and matrices
2	Manufacturing methods : Hand and spray lay – up.
3	Mechanical Properties -Stiffness and Strength.
4	Types of Laminates.
5	Applications of Composites Materials

Books	
	Text Books:
1.	K.K Chawla , Composite Materials- Science and Engineering, zpringer Verlag II edition,1998
2.	Autar Kaw, Mechanics of Composites, CRC Press II edition,2006
	Reference Books:
1.	Mein Schwartz Department of Defense , Composite Materials Handbook, USA 2002
2.	Ajay Kapadia , Non-Destructive Testing of Composite Materials, TWI Publications 2006
3.	R M Jones Taylor & Francis , Mechanics of Composite Materials, 2ndEdn,2015
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	The student will be introduced to the various composite components e.g. reinforcement and matrices.	un	1	1
2.	The student will employ principles of material selection and design for composite materials.	Ap	1,2	2
3.	The student will demonstrate basic knowledge on the various	Ap	1,2	2

	composite processing techniques.			
4.	Application of composites in various industries	un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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

Sl No	**Skill & competence enhanced**	**Applicable Industry**	**Job roles students can take up**

	after undergoing the course	Sectors & domains	after undergoing the course
1	Acquire Knowledge about composite materials	Aerospace, Automobile	Design &Development of composite materials
2	Applications of Composites	Aerospace, Automobile	Stress Analyst.
3	Non-Destructive Testing	Aerospace, Automobile	Can work in Nondestructive Testing units

Shakthi Prasad M
Name & Signature of Faculty members
involved in designing the syllabus

L Chikmath
Name & Signature of Faculty members
verifying/approving the syllabus

Aircraft systems

Course Code	22AE643	Course type	OEC	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 fundamental principles and concepts of aircraft systems, including their mechanical, electrical, hydraulic, pneumatic, and avionics subsystems integration.
2.	Comprehend the importance of aircraft system integration and its impact on the overall performance, safety, and efficiency of the aircraft.
3.	Apply knowledge of aircraft system regulations and safety considerations to ensure compliance and mitigate risks in aircraft operation and maintenance.
4.	Demonstrate the ability to analyze and evaluate the interdependencies and interactions between different aircraft systems.
5.	Apply theoretical knowledge to practical scenarios and problem-solving related to aircraft systems integration, operation, and maintenance

Pre-requisites : Elements of Aeronautics

Unit – I	Contact Hours = 8 Hours
Aircraft control systems-Cockpit controls, connecting linkages, mechanisms to control aircraft, primary and secondary systems, flight control systems (FCS), Flight control computer(FCC),Autopilot systems, Introduction to Aircraft Systems ,Types of Aircraft Systems (Mechanical, Electrical, Hydraulic, Pneumatic, etc.) ,Aircraft System Integration ,Aircraft System Safety and Regulations ,Maintenance and Inspection Procedures for Aircraft Systems	

Unit – II	Contact Hours = 8 Hours
Overview of Aircraft Electrical Systems, Aircraft Electrical Power Generation and Distribution ,Electrical Loads and Circuit Protection ,Batteries and Power Sources, Electrical Wiring and Connectors , Troubleshooting and Maintenance of Electrical Systems	

Unit – III	Contact Hours = 8 Hours
Introduction to Aircraft Hydraulic Systems ,Hydraulic Fluids and Filters , Hydraulic Power Generation and Distribution, Hydraulic Actuators and Components, Hydraulic System Maintenance and Troubleshooting ,Emergency Hydraulic Systems	

Unit – IV	Contact Hours = 8 Hours
Overview of Aircraft Pneumatic Systems ,Pneumatic Power Generation and Distribution , Pneumatic Components and Controls ,Cabin Pressurization Systems , Pneumatic System Maintenance and Troubleshooting	

Unit – V	Contact Hours = 8 Hours

Introduction to Aircraft Environmental Control Systems (ECS) ,Air Conditioning and Heating Systems ,Ventilation and Pressurization Systems ,Avionics Cooling Systems ,ECS Maintenance and Troubleshooting

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Rocket propulsion fundamentals
2	Electrical rockets, Fundamentals of orbital mechanics
3	Introduction to spacecraft attitude dynamics
4	Attitude determination, sensors
5	Introduction to flexibility/nonlinear effects on spacecraft attitude dynamics and control

Books	
	Text Books:
1.	"Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration" by Ian Moir and Allan Seabridge
	Reference Books:
1.	Alfred Leick, GPS Satellite Surveying Publisher: Wiley Edition: 4th Edition Year: 2014
2.	Christopher Jekeli, Inertial Navigation Systems with Geodetic Applications Publisher: Walter de Gruyter Edition: 1st Edition Year: 2001
3.	Cary R. Spitzer , Digital Avionics Handbook Publisher: CRC Press Edition: 3rd Edition Year: 2014
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Global navigation satellite systems and applications,iitroorkee,profarun k. saraf,https://nptel.ac.in/courses/105107194

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Gain a comprehensive understanding of aircraft systems, including their integration, operation, and maintenance, encompassing mechanical, electrical, hydraulic, pneumatic, and avionics subsystems.	Un	1	1,2,3
2.	Apply knowledge of aircraft system regulations, safety	Ap	1	1,2,3

	considerations, and problem-solving techniques to ensure safe and efficient aircraft operation and maintenance.			
3.	Demonstrate proficiency in analyzing, evaluating, and troubleshooting aircraft systems, fostering effective communication and teamwork skills in aircraft system-related tasks	An	1	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. **-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.** **-Lack of minimum score in IA test will make the student Not Eligible for SEE** **-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓												✓	✓	✓
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	Technical Proficiency	Aerospace Industry, Avionics Manufacturing Companies, Airlines and Aviation Operators, Maintenance, Repair and Overhaul (MRO) Facilities, Defense and Military, Research and Development, Flight Simulation Companies, UAV (Unmanned Aerial Vehicle) and Drone Industry, Government Regulatory Agencies	Avionics Technician/Engineer
2.	System Troubleshooting		Avionics Integration Specialist
3.	System Integration:		Avionics System Engineer
4.	Communication and Collaboration		Avionics Project Manager
5.	Safety Awareness:		Avionics Sales Engineer
6.	Analytical Skills:		Avionics Instructor/Trainer
7.	Continuous Learning		Avionics Systems Consultant

Shakthi Prasad M
Name & Signature of Faculty members involved in designing the syllabus

P P Katti
Name & Signature of Faculty members verifying/approving the syllabus

Experimental Aerodynamics

Course Code	22AE644	**Course type**	PEC	**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.	Basic of data analysis and uncertainty in flow measurement
2.	Understanding of complex flow visualization methods such as Schlieren and Shadowgraph
3.	Basic design of different tunnels
4.	Understanding of Flow measurement using different instruments

Pre-requisites: Fluid mechanics, Thermodynamics, Fundamentals of Aerodynamics and Compressible flows.

Unit – I	**Contact Hours = 8 Hours**
Examples of Fluid Mechanics Measurements: Wind-Tunnel Studies, Spatial and Temporal Resolution in Measurements, Classification of Deterministic Data, Random Data, Signal Analysis and Uncertainty Analysis.	

Unit – II	**Contact Hours = 8 Hours**
Low speed wind tunnel, Fundamental on the design of low speed wind tunnel, Power losses in low speed wind tunnel, High speed wind tunnel, Fundamental on the design of low speed wind tunnel, Losses in high speed wind tunnel, Supersonic wind tunnel diffuser, Effect of second throat.	

Unit – III	**Contact Hours = 8 Hours**
Qualitative Characterization: Flow Visualization in Liquid and Gaseous Medium, Colored Filament, Smoke, Vapor and Tufts Visualization, Image Processing Techniques, Identifying Structures – Optical Systems for Flow Measurement: Shadowgraph, Schlieren and Interferometric Techniques.	

Unit – IV	**Contact Hours = 8 Hours**
Pressure measurement techniques, Barometer and Manometer, Pressure transducers, Designing of Pitot and Pitot static tube for measurement in incompressible and compressible flow, Factors influencing Pitot static tube performance, Low-pressure measurement techniques.	

Unit – V	**Contact Hours = 8 Hours**

Introduction to different velocity measuring instruments, Hot wire Anemometer, Data analysis of Hot wire Anemometer, PIV techniques, Introduction to different temperature measuring instruments, Temperature measurement by thermal expansion, Temperature measurement by electrical effect, Thermocouple measurement, Pyrometer measurement, Temperature measurement problems in the flow.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	0	1	1	1	1

Unit No.	Self-Study Topics
2	Design of nozzle using method of characteristic
4	Bernoulli's Equation
5	Doppler effect

Books	
	Text Books:
1.	P. Bradshaw, Experimental Fluid Mechanics, Pergamon Press, 1970
2.	Rathakrishnan E, Instrumentation measurements and experiments in fluids., CRC Press; 2nd edition
3.	Taylor Francis, Fluid Mechanics Measurements, R.J. Goldstein (Ed.), Washington 1996. TA357.F684.
4.	W-J Yang, Handbook of Flow Visualization, 2nd edition, Taylor and Francis, 2001
5.	Low-Speed Wind Tunnel Testing, Rae, W. and Pope, A.
	Reference Books:
1.	Tropea, Cameron; Yarin, Alexander L.; Foss, John F. , Handbook of Experimental Fluid Mechanics, Springer, 2007.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Experimental Gas and Aerodynamics: https://archive.nptel.ac.in/courses/101/106/101106040/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Distinguish different techniques of flow visualization.	Un	1	1
2.	Designing of Pitot and Pitot static tube.	Ev, Cr	1,2	1
3.	Describe different temperature and velocity measuring instruments.	Un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓												✓	✓	
3	✓												✓	✓	
4	✓			✓									✓	✓	
ick 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	Different techniques of flow visualization.	Experiments in Aerodynamics	Employing different techniques for visualization of flow
2	Measurement of flow properties		Operate different flow measuring instruments

Sidyant Kumar
Name & Signature of Faculty members
involved in designing the syllabus

D A Ponnaswami
Name & Signature of Faculty members
verifying/approving the syllabus

Simulation Lab

Course Code	22AEL66	Course type		Credits L-T-P	0 - 0 - 2
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.	Comprehend the basic concepts of flight instrumentation.
2.	Impart the knowledge of Aircraft performance, flight testing and stability control simulation methods
3.	Impart the knowledge of stability control of flight in experimental method.
4.	Understand the flying qualities and hazardous flight testing.

Required Knowledge of :

Lab Experiment – I	Contact Hours = 2 Hours
Time Response Modeling of a Spring- Mass-Damper system.	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Effect of speed on Glide Performance	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Effect of Velocity on Climb Rate	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Simulation of Longitudinal Stability Modes on Advanced Flight simulator.	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Simulation of Lateral-Directional Stability Modes Advanced Flight simulator.	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Simulation of Aircraft Longitudinal modes and Analyze the Response	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Simulation of Lateral directional modes Analyze the Response	
Lab Experiment – 8	**Contact Hours = 2 Hours**

Frequency response for spring mass system, simulation of the oscillations.	
Lab Experiment – 9	**Contact Hours = 2 Hours**
Simulation of poles and zeros of a transfer function.	
Lab Experiment – 10	**Contact Hours = 2 Hours**
Stability analysis using root locus using MATLAB	

Books	
	Text Books:
1.	Nelson R. C., "Flight Stability and Automatic Control", McGraw Hill Education; 2 edition (1 July 2017), ISBN-13: 978-0070661103.
2.	Bandu N. Pamadi, "Performance Stability, Dynamics and Control of Airplanes", AIAA, 2004.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc21_ae05/preview Lectures from ' Introduction to Experiments in Flight' By Prof. A.K. Ghosh, IIT Kanpur

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.		6.	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.	Plot the root locus and bode plot.	Ap	1,2,3,5	1,2
2.	Calculate the dynamics response of aircraft.	Ap	1,2,3,5	1,2
3.	Use computational tools to model aircraft trajectory.	AP	1,2,3,5	1,2
4.	Estimate the performance of flight by using Flight testing methods.	An	1,2,3,5	1,2

Scheme of Continuous Internal Evaluation (CIE):

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

Conduct of Lab:

4. Conduction of the experiment: 15 marks + Viva voce: 5 marks
5. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks

6. Lab project/ Open ended expt: 10 marks

3. Lab Test: 15 marks

Eligibility for SEE:

2. 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.	Minimum marks required in SEE to pass: 20 out of 50		
4.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
5.	Viva-voce shall be conducted for individual student and not in a group.		

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	**√**	**√**	**√**		**√**							**√**	**√**	**√**	
3	**√**	**√**	**√**		**√**							**√**	**√**	**√**	
4	**√**	**√**	**√**		**√**							**√**	**√**	**√**	
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	**Knowledge about Aircraft Simulation**	**Aircraft Sector**	**Mass properties Engineer**
2	**Design of Aircraft control system**	**UAV sector**	**UAV Design Engineer**

A K Nakkala
Name & Signature of Faculty members
involved in designing the syllabus

P K Katti
Name & Signature of Faculty members
verifying/approving the syllabus

Employability Skills II

Course Code	22AECAE67	Course type	AEC	Credits L-T-P	1 – 0 - 0
Hours/week: L - T- P	1 – 0 – 0			**Total credits**	1
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 0 Hrs Total = 30 Hrs			**CIE Marks**	100

Course learning objectives	
1.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
2.	These skills make it easier to form relationships with people, create trust and dependability, and lead teams.
3.	In essence, they are essential for individual success in the workplace, their company's success, and their personal life also

Pre-requisites :

Unit – I	**Contact Hours = 4 Hours**
***Quantitative Aptitude*: Ratios, Proportions and Variations (2 Hours), Partnership (1 Hour), Time and Work (2 Hours) *Logical Reasoning:* Seating Arrangement (1 Hour)**	

Unit – II	**Contact Hours = 4 Hours**
Quantitative Aptitude: Time, Speed and Distance (2 Hours), Trains, Boats and Streams (2 Hours) ***Verbal Ability:*** Reading Comprehension (2 Hours)	

Unit – III	**Contact Hours = 4 Hours**
Quantitative Aptitude: Permutation and Combination (2 Hours), Ages (1 Hour) ***Logical Reasoning:*** Data Arrangement (1 Hour) ***Soft Skills:*** Interview Skills (1 Hour), Resume Building (1 Hour).	

Unit – IV	**Contact Hours = 4 Hours**
Quantitative Aptitude: Probability (2 Hours) ***Logical Reasoning:*** Clocks and Calendars (2 Hours), Syllogisms (2 Hours)	

Unit – V	**Contact Hours = 4 Hours**
Quantitative Aptitude: Data Interpretation (2 Hours) ***Logical Reasoning:*** Data Sufficiency (2 Hours) ***Verbal Ability***: Ordering of Sentences (1 Hour), Critical Reasoning (1 Hour)	

Books	
	Text Books:

	Name of the author(s), Title of the Book, Publisher, Edition/Year ______ and onwards
1.	The Aptitude Triad , BIZOTIC
2.	How to prepare for Quantitative Aptitude for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 4th Edition, 2018.
3.	How to prepare for Logical Reasoning for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.
4.	How to prepare for Verbal Ability and Reading Comprehension for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.
5.	How to prepare for Data Interpretation for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 5th Edition, 2018.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes
		3.	Assignments
		4.	Seminar

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.	Clear the Aptitude round of recruiters during placements	L2	10,12	
2.	Perform confidently during the Interview process	L2	10,12	
3.	Develop resumes that are grammatically correct and written in Business English	L2	10,12	
4.	Develop behaviors that are appropriate for a professional	L2	10,12	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two Assignments	Total Marks
Marks	30+30 = 60	20	10+10 =20	100
- Writing 2 IA tests are compulsory **-Student should score minimum 40% of 100 marks to pass the course.**				

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										✓		✓			
3										✓		✓			

4										✓		✓			
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	**Logical Thinking**	**IT Industry**	**Software Engineer**
2	**Problem Solving**	**Automotive**	**Developer**
3	**Communication Skills**	**Education Sector**	**Project Manager**

Name & Signature of Faculty members
involved in designing the syllabus

Name & Signature of Faculty members
verifying/approving the syllabus

ANNEXURE-I

Syllabus of VII Semester

Aircraft Design

Course Code	22AE71	**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.	Performance of different flights can be estimated
2.	Sizing of different components of aircraft can be done.
3.	Understand the different phases of Aircraft design process.

Required Knowledge of : Aircraft Performance, Aircraft Stability and control

Unit – I	**Contact Hours = 8 Hours**
Phases of aircraft design. Aircraft conceptual design process, project brief / request for proposal, problem definition information retrieval, aircraft requirements, configuration options Integrated product development and aircraft design. empty weight estimation –historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions. Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio airfoil considerations. Wing geometry and wing vertical location, wing tip shapes Tail geometry and arrangements. Thrust to weight ratio - statistical estimation, thrust matching. Wing loading.	

Unit – II	**Contact Hours = 8 Hours**
Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, wing, tail, control surfaces. Development of configuration lay out from conceptual sketch. The inboard profile drawing, wetted area, volume distribution and fuel volume plots Lofting- definition, significance and methods, flat wrap lofting. **Flipped Class content**: Special consideration in configuration layout.	

Unit – III	**Contact Hours = 8 Hours**
Fuselage design- crew station, passenger compartment, cargo provisions, weapons carriage, gun installation Landing gear arrangements, guidelines for lay out. Shock absorbers – types, sizing, stroke determination, gear load factors. Gear retraction geometry. Aircraft subsystems, significance to configuration lay out. The baseline design layout and report of initial specifications aircraft loads, Flight loads-atmospheric, maneuver- construction of flight envelope. Wing loads, Empennage loads, Fuselage loads. Propulsion system selection, jet engine integration, engine dimensions, Nozzle integration. **Flipped Class content**: Aircraft materials, design data- allowable, allowable bases. Failure theory.	

Unit – IV	**Contact Hours = 8 Hours**

The aircraft operating envelope. Take off analysis, balanced field length Landing analysis. Fighter Performance measures of merit. Effects of wind on aircraft performance. Initial technical report of baseline design analysis and evaluation. Refined baseline design and report of specifications. Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, fuel and oil costs, crew salaries Refined conceptual sizing methods. **Flipped Class content**: Trade studies - design trades, requirement trades, growth sensitivities

Unit – V	**Contact Hours = 8 Hours**
Longitudinal static stability and control, aerodynamic center estimation, wing and tail lift and elevator, Estimation ofwing, fuselage and nacelle pitching moment, thrust effect, trim analysis, take-off rotation, velocity stability, Lateral &directional stability and control, lateral directional derivatives, aircraft dynamic characteristics, steady roll, pull up,inertia coupling. **Flipped Class content**: Introduction to handling qualities(Cooper harper rating scale).	

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.Aircraft Conceptual 3D sketching 2.Creating Aerofoil and sketching
2	2	3.Estimating Wing Loading 4.Initial sizing of an Transport Aircraft
3	2	5.Weight Estimation of Fighter Aircraft 6.Design of Crew compartment
4	2	7.Wing Design and Drag Estimation 8.Engine Sizing

Unit No.	**Self-Study Topics**
1	Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio airfoil considerations
2	Special consideration in configuration layout
3	Aircraft materials
4	The aircraft operating envelope
5	Introduction to handling qualities(Cooper harper rating scale).
Books	
	Text Books:
1.	Raymer ,D.P., Aircraft Design : A Conceptual Approach, 3rd edn., AIAA Education series, AIAA, 1999,ISBN: 1-56347-281-0

2.	Howe, D., Aircraft Conceptual Design Synthesis, Professional EngineeringPublishing,London,2000,ISBN:1-86058-301-6
	Reference Books:
1.	Ajoy Kumar Kunda, "Aircraft Design", Cambridge University Press, UK, 2010
2.	E. H Bruhn, "Analysis and Design of Flight Vehicles Structures", Jacobs Publishing House, USA, New Edition, 1973.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/101/105/101105083/ Lectures by Pro.Manoranjan Sinha, of IIT Kharagpur.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Lab Test
3.	Flipped Classes	3.	Semester End Examination
4.	Practice session/Demonstrations in Labs	4.	
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.	**Describe** the Phases of the flight design process, Configuration layout and Trade studies.	Un	1	1,2
2.	**Estimate** take-off gross weight of simple cruise mission profile for calculating the emptyweight fraction.	AP	1,2,3	1,2
3.	**Analyze** the design performance parameters of an aircraft for a given application.	An	1,2,3	1,2

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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 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
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: 15 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√	√										√	√	
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	Knowledge about Aircraft Design.	Aircraft Sector	Mass properties Engineer
2	Design and Stability analysis of Flight Vehicles.	Fixed Wing UAV sector	UAV Design Engineer

Shakthi Prasad M
Name & Signature of Faculty members involved in designing the syllabus

A K Nakkala
Name & Signature of Faculty members verifying/approving the syllabus

Vibrations & Aero-elasticity

Course Code	22AE72	**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.	Understand Basic concepts of vibrations
2.	Understand The need for vibration analysis in aircraft structural systems
3.	Understand Merits and de-merits of vibrations
4.	Understand Applications of different solution methods to vibrational problems

Required Knowledge of : Calculus, Mechanics of Materials, Aircraft Structures

Unit – I	**Contact Hours = 8 Hours**
Introduction to vibration, Elements of a vibrating system, causes, requirements, desirable and undesirable effects, natural frequency, Resonance, degrees of freedom, classification of vibration, types of damping, single degree, two degrees and multiple degrees of freedom systems, formulation of equations of motion using different approaches.	

Unit – II	**Contact Hours = 8 Hours**
Free and Forced Vibrations, basics of damped and undamped vibration systems. Free vibration of undamped and damped single DoF systems: force equilibrium, Energy, Rayleigh's and Lagrange's method. Critical, over, under-damped systems, damping ratio, logarithmic decrement.	

Unit – III	**Contact Hours = 8 Hours**
Forced vibration of undamped and viscously damped single DoF systems with harmonic excitation; two-degree of freedom system- coordinate coupling, principal coordinates, eigenvalue problem, natural frequencies and mode shapes, normal modes. Introduction of multi-degrees of freedom problems.	

Unit – IV	**Contact Hours = 8 Hours**
Vibration of continuous system: vibrations of strings; free vibrations of prismatic bars; Ritz and Galerkin methods. Experimental techniques of vibration measurement and analysis methods. Seismic instruments, vibrometer, accelerometer, vibration absorbers	

Unit – V	Contact Hours = 8 Hours
Introduction to aero elasticity, Historical background, static and dynamic aero elastic phenomenon, Collar's aero elastic triangle, the definition of flutter, divergence, control effectiveness and control reversal: derivation and numerical	

Flipped Classroom Details

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

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
2	3	1. Free longitudinal vibrations of spring mass system
		2. Damped and Undamped forced vibration of spring mass system
		3. Undamped forced vibration of spring mass system
3	2	4. Balancing of rotating masses setup for static balancing at a plane
		5. Gyroscopic couple on motorized gyroscope
4	3	6. Critical speed or whirling speed of a rotating shaft
		7. Damped torsional vibrating system
		8. Principles of SDOF system to determine the acceleration due to gravity, spring stiffness and radius of gyration

Unit No.	Self-Study Topics
1	Isolation: Vibration isolation and transmissibility
2	Stability criterion: Self excited vibrations; criterion of stability; effect of friction on stability.
3	Free and forced vibration of multi-degree of freedom systems with and without viscous damping
4	Review of vibrations; Harmonically excited vibration; Vibration isolation, resonance, critical speeds of shafts
5	Flutter analysis with quasi-steady and unsteady aerodynamic loads

Books	
	Text Books:
1.	Rao, S.S., "Mechanical Vibrations", 4th Ed., Pearson Education, 2007
2.	Grover, G. K., "Mechanical Vibrations", 8th Ed., Nem Chand & Brothers, 2009
3.	Dowell, E. H., "A Modern Course in Aeroelasticity: Solid Mechanics and Its Applications", 5th Ed. Springer, 2014
	Reference Books:
1.	Meirovitch, L., Fundamentals of Vibration Analysis, 3rd Ed. McGraw-Hill, 2001.

2.	Das, J. B. K. and Srinivasa Murthy, P. L., "Mechanical Vibrations", Sapna publishers, 2008
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL course: Introduction to Mechanical Vibrations, by Dr. Anil Kumar IIT Roorkee. https://nptel.ac.in/courses/112107212
2.	Mechanical Vibrations, Prof. S.K. Dwivedy, and Prof. Rajiv Tiwari from IIT Guwahati http://www.nptelvideos.com/course.php?id=835

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Lab Test
3.	Flipped Classes	3.	Semester End Examination
4.	Practice session/Demonstrations in Labs	4.	
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.	Understand single and multiple degrees of freedom vibrating systems.	UN	1,2,3,8,9,10	1
2.	Discuss vibration measuring instruments for vibration testing	AN	1, 2	1
3.	Describe experimental techniques using equipment employed in industry.	AP	1, 2	1
4.	Implement vibration analysis theories to modern machineries, automobiles, airfoil sections and landing gears.	EV	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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 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

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: 15 marks
5. Viva voce: 10 marks

Eligibility for SEE: 1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE** 2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.** 3. Lab test is COMPULSORY 4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.** 5. 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:** Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√		
3	√	√											√		
4	√	√	√					√	√	√			√		
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	Operations and Failure Mechanism of Structural Components in different engineering fields	Mechanical Sciences	Design Engineer Stress Analyst Stress Engineer Safety Engineer

Shakthi Prasad M
Name & Signature of Faculty members
involved in designing the syllabus

Lokamanya Chikmath
Name & Signature of Faculty members
verifying/approving the syllabus

Guidance Navigation & Control

Course Code	22AE73	**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.	Understand air navigation, history, coordinate systems, ATC, flight rules, radio propagation, and communication principles in aviation
2.	Gain Knowledge of short and long-range NAVAIDs: ADF, VOR, DME, TACAN, RNSS, LORAN-C, OMEGA, INS, GPS, and their applications.
3.	Familiarize yourself with approach landing basics, ILS, MLS, DGPS, avionics receivers, transmitters, airborne antennas, and their applications.
4.	Learn types of controllers: proportional, integral, derivative, and combinations, along with compensation methods and compensators.
5.	Grasp state variable representation, advantages, disadvantages, matrix concepts, controllability, and observability.

Pre-requisites : Avionics

Unit – I	**Contact Hours = 10 Hours**
Air navigation, methods ,history of air navigation, earth coordinate system, earth mapping system, international navigation standards, air traffic control system: Visual flight Rule, Instrument flight rule, pilotage and dead reckoning, Radio Wave Propagation and Wave, Sky Wave, Los Wave, Communications	

Unit – II	**Contact Hours = 10 Hours**
Modern Guidance Laws, Guidance Scheme, Problems and Exercises, Aircraft Navigation: Introduction, Types of Navigation Short range Navigation: Automatic Direction Finder (ADF), VHF Omnidirectional Radio Range (VOR), Distance Measuring Equipment (DME), Tactical air navigation system-TACAN, Random or Area Navigation – RNAV.	

Unit – III	**Contact Hours = 10 Hours**
Long Range Navigation: Long Range Navigation (revision-C) -LORAN-C, Optimized Method for Estimated Guidance Accuracy – OMEGA , Very High Frequency Omni-Directional Range (VOR), Inertial Navigation System (INS), integrated navigation systems, problems and exercises, Global Positioning System – GPS . **Approach landing navigation:** Instrument Landing System-ILS, Microwave Landing System-MLS, Differential Global Positioning System-DGPS, and Airborne Antennas	

Unit – IV	**Contact Hours = 10 Hours**

Feedback control systems: Types of controllers – Proportional, Integral, Derivative controllers, Proportional – Integral, Proportional – Integral – Derivative controllers; Compensation methods – Series and feedback compensation, Lead, Lag and Lead-Lag Compensators.

Unit – V	**Contact Hours = 10 Hours**
State Variable Analysis of Linear Dynamical Systems: State Equations, State Transition Matrix, Properties of the State Transition Matrix, State Transition Equation, Examples, Relation with Transfer Function, Controllability and Observability of a Linear System, Formal Definition of State Controllability, Observability of Linear system, Problems	

Flipped Classroom Details

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

Unit No.	**Self-Study Topics**
1	Antenna design
2	Design of navigation systems
3	Design of lead lag compensator
4	Kalman and gilbert Equations

Books	
	Text Books:
1.	R.P.G. Collinson., "Introduction to Avionics Systems", Springer,3rd edition, 2011, ISBN-13: 978-9400707078
2.	Ian Moir, Allan Seabridge, Aircraft Systems: Mechanics, Electrical and Avionics Subsystems Integration, Wiley, 3rd Edition, 2012.
3.	Control systems Manik D. N Cengage 2017
4.	Automatic Control Systems Farid G., Kuo B. C McGraw Hill Education 10th Edition,2018
	Reference Books:
1.	Spitzer, C.R., "Digital Avionic Systems", McGraw-Hill Inc., US, 2nd edition, 1992, ISBN-13: 978-0070603332.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/101/108/101108056/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Interpret the knowledge of air navigation, history, systems, communication, and radio wave propagation.	UN	1,2	1,2,3
2.	Choosing short and long-range & landing NAVAIDs	AP	1,2	1,2,3
3.	Solve feedback control problems, predict responses, and apply compensation methods effectively.	AP	1,2	1,2,3
4.	Examine state variable characteristics, solve equations, and apply controllability concepts.	AN	1,2	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓	✓											✓	✓	✓
3	✓	✓											✓	✓	✓
4	✓	✓											✓	✓	✓
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	Understanding of air navigation, history, coordinate systems, ATC, flight rules, radio propagation, and communication principles in aviation	Aerospace, Aviation, Defense	Air Navigation Specialist, ATC Specialist, Communication Systems Engineer
2	Knowledge of short and long-range NAVAIDs: ADF, VOR, DME, TACAN, RNSS, LORAN-C, OMEGA, INS, GPS, and their applications	Aerospace, Aviation, Defense	Navigation Systems Engineer, Avionics Engineer, GPS Specialist
3	Familiarity with approach landing basics, ILS, MLS, DGPS, avionics receivers, transmitters, airborne antennas, and their applications	Aerospace, Aviation, Defense	Landing Systems Engineer, Avionics Receiver/Transmitter Engineer, Antenna Design Engineer
4	Learning types of controllers: proportional, integral, derivative, and combinations, along with compensation methods and compensators	Aerospace, Aviation, Defense, Electronics	Control Systems Engineer, Avionics Control Engineer, Systems Design Engineer
5	Grasping state variable representation, advantages, disadvantages, matrix concepts, controllability, observability, and Kalman/Gilberts test	Aerospace, Aviation, Defense, Electronics	Control Systems Analyst, Avionics Systems Engineer, Control Theory Specialist

P P Katti
Name & Signature of Faculty members
involved in designing the syllabus

A K Nakkala
Name & Signature of Faculty members
verifying/approving the syllabus

Fatigue and Fracture Mechanics

Course Code	22AE741	Course type	PEC	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	4 Hours			SEE Marks	100

Course learning objectives	
1.	To understand the basic concepts of Fracture Mechanics
2.	To predict and analyze fracture toughness by energy criterion, stress intensity approach, CTOD and J-Integral method
3.	To study the concept of fatigue loading, SN curves and crack growth of a structural component
4.	To understand non-destructive test techniques and applications to various structural components.

Pre-requisites : Mechanics of materials, Aircraft Structures

Unit – I	Contact Hours = 8 Hours
Failure and their cause, techniques of failure analysis, conventional design concepts, inadequacies of conventional design, modern design approach, fracture based design in aircraft structures, Mechanics of fracture: Griffith theory of fracture, Irwin-Orowan modification, concepts of G and R, relation between G and K, Westergaard's approach for SIF, DCB specimen, concept of load control and displacement control.	

Unit – II	Contact Hours = 8 Hours
Fractures toughness: Determination of fracture toughness, crack tip plasticity, plastic enclaves and their effect on energy release rate, Concept of plastic zone criterion, R curve concept, J-integral , COD criterion.	

Unit – III	Contact Hours = 8 Hours
Cyclic stress-strain controlled fatigue, fatigue crack initiation mechanisms, parameters affecting fatigue.	

Unit – IV	Contact Hours = 8 Hours
Designing and testing for fracture resistance, principles of fracture safe design, improved toughness in ceramics, composites - examples in failure analysis, Failures in composite structures, damaged mechanics concept.	

Unit – V	Contact Hours = 8 Hours
Non Destructive Testing (NDT) – visual Inspection, dye-penetrant inspection, fluorescent-penetrant inspection, magnetic-particle inspection (magnaflux), radiological inspection, ultrasonic inspection, eddy current inspection	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1.	Crack propagation methods
2.	Modelling and analysis of damage using FEA tool
3.	Structural Health Monitoring (SHM)
4.	Damage Tolerance design

Books	
	Text Books:
1.	T.L. Anderson, Fracture Mechanics: Fundamentals and Application, CRC Press, 1994
2.	Prashant Kumar, Elements of Fracture Mechanics, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2009.
	Reference Books:
1.	D. Broek, Elementary Fracture Mechanics, pub. Marinus Nijhoff, 1986
2.	S. Teleman and A.J. McEvily, *Fracture of Structure Materials*, John Wiley and Sons, 1961.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Dr. K. Ramesh,Introduction to Engineering Fracture Mechanics. IIT Madras https://archive.nptel.ac.in/courses/112/106/112106065/

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 Assignment (OA)/ Certification
4.	Online classes	4.	Course Project
		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 -	**Learning Level**	**PO(s)**	**PSO(s)**

Analysis; Ev - Evaluate; Cr - Create				
1.	Understand fundamentals of fracture through conventional and modern design approaches	Un	1,2	1,3
2.	Solve fracture based problems by LEFM Approach using Griffith's and Irwin's approach	Ap	1,2	1
3.	Solve fracture based problems by EPFM approach using CTOD & J-Integral methodology	Ap	1,2	1
4.	Distinguish and infer on failure mechanisms in composites	An	1,2	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√		
3	√	√											√		
4	√	√											√		
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.	Characteristic behavior of Aircraft structural components	Materials and Metallurgy	Analyst Engineer
2.	Damage Tolerance Design	Materials and Metallurgy	Stress Engineer
3.	Selection of Materials for operational conditions	Aerospace, Mechanical and Marine Engineering	Stress Engineer, MRO Lead

Lokamanya Chikmath
Name & Signature of Faculty members
involved in designing the syllabus

Shakthi Prasad M
Name & Signature of Faculty members
verifying/approving the syllabus

Noise, Vibration & Harshness

Course Code	22AE742	**Course type**	**PEC**	**Credits L – P- T/SDA**	2 – 0 - 1
Hours/week: L - T- P	2 – 0 – 2			**Total credits**	3
Total Contact Hours	L = 24 Hrs; T = 0 Hrs; P = 16 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand fundamentals of Noise, Vibration, and Harshness (NVH), develop domain knowledge in NVH, and learn applications in automotive industry
2.	Develop knowledge in finite element based formulation for eigenvalue, frequency response, and transient dynamic problems
3.	Develop knowledge in modal and direct frequency response approaches used for the solution of vibration problems
4.	Understand optimization problem formulation, solution techniques, and results interpretation
5.	Understand the Difference between flutter instability and resonance, Elementary theory of buffeting.

Required Knowledge of : Mechanical Vibrations & Finite Element Method

Unit – I	**Contact Hours = 4 Hours**
NVH fundamentals: Definition of NVH, Vehicle noise - Direct sound generation mechanism: airborne sound; Indirect sound generation mechanism: structure borne sound; Subjective response sound, Acoustic variables, basic attributes of sound such as wavelength, period, frequency; order of vibration, time verses frequency domain; relation between vehicle speed, wavelength, & frequency; speed of sound, Decibel scale, Wave equation, types of sound fields, Measures of sound: Sound pressure, sound intensity and sound power, Combining sources: dB arithmetic, Octave bands, Beating, Human hearing: frequency Versus sound pressure level, A-B-C-D sound ratings, Loudness: phons and sones as noise descriptors;	

Unit – II	**Contact Hours = 7 Hours**
Finite Element formulation for 1D and 2D eigenvalue problem: Introduction to Hamilton principle, principle of minimum potential energy, stresses and equilibrium conditions, strain displacement relationship, stress strain relationship; stiffness and mass matrix for 1D and 2D problems including spring, truss, beam, and 2D CST; real eigenvalue problem formulation; Raleigh quotient; generalized mass, stiffness, and force vectors; consistent and lumped mass matrix and rigid body modes	

Unit – III	**Contact Hours = 2 Hours**
Damping & dynamic loads : Modal damping, Raleigh Damping, structural damping, frequency & time dependent loads and its application in automotive industry	

Unit – IV	Contact Hours = 6 Hours
forced harmonic and transient dynamic response analyses: Mode superposition method and direct method for solution of forced harmonic and transient dynamic analyses;	

Unit – V	Contact Hours = 5 Hours
Wing divergence and control system reversal for an idealized two dimensional wing and approximate solution for a finite wing. Flutter phenomena and flutter analysis. Difference between flutter instability and resonance. Simplified expressions for aerodynamic forces and moments for an oscillating airfoil. Determination of flutter speed and frequency for an idealized two dimensional wing as well as for a finite wing. Methods of flutter control and prevention. Elementary theory of buffeting.	

Flipped Classroom Details

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

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment (for Mechanical Engineering)
2	**1**	Normal mode analysis for SDOF spring mass system car model; find out natural frequency and analyze results
3	**1**	Simulate SDOF spring mass system car model with under damping, critical damping, and over damping & with initial conditions
3	**1**	Forced frequency response: Simulate SDOF spring mass system with base motion modeled using Fourier series; analyze the problem with direct & modal frequency response
2	**1**	Normal modes analysis for two d.o.f. quarter car model, identify natural frequencies and mode shapes
3	**1**	Analyze two d.o.f. half car model for a car going over a bump using transient dynamic analysis; study effects of various parameters on vibration characteristic of the car
3	**1**	Normal modes and frequency response analysis for a multi degree of freedom system e.g. a body-in-white or chassis or similar structure & analyze results
3	**1**	Normal modes analysis of a truss structure, beam structure, and 2D plate & analyze results

Books	
	Text Books:
1.	T.R. Chandrupatla & A.D. Belegundu, Introduction to finite element in Engineering, Pearson, 4^{th} Edition
2.	P. sheshu, Finite Element Analysis, PHI Learning Pvt. Ltd., New Delhi, 2003
3.	R L Bisplinghoft, H Ashley and R L Halfman, Aeroelasticity, Addison Wesley.
	Reference Books:
1.	W.T. Thomson, Theory of vibration with applications, CBS publications, 5^{th} Edition

2.	S. S. Rao, Mechanical Vibrations, Pearson, 4th Edition
3.	K.J. Bathe, Finite element procedures, Prentice-Hall, 1996
4.	ABAQUS Theory Manual, Dassault Systemes
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc22_me76/preview
2.	https://onlinecourses.nptel.ac.in/noc22_me43/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 the fundamental modes of vibration and vibration isolation	L2	1	1
2.	Demonstrate of different tools to solve dynamic problems for vibration.	L3	1	1
3.	Apply the governing equation of motion to solve vibration related engineering problems	L2	1,2	1
4.	Explain the Difference between flutter instability and resonance, Elementary theory of buffeting.	L3	1	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	Conduction	Lab test	
30 marks	30 marks	10 marks	30 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				
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: 15 marks
5. Viva voce: 10 marks

Eligibility for SEE:

1. **Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. Lack of minimum score in IA test will make the student Not Eligible for SEE**
2. **Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Lab component.**
3. Lab test is COMPULSORY
4. **Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.**
5. 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. 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 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	**PO1**	**PO2**	**PO3**	**PO5**	**PO10**	**PSO1**	**PSO2**	**PSO3**
1	✓			✓	✓	✓		
2	✓		✓	✓	✓	✓		
3	✓	✓	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	✓	✓	

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			

P P Katti
Name & Signature of Faculty members involved in designing the syllabus

L Chikmath
Name & Signature of Faculty members verifying/approving the syllabus

Design of UAS

Course Code	22AE743	**Course type**	PEC	**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.	Comprehend the detailed overview of Fixed Wing UAV design.
2.	Impart the knowledge of Aerodynamic and control design of UAVs.
3.	Impart the knowledge of stability control of UAV by different approaches.
4.	Understand the Payload and communication system design.

Pre-requisites : Aircraft Performance, Aircraft Stability and control, Flight Vehicle Design

Unit – I	**Contact Hours = 8 Hours**
Introduction, UAV Classifications, Review of a Few Successful UAVs ,Design Project Planning Decision Making ,Design Criteria, Objectives, and Priorities ,Feasibility Analysis ,Design Groups , Design Process Systems Engineering Approach , UAV Conceptual Design ,UAV Preliminary Design , UAV Detail Design Design Review, Evaluation, Feedback ,UAV Design Steps. **Flipped Class content:** Onboard and ground based data acquisition system.	

Unit – II	**Contact Hours = 8 Hours**
Introduction, Fundamentals of Aerodynamics, Wing Design, Tail Design, Vertical Tail Design-Parameters, Vertical Tail Location, Vertical Tail Moment Arm, Planform Area Incidence, Other Vertical Tail Parameters, Vertical Tail Design Technique, and Fuselage Design. **Flipped Class content**: Aerodynamic Design of Quadcopters	

Unit – III	**Contact Hours = 8 Hours**
Modeling Technique, Fundamental Model, Transfer Function, State-Space Representation, Aerodynamic Forces and Moments, Simplification Techniques of Dynamic Models, Fixed-Wing UAV Dynamic Models and Dynamic Model Approximation. **Flipped Class content**: Quadcopter (Rotary-Wing) Dynamic Model.	

Unit – IV	**Contact Hours = 8 Hours**
Fundamentals of Control Systems, Flight Control Requirements, and Control Modes. Controller Design- PID Controller, Optimal Control – LQR, Gain Scheduling Robust Control Digital Control. **Flipped Class content**: Autonomy.	

Unit – V	Contact Hours = 8 Hours
Fundamentals, Guidance Laws, Command Guidance Law, PN Guidance Law Pursuit Guidance Law Waypoint Guidance Law, Sense and Avoid. Inertial Navigation System, Kalman Filtering, Position Fixing Navigation, Navigation in Reduced Visibility Conditions, Navigation Disturbances and Navigation System Design. **Flipped Class content**: GPS, Inertial Navigation Sensors.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1	Application of Fixed wing Vs Rotary wing UAVs
2	Fixed wing UAV Fabrication techniques
3	Role of Stability Derivatives in UAV Design
4	Basics of Laplace transforms and Differential equations
5	Px4 control Tuning for UAV

Books	
	Text Books:
1.	Mohammad H Sadraey, Design of Unmanned Aerial systems, Wiley, 2020.
2.	Reg Austin, "Unmanned Air Systems: UAV Design, Development and Deployment", First Edition,Wiley Publishers, 2015.
	Reference Books:
1.	Mirosaw Adamski, "Power units and power supply systems in UAV", New Edition, Taylor and Francis Group publishers, 2014.
2.	Skafidas, "Microcontroller Systems for a UAV", KTH, TRITA-FYS 2002:51 ISSN 0280-316X. 34, 2002.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/101/105/101105083/ Lectures by Pro.Manoranjan Sinha, of IIT Kharagpur.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Describe** the Design process, Control Navigation and Guidance systems in UAVs.	Un	1	1,2
2.	**Solve** 6DOF Equation of motion and **Design** the Uav components.	AP	1,2,3	1,2
3.	**Analyze** the design performance parameters of Controller and guidance systems of UAV.	An	1,2,3,5	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. **-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.** **-Lack of minimum score in IA test will make the student Not Eligible for SEE** **-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√	√										√	√	
3	√	√	√		√								√	√	
ick 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	Knowledge about UAV Systems Design.	UAV Sector	UAV Design Engineer,
2	Design and Analysis of Control systems for Flight vehicles	UAV, Aircraft and Space sector	Control system Engineer

A K Nakkala
Name & Signature of Faculty members
involved in designing the syllabus

I V patil
Name & Signature of Faculty members
verifying/approving the syllabus

Aircraft Systems, Testing & Manufacturing Processes

Course Code	22AE744	**Course type**	PEC	**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 basics of flight and related concepts.
2.	Learn to analyze the performance parameters of the aircraft.
3.	Understand various aircraft manufacturing processes.
4.	Differentiate different testing mechanisms of aircraft parts.

Pre-requisites : Basic Aerodynamics, Aircraft Propulsion, Basics of Aircraft Systems

Unit – I	**Contact Hours = 8 Hours**
Introduction to Aeronautics: History and evolution of flight, Anatomy of fixed wing Aircraft, Anatomy of rotary wing aircraft.	

Unit – II	**Contact Hours = 8 Hours**
Fluid Mechanics and Aerodynamics: Introduction to Fluid mechanics, Basic definitions, Lift and Drag forces, Airfoil nomenclature, Introduction to Aircraft Performance, Basics of Helicopter dynamics	

Unit – III	**Contact Hours = 8 Hours**
Advanced Aircraft Manufacturing Processes: Fundamental of Aircraft Design, Introduction to Aircraft Structures, Aircraft Materials and Processes, Aircraft Manufacturing Processes. Composites and advanced Materials, Unconventional machining and forming processes in Aerospace Industry	

Unit – IV	**Contact Hours = 8 Hours**
Aircraft Mechanical Systems: Introduction to Aircraft Propulsion, Aircraft Fuel system, Hydraulic and Pneumatic systems, Landing gear systems, Environmental control system, Flight Control system	

Unit – V	**Contact Hours = 8 Hours**

Aircraft Electrical Systems and testing: Aircraft Electrical system, cockpit instrumentation and display, Avionics system, EMI / EMC, Advanced Aircraft systems, Ground testing of Aircraft Structures, Flight test Instrumentation.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
NA	NA

Books	
	Text Books:
1.	Aircraft Design and Manufacturing, HAL Management Academy, Bengaluru
2.	Aircraft Systems, HAL Management Academy, Bengaluru
	Reference Books:
1.	Introduction to Flight, John D Anderson, McGraw-Hill Education
2.	Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration, Ian Moir, Allan Seabridge
3.	Aircraft Systems, David A. Lombardo, McGraw Hill Education; 2nd edition
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Understand basic working of fixed wing and rotary aircraft	Un	1,2,3,5,11,12	1
2.	Quantify the lift and drag forces and performance parameters	Un	1,2,3,5,11,12	1
3.	Discuss the advanced aircraft manufacturing processes	Un	1,2,3,5,11,12	1
4.	Illustrate various aircraft mechanical systems	Un	1,2,3,5,11,12	1
5.	Understand aircraft electrical systems and aircraft testing	Un	1,2,3,5,11,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. -Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests. -Lack of minimum score in IA test will make the student Not Eligible for SEE -Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√	√		√						√	√	√		
3	√	√	√		√						√	√	√		
4	√	√	√		√						√	√	√		
5	√	√	√		√						√	√	√		
ick 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	Basic of Aircraft design, systems and testing	Aerospace	Maintenance Engineer , Testing Engineer

A K Nakkala
Name & Signature of Faculty members involved in designing the syllabus

Shakthi Prasad M
Name & Signature of Faculty members verifying/approving the syllabus

Integrated Vehicle Health Monitoring

Course Code	22AE751	**Course type**	OEC	**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.	Comprehend the principles, functions and practices adapted in maintenance activities of aerospace vehicles
2.	To understand the working principle of IVHM
3.	Acquire the knowledge about different types sensors used in airplane
4.	To learn the data management system of aerospace vehicles

Pre-requisites : Aircraft Materials, NDE Techniques

Unit – I	**Contact Hours = 8 Hours**

Introduction to Structural Health Monitoring (SHM):

Definition, principles, significance of SHM, steps involved in SHM, concept of safety in aerospace vehicles, basic principles of Damage Tolerance (DT) design, potential applications in civil, naval, aerospace and manufacturing engineering.

Unit – II	**Contact Hours = 8 Hours**

IVHM:

Introduction, configurations & basic structure of IVHM systems, evolution of IVHM, key technologies, examples of IVHM system, principle to integrate SHM with vehicles health, vehicle fleet health, fault detection and diagnosis, prognosis and metrics

Unit – III	**Contact Hours = 8 Hours**

Operational evaluation: Sensor technology, different types of sensors used and their locations in aircraft, piezoelectric wafer active sensors, data acquisition and cleansing procedures, elastic waves in solid structures, guided waves, data management

Unit – IV	**Contact Hours = 8 Hours**

Feature extraction methods: Basic concepts, bandwidth, signal types, convolution, identify damage sensitive properties, signal processing, Fourier and short term Fourier transform, wavelet analysis, filter response time, detectors and recorders. Analog analyzer types, State –of –Art damage identification and pattern recognition methods, feature extraction algorithm

Unit – V	Contact Hours = 8 Hours
Case studies: Concept of Condition Based Monitoring (CBM), vehicle level reasoning systems, IVHM model, Case studies: IVHM based flaw detection in Aerospace vehicle components: plates and pipes, joints, engines and avionics systems	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1.	Simulation of damage in aircraft components
2.	Signal analysis and condition monitoring
3.	Case studies of damage tolerance design
4.	Recent developments and regulation in safety aspects of aerospace vehicles

Books	
	Text Books:
1.	Gopalkrishnan S, Ruzenne M, Hanagud S, Computational Techniques for Structural Health Monitoring, Springer, 2011
2.	Staszewski W J, Boller C, Tomlinson G R, Health Monitoring of Aerospace Structures: Smart Sensor Technologies and Signal Processing, John Wiley & Sons, 2003
3.	Ian K Jennions, Integrated Vehicle Health Management: The Technology, SAE International, 2013
	Reference Books:
1.	Worden K, Dulieu-Barton J M, An overview of intelligent fault detection in systems and structures, International Journal of Structural Health Monitoring, 2004
2.	NASA technical report, A concept of operations for an integrated vehicle health assurance system, NASA/TM—2013-217825, 2013
3.	
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Mr. Shriram Vasudevan, Integrated Vehicle Health Management with Blockchain for Aircraft, Team ChainOsys https://www.youtube.com/watch?v=nmwXP8b3d1s
2.	Dr. A. K. Gosh, Aircraft Maitenance, IIT Kanpur https://nptel.ac.in/courses/101104071

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Impact of trust, human factors, and evidential integrity in system development.	Un	1,2	1
2.	Taxonomy of IVHM, as well as basic principles	Ap	1,2	1
3.	Search for the root cause of the fault and simulation of damage	Ap	1,3,5, 10	2
4.	Implementation of IVHM in real life situations	An	1,5,12	2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100
-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks. **-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.** **-Lack of minimum score in IA test will make the student Not Eligible for SEE** **-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√											√	√	
3	√	√	√		√					√			√	√	
4	√				√							√	√	√	
ick 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	Health and Usage Monitoring Systems (HUMS)	Data sciences AI & ML	Data Analyst
2	Systems engineering and quality management	Aerospace, Mechanical, Civil and Marine Engineering	MRO Engineer

Lokamanya Chikmath
Name & Signature of Faculty members involved in designing the syllabus

Shakthi Prasad M
Name & Signature of Faculty members verifying/approving the syllabus

Basics of Flight Simulation

Course Code	22AE752	**Course type**	OEC	**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.	Comprehend the detailed overview of Basics of Flight simulation.
2.	Impart the knowledge of Aerodynamics and stability of Aircrafts.
3.	Impart the knowledge of stability and control of Heavier than Air Flights.

Pre-requisites : Engineering Mathematics and Mechanics

Unit – I	**Contact Hours = 8 Hours**
Introduction, System Dynamics, The Changing Role of Simulation, The Concept of Real-time Simulation, Pilot Cues. **Flipped Class content:** Examples of Simulation	

Unit – II	**Contact Hours = 8 Hours**
Equations of Motion, Aerodynamic Model, Differential Equations, Numerical Integration, Data Acquisition, Flight Data. **Flipped Class content**: Problems in Modelling	

Unit – III	**Contact Hours = 8 Hours**
Principles of Flight Modelling, The Atmosphere, Forces, Moments, Axes Systems and Equations of Motion. **Flipped Class content:** Solving Aircraft Equations of Motion	

Unit – IV	**Contact Hours = 8 Hours**
Fundamentals of Control Systems, Flight Control Requirements, and Control Modes. Controller Design-PID **Flipped Class content**: Flight Management Systems.	

Unit – V	**Contact Hours = 8 Hours**

Principles of Navigationm, Primary Flight Information, Inertial Navigation Systems,GPS, Automatic Direction Finding (ADF), VHF Omnidirectional Range (VOR), Distance Measuring Equipment (DME), Instrument Landing Systems (ILS). **Flipped Class content**: 3D Graphics Operations, Real-time Image Generation.

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1.	Training versus Simulation
2.	Quaternions
3.	Trimming
4.	Head-up Displays
5.	The Flight Director

Books	
	Text Books:
1.	David Allerton, Principle of Flight Simulation, Wiley, 2009.
2.	Nelson R. C., “Flight Stability and Automatic Control”, McGraw Hill Education; 2 edition (1 July 2017), ISBN-13: 978-0070661103.
	Reference Books:
1.	Nandan K. Sinha and N. Ananthkrishnan “Advanced Flight Dynamics with Elements of Flight Control” CRC Press 2017.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	**Describe** the basics of flight simulation	Un	1	1,2
2.	**Solve** Aircraft Equation of motion.	AP	1,2,3	1,2
3.	**Analyze** the importance of flight simulation in developing process of Aircrafts.	An	1,2,3,5	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√	√	√										√	√	
3	√	√	√		√								√	√	
ick 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	Knowledge about Flight simulator	UAV, Aircraft and Space	Flight simulation Engineer,

	Design.	sector	
2	Design and Analysis of Control systems for Flight vehicles	UAV, Aircraft and Space sector	Control system Engineer

A K Nakkala

Name & Signature of Faculty members involved in designing the syllabus

P P Katti

Name & Signature of Faculty members verifying/approving the syllabus

Airline and Airport Operations

Course Code	22AE753	**Course type**	OEC	**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

Unit No.	Self-Study Topics
1.	Divisions of ATC
2.	GLONAS, PBN
3.	SSR Operations in Defence
4.	ARFL for various Aircrafts
5.	Different PAPIs and ILS systems

	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
	Reference Books:
1.	"PANS RAC ICAO DOC 4444", Latest Edition, The English Book Store, 17-1, Connaught Circus, New Delhi.
2.	
3.	
	E-resources (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.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Illustrate basic concepts of Air Traffic Control.	Un	1	1

2.	Compare the various air traffic systems.	Un	1	1
3.	Describe flight information systems and subsystems.	Un	1	1
4.	Quantify Aerodrome Data.	Un	1	1
5.	Recognize Navigation and other services of aircraft systems.	Un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	✓												✓		
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 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

D A Ponnaswami
Name & Signature of Faculty members involved in designing the syllabus

I V Patil
Name & Signature of Faculty members verifying/approving the syllabus

Air breathing Engines

Course Code	22AE754	Course type	OEC	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 of IC engines.
2.	Gain the knowledge of gas turbine and their working principle
3.	Understand the working principle of aircraft power plants
4.	Learn the theory behind gas turbine working
5.	Acquire the knowledge about various material used in air breathing engines.

Pre-requisites : Thermodynamics

Unit – I	Contact Hours = 8 Hours
Classification, I.C. Engines parts, 2 and 4 stroke petrol and 4-stroke diesel engines. P-V Diagrams of Otto and Diesel cycles. Simple problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency and specific fuel consumption	

Unit – II	Contact Hours = 8 Hours
Gas turbines: Classification, Working principles and Operations of Open cycle and closed cycle gas turbines. Aircraft power plants, classification based on power plant and location and principle of operation. Materials used in IC engines, gas turbine engines, applications of super alloys; nickel alloys, titanium alloys and ceramics, composites.	

Unit – III	Contact Hours = 8 Hours
Aircraft power plants – basic principles of piston, jet engines; radial piston engines, turbojet engine, turboprop engine, turbofan engine, turbo shaft engine, ram jet and scram jet. Brayton cycle and its application to gas turbine engines; use of propellers and jets for production of thrust, Advance engines and simple problems.	

Unit – IV	Contact Hours = 8 Hours
Gas Turbine: Induction, exhaust and cooling systems, anti-icing of engine, engine mountings, thrust augmentation. Compressor surge and stall, bleed control system. Principles of operation, general constructional details and functions of fuel and oil systems, ignition and starting systems and their components. Engine controls of various types, including Full Authority Digital Electronic Control Engine instruments. Power augmentation devices, thrust reversers and auxiliary power units.	

Unit – V	Contact Hours = 8 Hours
Engine Maintenance: Piston/Gas Turbines: Periodical servicing procedures, engine installation checks, control rigging, ground running checks, priming, bleeding and Performance checks. Engine on condition maintenance. Trouble shooting and rectification. Inspection after shock landing. Crack detection. Procedure for long and short terms storage of engine and accessories, engine preservation and depreservation.	

Flipped Classroom Details

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

Unit No.	Self-Study Topics
1.	Classification, I.C. Engines parts, 2 and 4 stroke petrol and 4-stroke diesel engines
2.	Operations of Open cycle and closed cycle gas turbines
3.	Basic principles of piston, jet engines
4.	Full Authority Digital Electronic Control Engine instruments. Power augmentation devices, thrust reversers and auxiliary power units.
5.	Engine preservation and depreservation.

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, 978007068192
3.	H Cohen, G F C Rogers and H I H Sarvanmutto, Gas Turbine Theory, John Wiely
4.	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
	Reference Books:
1.	Hill, P.G. & amp; Peterson, C.R., "Mechanics & Thermodynamics of Propulsion" Addison –Wesley Longman INC, 1999, ISBN-13: 978-0201146592.
2.	Michacl J. Krose Thomas W.Wild, Bent, Aircraft Power Plants, McGraw Hill 1994
3.	
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	NPTEL: Online Resources: Lecture by: Prof. BhaskarRoy , 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.	Assignment- Open/Industry/Certification

3.	Flipped Classes	3.	Course Project
4.	Online classes	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.	Explain the basic principle of IC engines and illustrate the working principle of gas turbine	Ap	1	1
2.	Describe the working principle of aircraft power plants and compare various material used in air breathing engines.	Ap	1	1
3.	Demonstrate Periodical servicing procedures of Engine Maintenance	Ap	1	1
4.	Explain various systems of gas turbine engines	Un	1	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of at least 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE 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 ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

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	√												√		

3	√												√		
4	√												√		
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 Knowledge about Gas turbine and IC engines	Maintenance, Propulsion	Maintenance engineer, Service Engineer, Technical Publication consultant

I V Patil
Name & Signature of Faculty members
involved in designing the syllabus

P M Banakar
Name & Signature of Faculty members
verifying/approving the syllabus

Indian Knowledge System

Course Code	22AE77	**Course type**	**HSMS**	**Credits L-T-P**	1– 0 – 0
Hours/week: L – T- P	1 – 0 – 0			**Total credits**	1
Total Contact Hours	L = 15Hrs; T = 0 Hrs; P =0 Hrs Total = 15 Hrs			**CIE Marks**	100
Flipped Classes content	**03 Hours**			**SEE Marks**	--

Course learning objectives	
1.	To understand the importance of ancient knowledge to a society and familiarize with vedas and vedangas
2.	To understand the concepts of science and technology in ancient India

Pre-requisites: Nil

Unit – I	**Contact Hours = 5 Hours**
Importance of ancient knowledge and IKS. IKS corpus – a classification framework, history and unique aspects of IKS. Introduction to vedas and vedangas, vedic life. Indian philosophical systems – development and unique features, vedic schools of philosophy. Panchatantra – puranas and itihasa as a source of wisdom.	

Unit – II	**Contact Hours = 5 Hours**
Foundational concepts for science and technology – importance & role of Sanskrit in Natural language processing, stages of speech in Sanskrit vocabulary, number system in India, salient features of numerical system- measurement for time, distance & weight.	

Unit – III	**Contact Hours = 5 Hours**
Science, Engineering and Technology in IKS – unique aspects of Indian Mathematics and astronomy, functions in Mathematics, historical development of astronomy, elements of Indian calendar. The rise and fall of great Indian technology, mining, metal working, alloys in India Irrigation practices and architecture in India	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**
No. for Flipped Classroom Sessions	**1**	**1**	**1**

Books	
	Text Books:
1.	B. Mahadevan, V. R. Bhat and R. N. Nagendra Pavana, “Introduction to Indian Knowledge system - Concepts and Applications”, PHI, 2023

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 Assignments (OA)
4.	Online classes	4.	

Course Outcomes (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** the importance of ancient knowledge to a society and familiarize with vedas and vedangas	**Un**	**6,7**	**1**
2.	**Understand** the fundamental concepts of science and technology in ancient India	**Un**	**6,7**	**1**

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Addition of two Assignments	Case study/Activity	Total Marks
Marks	30+30 = 60	10+10 =20	20	100
- Writing 2 IA tests are compulsory. **-Student should score minimum 40% of 100 marks to pass the course.**				

CO-PO Mapping (Planned) [tick mark relevant ones]													**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						✓	✓						✓		

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Annexure –I

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
		22AE591	National Service Scheme (NSS)	NSS coordinator								
10	MC	22AE592	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor	0	0	2		0	100	-	100
		22AE593	Clubs-Social, Cultural & Academic	Coordinators								

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
		22AE681	National Service Scheme (NSS)	NSS coordinator								
8	MC	22AE682	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor	0	0	2		0	100	--	100
		22AE683	Clubs-Social, Cultural & Academic	Coordinators								

SPORTS/ NSS/ CLUB/ CHAPTER SYLLABUS FOR 2021/2022 SCHEME

ACM STUDENT CHAPTER

<table>
<tr><td>Course Code</td><td>21AEC75/ 22XXXXX</td><td>Course type</td><td>AEC/MC</td><td>Credits L-T-P</td><td>0 – 0- 2</td></tr>
<tr><td>Hours/week: L-T-P</td><td colspan="3">0 – 0 – 2</td><td>Total credits</td><td>1- 21 scheme
0- 22 scheme</td></tr>
<tr><td rowspan="2">Total Contact Hours</td><td colspan="3" rowspan="2">L = 0Hrs; T = 0Hrs;P = 2Hrs
Total = 20Hrs</td><td>CIE Marks</td><td>100</td></tr>
<tr><td>SEE Marks</td><td>--</td></tr>
</table>

Course learning objectives	
1.	Promote technical and professional development of students
2.	Foster a sense of community and collaboration
3.	Encourage research and innovation
4.	Promote diversity and inclusion

Pre-requisites : nil

One week workshop on data analytics	**Contact Hours = 25 Hours**

Details of the Activity

The Data Analytics Workshop is a comprehensive one-week program designed to equip students with essential skills and knowledge in the field of data analytics. This workshop aims to introduce students to the fundamentals of data analysis, statistical techniques, data visualization, and machine learning algorithms. By the end of the workshop, participants will gain practical experience in working with data, analyzing insights, and making data-driven decisions. The workshop will end with students solving a data analytics problem given by the industry personnel

Ignite: 24 hours Hackathon	**Contact Hours = 24 Hours**

Ignite is a thrilling 24-hour hackathon that aims to bring together aspiring engineers and innovators to explore and tackle emerging trends in the field of engineering. This high-energy event provides participants with a platform to showcase their creativity, problem-solving skills, and technical expertise. Throughout the hackathon, participants will collaborate in teams to develop innovative solutions that address real-world challenges posed by the latest trends in engineering.

ExploreTech: Awareness Sessions on Recent Technologies for School Students by Engineering Students	**Contact Hours = 10 Hours**

Details of the Activity

ExploreTech is a dynamic initiative aimed at introducing school students to recent and emerging technologies, empowering them to embrace and understand the rapidly evolving digital world. Led by enthusiastic engineering students, these awareness sessions provide an engaging platform for students to explore cutting-edge technologies such as artificial intelligence, Internet of Things (IoT), virtual reality, robotics, and blockchain. Through interactive demonstrations, discussions, and hands-on activities, ExploreTech sparks curiosity and inspires students to pursue careers in STEM fields.

Tech Quest	Contact Hours = 08 Hours
Details of the Activity **TechQuest is an exhilarating event that combines the thrill of a treasure hunt with the excitement of technology. It challenges participants to solve a series of technical puzzles, riddles, and challenges to unlock clues and navigate their way to the ultimate treasure. TechQuest provides a unique platform for participants to showcase their problem-solving abilities, technical knowledge, and teamwork skills while fostering a spirit of friendly competition and innovation.**	

Tech Expo	Contact Hours = 20 Hours
Details of the Activity **TechExpo is an event that celebrates the wonders of technology through an immersive and captivating experience. It brings together enthusiasts, professionals, and industry leaders to showcase the latest advancements, cutting-edge innovations, and future possibilities across various technical domains. TechExpo offers a unique platform for attendees to explore, learn, and engage with the forefront of technology in an interactive and awe-inspiring setting.**	

Books	
	Text Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
3.	
4.	
	Reference Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learninglevel.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand, Analyze and apply** the latest advancements, trends, and concepts in their specific technical domain.	Un, An, Ap	1,2,3,5,8,9,10,12	

2.	Effectively**communicate** their ideas, collaborate with others, and articulate their **understanding** of the technical concepts presented.	Un, Cr,Ap	1,2,3,5,6,8,9,10,12	
3.				
4.				

Scheme of Continuous Internal Evaluation (CIE):

Components	Development of solution/ presentation	Report	Total Marks
Marks	50	50	100

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	
2	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓	✓
3															
4															
5															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Astronomy club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs;P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To learn about stellar maps
2.	To learn about the sun and the moon
3.	To study motion of planets and their satellites
4.	To study deep sky objects

Pre-requisites :

Activity– IStellar maps	Contact Hours = 12 Hours
Learn about the stellar maps, celestial coordinates	

Activity– IIOptics of telescope	Contact Hours = 12 Hours
Study the optics and types of telescopes. To learn about different types of telescope	

Activity– IIIThe sun and the moon	Contact Hours = 12 Hours
Observation of the sun, sunspots, moon, lunar craters.	

Activity– IVPlanets	Contact Hours =12 Hours
Study of motion of planets and observation of planets.	

Activity– VStar clusters and nebula	Contact Hours = 12 Hours
Study and observation of nebula and star clusters.	

Books	
	Text Books:
1.	Frank Shu, The physical Universe
	Reference Books:
1.	H. Karttunen. Fundamental Astronomy, Springer

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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 constellations and stars**	Re	1	

2.	**Understand motion of the celestial objects and its observation process**	Un	1	
3.	**Understand the motion and nature of the stars and planets**	Un	1	
4.	**Understand the nebula and galaxies**	Un	1	

Scheme of Continuous Internal Evaluation (CIE):

Components	Activity report - 1	Activity report 2	Activity report - 3	**Activity report -4**	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1															
2															
3															
4															
5															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Club Title: The Changemaker's' Society Student Chapter

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs;P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Identify the needs and problems of the society and finding solutions to the same.
2.	To achieve the United Nations Sustainable Development Goals (SDGs).
3.	To promote the importance of recycling and sustainability.
4.	To aid students in improving certain qualities like communication, decision making, problem solving, creativity and teamwork.

Pre-requisites:

1. Students should have a mindset to bring about a social and sustainable change in the society.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should possess problem solving and teamwork mindset.

Activity– I: Water Management	Contact Hours= 20 Hours

Details of the Activity –

1. Proposing solutions for better water management and ways to increase ground water levels.
2. Collaborating and volunteering for water rejuvenation projects.

Activity– II: Rural Survey	Contact Hours= 20 Hours

Details of the Activity –

1. **Carrying out survey in rural areas about the various government schemes.**
2. **Making list of people who do not own a voter ID card and explaining them the importance of voting.**
3. **Data of the various occupation and suggesting the modern techniques that can be used in the respective field.**

Activity– III: Sustainability	Contact Hours= 20Hours

Details of the Activity –

1. To promote sustainable products.
2. In order to reduce plastic consumption, promoting use of cotton, cloth bags.
3. Importance of reusing existing products.

Activity– IV: Women Empowerment	Contact Hours= 20 Hours

Details of the Activity–

1. Promoting the importance of women in technical workspace.
2. Conducting events surrounding empowering women.
3. Importance of girl child education.

Activity– V: Digital Commerce	Contact Hours= 20 Hours

Details of the Activity –
1. **Survey on the usage of instant real time payment systems like UPI.** 2. **Encouraging people to carry out trade and commerce through online digital platforms.**

Books	
	Text Books:
1.	**Meenakshi P., "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi (2006).**
2.	**"SustainabilityEngineering:Concepts,DesignandCasestudies",PrenticeHall,1stEdn,2015**
	Reference Books:
1.	**Ni bin Chang, "System Analysis for sustainable Engineering: Theory and applications", McGraw Hill Publications,1stEdn.,2010**
2.	**ToolseeramRamjeawon,"IntroductiontoSustainabilityforEngineers", CRCPress,1stEdn.,2020.**
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	**--**

Course delivery methods		**Assessment methods**	
1.	**Chalk and Talk**	1.	Competition
2.	**PPT and Videos**	2.	Activity presentation
3.	**Activity**	3.	Online Quizzes (Surprise and Scheduled)
4.	**Demo/Training**	4.	Seminar/Surveys/Assignments
		5.	IA tests

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.	**To understand the importance of environment and water crisis**	**2**	**1,6,7**	**1**
2.	**ApplicationofSustainableEngineeringConceptsandPrinciplesinEngineering**	**2**	**1,6,7**	**1**

Scheme of Continuous Internal Evaluation (CIE):

Components					**Total Marks**
Marks					100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**

2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓					✓	✓						✓		
2	✓					✓	✓						✓		
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Computer Society of India

<table>
<tr><td>Course Code</td><td>21XXXXX/
22XXXXX</td><td>Course type</td><td>AEC/MC</td><td>Credits L-T-P</td><td>0 – 0- 2</td></tr>
<tr><td>Hours/week: L-T-P</td><td colspan="3">0 – 0 – 2</td><td>Total credits</td><td>1- 21 scheme
0- 22 scheme</td></tr>
<tr><td rowspan="2">Total Contact Hours</td><td colspan="3" rowspan="2">L = 0Hrs; T = 0Hrs;P = 2Hrs
Total = 20Hrs</td><td>CIE Marks</td><td>100</td></tr>
<tr><td>SEE Marks</td><td>--</td></tr>
</table>

	Course learning objectives
1.	**Identify needs and problems of the society and help them in resolving the same.**
2.	**To impart the computer knowledge to school students.**
3.	**Make the students industry ready by involving them in various technical competitions.**

Pre-requisites: NIL

Activity– I	**Contact Hours = 5 Hours**

1. e-Shrama of Central Government (15M): Students go to various Rural areas and New Building/Apartment Construction areas and help the needy people to get registered to the e-Shrama portal of Central Government.
2. Poster making and Presentation (10M):Students need to come up with creative ideas in line with the themes given, make digital/handmade poster for the same and present.

Activity– II	**Contact Hours =5 Hours**

3. Project Shiksha (15M): Students visits various Government schools and disseminate the computer knowledge to school students in different medium of languages.
4. **Web Design (10M):** Students will be asked to design a website for the real world or open-ended problem given to them.

Activity–III	**Contact Hours = 5 Hours**

4. Coding (25M): Competition for students, where they have to code in C/Python/Java language for the problem statement given to them.

Activity– IV	**Contact Hours = 5 Hours**

6. Hackathon (25M): It isa social coding event that brings computer programmers and other interested people together to improve upon or build a new software program.

	Books
	Text Books:
1.	David Griffiths, Head First C: A Brain-Friendly Guide, Shroff, 1st edition
2.	Gerardus Blokdyk, Hackathon A Complete Guide - 2021 Edition
	e-Resources:
1.	https://onlinecourses.swayam2.ac.in/ugc23_ge04/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	Report Writing

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.	Leadership and team work qualities will be **developed** among students	L3	9, 10, 12	1, 3
2.	**Evaluate** students by using technical skills to address societal issues	L5	1, 2, 3 ,4, 6, 8, 12	1, 2, 3
3.	Allows the concrete **deployment** of new ideas to be organized	L3	1, 2, 3, 12	1, 3
4.	**Enhancement** of professional and technical skills of the students	L4	1,2,3,5,9,10, 12	1, 3

Scheme of Continuous Internal Evaluation (CIE):

Components	**Activity– I**	**Activity–II**	**Activity–III**	**Activity– IV**	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1									√	√		√	√		√
2	√	√	√	√		√		√				√	√	√	√
3	√	√	√									√	√		√
4										√		√	√		√
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Detailed Syllabus Template
Fluid Power Society of India

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs;P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To develop skilled Fluid Power human resources
2.	To Nurture integrity, creativity and entrepreneurship
3.	To create and sustain a Fluid Power community in which students acquire knowledge and skills to apply it professionally with due consideration for ethical, ecological, and economic issues

Pre-requisites :

Activity– I	**Contact Hours = 4 Hours**
Industry visit to Fluid Power industries in and around Belgaum. Internship opportunities in Fluid Power industries. Participation in seminars/webinars related to Fluid Power	

Activity– II	**Contact Hours = 4 Hours**
Visit to schools and teaching the students the basics of Fluid power with mini projects and models.	

Activity– III	**Contact Hours = 4 Hours**
Visit to diploma colleges to organize competitions/projects related to Fluid Power where in the diploma students will get chance to develop their skills, knowledge and their leadership qualities.	

Activity– IV	**Contact Hours =4Hours**
Participation in the Fluid power challenge organized by FPSI. The Fluid Power Challenge is an annual competition platform opened to Engineering students which expands the opportunity for students to apply the concepts of fluid power and come up with innovative design ideas.	

Activity– V	**Contact Hours = 4 Hours**
Community service activity – visit to old age homes, orphanages etc. spending time with the kids and old age people doing some meaningful activities and donations.	

Course delivery methods		**Assessment methods**	
1.	PPT and Videos	1.	Competition

2.	Activity	2.	Activity presentation
4.	Demo/Training	4.	Seminar/Surveys/Assignments

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. To Promote Fluid Power technology and foster an innovative environment for the Fluid Power industry	L2	6,9,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Activity 1 (Attendance &Report)	Activity 2 (Attendance & Report)	Activity 3 (Attendance & Report)	Activity 4 (Attendance & Report)	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics:Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						√			√	√			√		
Tick mark the CO, PO and PSO mapping															

Prof. Prajakta Patil

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

IEEE Power and Energy Student Chapter

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0Hrs; T = 0Hrs;P = 2Hrs Total = 20Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To arrange regular events on the campus specifically dealing with the latest technologies
2.	To strive towards achieving more IEEE-sponsored awards and aim at representing papers in international conferences
3.	To work towards inspiring more students to become members and increase Membership Retention, through the benefits of IEEE
4.	To increase the students interest in publishing technical articles and participation in the technical events.

Pre-requisites :

Activity– I Introduction to Power and Energy Systems	**Contact Hours = 4 Hours**
Overview of power and energy systems, including power generation, transmission, distribution, and utilization. Introduction to the electric power industry, its structure, and key stakeholders. (Industrial visit)	

Activity– II Power System Analysis	**Contact Hours = 4 Hours**
Fundamentals of power system analysis, including power flow analysis, fault analysis, and stability analysis. Introduction to software tools used for power system simulation and analysis. (Technical quizzes)	

Activity– III Renewable Energy Technologies	**Contact Hours = 4 Hours**
Study of various renewable energy sources, such as solar, wind, hydro, and biomass. Analysis of renewable energy integration into the grid, energy storage systems, and emerging trends in renewable energy technologies. (Model making competition)	

Activity–IV Emerging Technologies and Trends	**Contact Hours = 4 Hours**
Exploration of emerging technologies and trends in the power and energy sector, such as electric vehicles, energy storage systems, microgrids, and distributed energy resources. Discussion on their impact on the power system and future energy landscape. (Poster presentation)	

Activity– V Professional Development and Networking	**Contact Hours= 4Hours**

Activities focused on professional development, including workshops, seminars, and guest lectures by industry experts. Opportunities for networking, knowledge sharing, and collaboration with fellow PES members and professionals in the power industry.(Expert talks)

Books	
	Text Books:
1.	"Power System Analysis" by John J. Grainger and William D. Stevenson Jr.
2.	"Distributed Generation and its Implications for the Utility Industry" by Fereidoon P. Sioshansi.
3.	IEEE PES bimonthly magazines
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://ieee-pes.org/
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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.	Students will acquire a solid understanding of power system components, operation, and control. They will learn about power generation, transmission, distribution, and utilization, including topics such as power flow analysis, fault analysis, stability analysis, and protection schemes.	Ap	1,3,5,9,10	1,3
2.	Students will be introduced to energy storage technologies and their applications. They will learn about different types of energy storage systems, such as batteries, flywheels, and pumped hydro storage. They will understand the role of energy storage in grid stabilization, peak shaving, renewable energy integration, and microgrid applications.	Ap	1,3,5,9,10	1,3
3.	Students will develop problem-solving and analytical skills through practical exercises, case studies, and hands-on projects. They will learn to analyze and address power system problems, perform simulations, and apply relevant tools and techniques to optimize power system performance.	Ap	1,3,5,9,10	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Activity-1	Activity-2	Activity-3	Activity-4	Total Marks

Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓		✓				✓	✓			✓		✓
2	✓		✓		✓				✓	✓			✓		✓
3	✓		✓		✓				✓	✓			✓		✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

INDIAN RED CROSS SOCIETY (IRCS)

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0Hrs; T = 0Hrs;P = 2Hrs Total = 20Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Enrich the spirit of democratic living.
2.	Uphold the needs and values for selfless services
3.	Learn to appreciate other man's point of view
4.	Realize the welfare of individual dependence of the welfare of the society.

Pre-requisites: Rational Mind, heart of gold, hale hearty body and culturally sound.

Activity– IENVIRONMENTAL ENRICHMENT & CONSERVATION	**Contact Hours =**

Details of the Activities:

1. Plantation of saplings [their preservation & upkeep/maintenance]
2. Environment awareness seminars and workshops [create consciousness]
3. Cleaning of villages/ neighborhood wells, ponds & lakes
4. Prevention of soil erosion [soil conservation]
5. Preservation of cultural heritage [protect & upkeep of monuments / create awareness]

Activity– IIHEALTH, NUTRITION & FAMILY WELFARE PROGRAMS	**Contact Hours =**

Details of the Activities:

1. Health Education / Child development programs [primary health care]
2. Nutrition Programs [Medical college or home science]
3. Clean drinking water programs
4. Medico social Surveys [Cases of malaria, Covid, etc.]
5. Blood Donation camps

Activity– IIISOCIAL SERVICE PROGRAMS	**Contact Hours =**

Details of the Activities:

1. Day camp at Hospital/ Old Age [cheer patients / old aged, hobby activity, etc.]
2. Work with NGOs of child welfare.
3. Work in institute for physically handicaps or orphanage
4. Cleaning of slums

Activity– IVWOMEN EMPOWERMENT PROGRAMS	Contact Hours =

Details of the Activities:

1. Educating women about their constitutional & legal rights [both literate & illiterate]
2. Women's contributions to economic & social well-being of the community programs
3. Awareness programs to show all occupations are open to them [Rural women]
4. Training programs / workshops to rural, illiterate, unskilled, unemployed [Tailoring-sewing]

Activity– VEMERGENCIES PROGRAMS / CALAMITIES	Contact Hours =

Details of the Activities: **[Indian Red Cross Society Related Activities]**

1. Assist Govt Depts/ NGOs in distribution of medicines, cloths, grocery, etc.
2. Help Health authorities in immunization & inoculation
3. Work with people in reconstruction [houses, roads, etc.]
4. Support the local authorities in rescue & relief work
5. Collection of cloths, food, etc send them to affected areas

Books	
	Text Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	VTU Handbook
3.	
4.	
	Reference Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		Assessment methods	
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Activity Annual Report
4.	Training/workshops/seminars	4.	

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.	Cater to develop the holistic and integrated persona	Un	2	
2.	Grow passion and compassion for selfless community service	Un	2	
3.	Connect the different peer groups.	Un	3	
4.	Constitutes a bond of patriotism, national integration & communal harmony			

Scheme of Continuous Internal Evaluation (CIE):

Components	III sem	IV sem	V sem	VI sem	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1															
2															
3															
4															
5															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

The Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE)

Course Code	**21XX83**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs;P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Students should identify the technical problem of the society and able to give solutions.
2.	Students should build technical abilities to serve the society.
3.	Students should be ready to sacrifice some of the time and wishes to achieve targets on time.

Pre-requisites: Communication skill, Environmental and safety awareness.

Activity– I Education	**Contact Hours = 4 Hours**
Awareness of latest technologies and development in the rural areas on Design thinking, Net zero energy building, Human comfort * Latest electromechanical devices and Computer literacy.	

Activity– II Agriculture/Food industry	**Contact Hours = 4 Hours**
Visit to the nearby farm and providing alternate solutions Identifying the role of Engineers to support the farmers in their basic needs of food items preservationand pests control in farming locations and transportations, Improvement in the existing control system of farming/food industry through the solutions in the above said fields*.	

Activity–III Refrigerants and HVAC like systems	**Contact Hours = 4 Hours**
Creating technical awareness for high school/ diploma students regarding HVAC system requirements by workshops, Its proper selection and maintenance as per standards, Hazards, comfort, safety etc*.	

Activity– IV Solar/Renewable energy utilization	**Contact Hours = 4 Hours**
Importance of solar/wind in the buildings. Eco friendly solar/wind etc-applications like in refrigeration, HVAC systems etc * Solar/wind power stations in the buildings or village areas	

Activity– V Health	**Contact Hours = 4Hours**
Visit one of the medical hospital Identify the role of Engineers in medical field, ***Preparing any required comfortable equipment plan/model/report/project in Refrigeration/Heating/Cooling systems from used components or new components (*common for all activities planned).**	

Course delivery methods	**Assessment methods**

Components	2	2	2	**2**	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100 **Any Two activities- 100 marks**					

1	Visits	1.	Competition
2	Demo/Training	2.	Activity presentation
3	Activity	3	Seminar/Surveys/Assignments
		4	Report preparation

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 technical knowledge to create awareness in improving the society.**	3	1,10	1
2.	**Understand the importance of his / her responsibilities towards society.**	2	2	1
3.	**Apply the engineering skills and develop the multidisciplinary approaches in sharing knowledge and creating models/projects/technical reports.**	3		1

Scheme of Continuous Internal Evaluation (CIE):

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	√					√				√			√		
2		√				√	√		√	√			√		
3			√			√			√	√			√		
Tick mark the CO, PO and PSO mapping															

Prashant Kakkamari
Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Indian Society for Technical Education

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To enhance students' skills like practical knowledge, problem-solving abilities, communication skills, leadership qualities, and teamwork capabilities.
2.	To bridge the gap between theoretical learning and practical applications, exposure to real-world engineering practices.
3.	To facilitate students with career guidance and placement support.
4.	To inculcate societal concern, by addressing societal problems.

Pre-requisites : NIL

Activity– I: Skill development (25M)	**Contact Hours = 5Hours**

The chapter focuses on developing technical and non-technical skills of students. Organizing workshops, seminars, and training programs to enhance students' practical knowledge, problem-solving abilities, communication skills, leadership qualities, and teamwork capabilities.

Technical events and competitions:

Organizing technical events, competitions, and project exhibitions to promote innovation, creativity, and technical expertise among students. These events provide students with opportunities to showcase their skills, work on challenging projects, and learn from their peers.

Activity– II: Industry interaction (25M)	**Contact Hours = 5Hours**

Encouraging interaction and collaboration between students and the industry. It facilitates industrial visits, internships, and guest lectures by industry experts to bridge the gap between theoretical learning and practical applications, and to provide students with exposure to real-world engineering practices.

Activity– III : Career guidance and placement support (25M)	**Contact Hours = 5Hours**

The chapter assists students in their career planning and provides guidance for higher studies and job placements. It conducts sessions on resume building, interview preparation, and soft skills development to enhance students' employability.

Activity– IV: Social and community initiatives (25M):	**Contact Hours = 5Hours**

Promoting social responsibility and community engagement among students. Students will participate in social welfare activities (Blood Donation Camp), environmental initiatives (Plantation Drive), and technical outreach (Digital Literacy for School Children) programs that benefit society.

Books	
	Text Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
3.	
4.	
	Reference Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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.	**Develop** technical skills in their area of interest.	Ap	1,2,3,5	1,2
2.	**Identify** the gap between theoretical learning and practical applications.	Ap	1,2,3,5	1,2
3.	**Examine** the soft skills to enhance employability	An	1,2,3,5	1,2
4.	**Solve** the social and environmental concerns by **applying** and **analyzing** the technical skills.	Ap, An	1,2,3,5,6,7,8,9	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	**Activity– I**	**Activity–II**	**Activity–III**	**Activity– IV**	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓	✓		✓								✓	✓	
2	✓	✓	✓		✓								✓	✓	
3	✓	✓	✓		✓								✓	✓	
4	✓	✓	✓		✓	✓	✓	✓					✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

1. **Dr. Sharada M. Kori**

Cultural club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To provide understanding of concepts of Cultural Events: Music, Dance, Public speech, Fine Arts, Literary Etc

Pre-requisites :Basic Knowledge of Cultural Events

Activity– I (Title)	**Contact Hours = 4 Hours**

Details of the Activity

1. Performing a group Song/Dance (Any song which includes beautiful chorus)
2. Performing on Theme based songs.

Activity– II (Title)	**Contact Hours = 4 Hours**

Details of the Activity

General Knowledge Quiz activity:

Round 1: History and Geography ,Round 2: Science and Technology

Round 3: Literature and Arts, Round 4: Sports and Entertainment

Activity– III (Title)	**Contact Hours = 4 Hours**

Details of the Activity

activities for a public speaking:

1)Impromptu Speaking 2)Persuasive Speech

Activity– IV (Title)	**Contact Hours = 4 Hours**

Details of the Activity:

Fine Arts:

Art and its application in the real world ,Role of form in art, Principles of design in art

Aesthetics: Aestheticism in art

Understanding Indian aesthetics

History of Aestheticism and Art in India

Computer Graphics: Introduction to graphic software: Adobe Photoshop

Activity– V (Title)	**Contact Hours = 4 Hours**
Details of the Activity: **Literary** **Debate:** What is Debate Writing, Debate Writing: How to go about it, DO'S AND DONT'S Debate **EXTEMPORE** Writing Samples | Debate Writing Solved Examples. Why are they important? extempore? Extempore, Skills you need, how to succeed in extempore	

Course delivery methods		**Assessment methods**	
1.	PPT and Videos	1.	Activity presentation
2.	Activity	2.	Online Quizzes (Surprise and Scheduled)
2.	Demo/Training	3.	Seminar/Surveys/Assignments

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.	Understand ,and explore more about various aspects of Cultural events	L2	6	
2	Apply the Knowledge gained and take it as carrier	L1, L3,L4	4,8	

Scheme of Continuous Internal Evaluation (CIE):

Components					Total Marks
Marks					100
Minimum score to pass the course: 40 OUT OF 100					

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
1				✓		✓									
2								✓							
3															
4															
5															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

UHV cell

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To provide understanding of basic human values
2.	To communicate about the need for education for life

Pre-requisites : English Language, Social Studies

Activity– I (Title)	**Contact Hours = 4 Hours**
Details of the Activity Paint your thoughts about UHV Based on the Lecture by Eminent personalities, students are asked either to Paint or Sketch and present their thoughts.	

Activity– II (Title)	**Contact Hours = 4 Hours**
Details of the Activity Group discussion One particular topic will be chosen for discussion, different groups of students are made and the discussion will be held.	

Activity– III (Title)	**Contact Hours = 4 Hours**
Details of the Activity Writing skit based on Scenario given. Based on visit , lecture and discussion ,students will be asked to write a Skit/Report .	

Activity– IV (Title)	**Contact Hours =4 Hours**
Details of the Activity On particular topic students will be asked to search best video Content of the Best video will explored.	

Activity– V (Title)	**Contact Hours = 4 Hours**

Details of the Activity Sketch your thoughts about UHV Based on the Lecture by Eminent personalities, students are asked either to Sketch and present their thoughts.

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

Course delivery methods		**Assessment methods**	
1.	Paint /Sketch your thoughts about UHV	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments

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	L2	6	
2.	Understand the human values, work ethics, respect to theirs and stress management.	L1, L3	8	

Scheme of Continuous Internal Evaluation (CIE):

Components					Total Marks
Marks					100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics:Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2	PSO3
1						✓									
2								✓							
3															
4															
5															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

NATIONAL SERVICE SCHEME [NSS]

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0Hrs; T = 0Hrs;P = 2Hrs Total = 20Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Enrich the spirit of democratic living.
2.	Uphold the needs and values for selfless services
3.	Learn to appreciate other man's point of view
4.	Realize the welfare of individual dependence of the welfare of the society.

Pre-requisites: Rational Mind, heart of gold, hale hearty body and culturally sound.

Activity– IENVIRONMENTAL ENRICHMENT & CONSERVATION	**Contact Hours =**

Details of the Activities:

6. Plantation of saplings [their preservation & upkeep/maintenance]
7. Environment awareness seminars and workshops [create consciousness]
8. Cleaning of villages/ neighborhood wells, ponds & lakes
9. Prevention of soil erosion [soil conservation]
10. Preservation of cultural heritage [protect & upkeep of monuments / create awareness]

Activity– IIHEALTH, NUTRITION & FAMILY WELFARE PROGRAMS	**Contact Hours =**

Details of the Activities:

6. Health Education / Child development programs [primary health care]
7. Nutrition Programs [Medical college or home science]
8. Clean drinking water programs
9. Medico social Surveys [Cases of malaria, Covid, etc.]
10. Blood Donation camps

Activity– IIISOCIAL SERVICE PROGRAMS	**Contact Hours =**

Details of the Activities:

5. Day camp at Hospital/ Old Age [cheer patients / old aged, hobby activity, etc.]
6. Work with NGOs of child welfare.
7. Work in institute for physically handicaps or orphanage
8. Cleaning of slums

Activity– IVWOMEN EMPOWERMENT PROGRAMS	Contact Hours =

Details of the Activities:

5. Educating women about their constitutional & legal rights [both literate & illiterate]
6. Women's contributions to economic & social well-being of the community programs
7. Awareness programs to show all occupations are open to them [Rural women]
8. Training programs / workshops to rural, illiterate, unskilled, unemployed [Tailoring-sewing]

Activity– VEMERGENCIES PROGRAMS / CALAMITIES	Contact Hours =

Details of the Activities: **[Indian Red Cross Society Related Activities]**

6. Assist Govt. Depts. / NGOs in distribution of medicines, cloths, grocery, etc.
7. Help Health authorities in immunization & inoculation
8. Work with people in reconstruction [houses, roads, etc.]
9. Support the local authorities in rescue & relief work
10. Collection of cloths, food, etc send them to affected areas

Books	
	Text Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	VTU Handbook
3.	
4.	
	Reference Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		**Assessment methods**	
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Activity Annual Report
4.	Training/workshops/seminars	4.	

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.	Cater to develop the holistic and integrated persona	Un	2	
2.	Grow passion and compassion for selfless community service	Un	2	
3.	Connect the different peer groups.	Un	3	
4.	Constitutes a bond of patriotism, national integration & communal harmony			

Scheme of Continuous Internal Evaluation (CIE):

Components	III sem	IV sem	V sem	VI sem	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1															
2															
3															
4															
5															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Detailed Syllabus Template
IEEE Student Branch

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives: Student should be able to	
1.	Inculcate ethics to be applied to interact with the professionals of the society.
2.	Design the awareness programs for less privileged school kids.
3.	Plan and execute programs for societal benefits for all age groups using technology.

Pre-requisites: None

Activity– I (School Outreach Program)	**Contact Hours = 4 Hours**
2-3 sessions in 2 days' time span. Arts and Crafts related activities for 1st to 4th standard, Awareness about Health, Hygiene and Environmental Science to 5th to 7th standard, Awareness towards Technology and Engineering to 8th to 10th standard students of a government school.	

Activity– II (Environmental Services Program)	**Contact Hours = 4 Hours**
At least 2 half a day sessions of plantation drive in association with NGO or Forest Department along with training on up-keeping of the plant. Regular observation and inspection of the growth of the plant for minimum 3 months post plantation.	

Activity– III (Science and Technology project model donation)	**Contact Hours = 4 Hours**
Effective and cheap science model development using latest technology and engineering to be donated to Pre-University, Diploma and ITI institutions. Simple Science project model demonstration and donation to government schools.	

Activity– IV (Design Thinking workshop)	**Contact Hours = 4 Hours**
Empathizing and Creating solutions for societal related issues after visiting government schools, rural schools, Old age homes, orphanages etc. Approaching NGO's and Social service foundations in the society to jointly conduct survey and use Design Thinking approach to devise product or process and a solution or an idea.	

Activity– V (Social Service using Technology/Engineering)	**Contact Hours = 4 Hours**
Identifying girl students, meritorious students from government schools in the area and locality and generate a database. Through the help of NGO's, approaching government establishments who can spread awareness of the various government schemes available in terms of scholarships and funding. For old age homes, orphanages using the same service approach to make government schemes reach the actual needy	

public of the society.

Books	
	Text Books:
1.	Product Design and Development by Ulrich, Karl T., Eppinger, Steve D. and Yang, Maria C.,7th ed., McGraw-Hill Education.
	Reference Books:
1.	Design: Creation of Artifacts in Society by Prof. Karl Ulrich, U. Penn
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	Product Engineering and Design Thinking By Prof. Pranab K Dan , Prof. Prabir Sarkar | IIT Kharagpur, IIT RoparLink: https://onlinecourses.nptel.ac.in/noc23_me52/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments

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 professionalism and ethics in effective communication with authorities.**	Ap	3,4,5,6,7,8,9,10,12	2,3
2.	**Apply the designed programs for societal benefits**	Ap	3,4,5,6,7,8,9,10,12	2,3
3.	**Analyze the effectiveness of the programs conducted on the society and target audience groups.**	An	3,4,5,6,7,8,9,10,12	2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Activity 1 and 2	Activity 3	Activity 4	Activity 5	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
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	Analytical Thinking	IT, Core	Engineering and Administrative
2	Team Building	IT, Core	Team Lead, Project Manager
3	Time Management, Long-Short Term Planning	IT, Core	Team Lead, Program Manager

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Club title: Photography Club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0–0-1
Hours/ week :L-T-P	0–0 –2			**Total credits**	1-21scheme 0-22scheme
Total Contact Hours	L=0Hrs;T=0Hrs;P =2HrsTotal=20Hrs			**CIE Marks**	100
				SEE Marks	--

Courselearningobjectives	
1.	Learning the basic elements of photography.

Pre-requisites:

1. Basics of photography.
2. Creative thinking.

2.	Enhance creative thinking ability to capture photos.
3.	Understanding the different types of photography.

Activity–I:Basicsofphotography	**Contact Hours=04Hours**

Details of the Activity–

1. Session on basics of photography.
2. Learning and exploring the modern tools and accessories used in photography.

Activity–II: Society photography	**Contact Hours=04Hours**

Details of the Activity–

1. Societal needs and Impact of photography on society
2. Promoting the local vendors.

Activity–III: Village photography	**Contact Hours=04Hours**

Details of the Activity–

1. Exploring the beauty of our surroundings and people.
2. Encouraging people to plant saplings and avoid deforestation via photography.

Activity–IV: Nature/ Festival photography	Contact Hours=04Hours
Details of the Activity– 1. Capturing creative and beautiful l pictures amidst the nature. 2. Show casing the variety and importance of our culture and traditions.	

Activity–V:Buildings and Architectures photography	Contact Hours=04Hours
Details of the Activity– 1. Capturing the highlights of ancient Indian architectures. 2. Exploring new concepts of photography.	

	Books
	TextBooks:
1.	Sarvas, Risto,From Snapshots to Social Media - The Changing Picture of Domestic Photography, Springer London, 2011, XI, 199p
2.	Better Photography, Publication: Mumbai Network18 Media and Investments Ltd, 2013, 184p.
	Reference Books:
1.	Johnson, Charles S., Science for the curious photographer, Natick, Mass., A.K. Peters, 2010, x, 185 p.
	E-resourses:
1.	https://alison.com/topic/learn/68316/introduction-to-digital-photography-learning-outcomes
2.	https://www.udemy.com/topic/photography/free/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Activity presentation
2.	PPT and Videos	2.	Seminar/Field trip/Assignments
3.	Activity		
4.	Demo/Training		

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.	**Understand** the basics of photography.	Un	12	2
2.	**Capture and experience** the photos of nature, culture, people of India to promote the diversity.	Ap	6, 8, 9	2
3.	Use and **apply** the knowledge of the modern gears and accessories used in photography.	Ap	5	2

Scheme of Continuous Internal Evaluation(CIE):

Components	Activity presentation	Seminar/ Field trip/ Assignments	Total Marks
Marks	50	50	100

Rubrics: Levels	Target
1(Low)	**60%ofthestudentsscoreLessthan50%ofthetotalmarks.**
2(Medium)	**60%ofthestudentsscore50–70%ofthetotalmarks.**
3(High)	**60%ofthestudentsscoreMorethan70%ofthetotalmarks.**

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															

Prof. Tushar T. Hawal

Name & Signature of Faculty members
Involved in designing the syllabus

Name & Signature of Faculty members
verifying/approving the syllabus

Detailed Syllabus Template
RISE club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0Hrs; T = 0Hrs;P = 2Hrs Total = 20Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Leadership Skills: RISE aims to develop students' leadership abilities by providing opportunities to organize and lead club activities, manage projects, and collaborate with others.
2.	Personal Development: RISE may seek to help students enhance their personal development by encouraging self-reflection, self-awareness, and self-improvement.
3.	Networking and Social Skills: RISE could focus on fostering a strong sense of community and promoting networking among its members
4.	Cultural Awareness and Diversity: RISE may emphasize embracing and appreciating cultural diversity.

Pre-requisites :

Treasure Hunt	**Contact Hours = 8 Hours**
Details of the Activity A captivating treasure hunt event, where participants pay an entry fee that will be donated to an orphanage. This event exemplifies the values of philanthropy, community engagement, and compassion. By combining the excitement of a treasure hunt with the opportunity to contribute to a worthy cause, the event encourages participants to embrace the importance of giving back and supporting those in need. It instills a sense of empathy and highlights the power of collective action in making a positive impact on the lives of others.	

Free Vacation drive for pets	**Contact Hours = 8 Hours**
Details of the Activity A remarkable event aimed at providing free vaccinations to pets. This initiative embodies values of responsible pet ownership, animal welfare, and community service. By offering accessible and cost-free vaccinations, the event promotes the health and well-being of pets, ensuring they receive necessary protection against diseases. Additionally, it encourages pet owners to prioritize the care and safety of their furry companions, fostering a culture of responsible pet ownership.	

Plantation Drive	**Contact Hours = 8 Hours**
Details of the Activity An impactful plantation drive, exemplifying values of environmental stewardship, sustainability, and community engagement. This event aims to promote the importance of preserving and enhancing the natural environment by encouraging participants to plant trees and contribute to reforestation efforts. By actively engaging in this drive, the club fosters a sense of responsibility towards the planet, instilling values of conservation and a deeper understanding of the crucial role trees play in maintaining a healthy ecosystem.	

Blood Donation Drive	**Contact Hours = 8 Hours**
Details of the Activity a meaningful blood donation drive, embodying values of compassion, altruism, and community service. This event highlights the significance of donating blood to save lives and addresses the constant need for a steady blood supply in medical emergencies. By encouraging participants to donate blood, the club promotes a sense of empathy and care for others, inspiring individuals to contribute selflessly to the well-being of their community	

Talk on climate change	**Contact Hours = 8 Hours**
Details of the Activity an enlightening talk on climate change, showcasing values of environmental consciousness, education, and advocacy. This event aims to raise awareness about the urgent challenges posed by climate change and its impact on the planet. By hosting this talk, the club promotes a deeper understanding of the issue, encourages sustainable practices, and empowers individuals to take action in their daily lives.	

Books	
	Text Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
3.	
4.	
	Reference Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
2.	
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	
2.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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.				
2.				
3.				
4.				

Scheme of Continuous Internal Evaluation (CIE):

Components					Total Marks
Marks					100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

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															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Detailed Syllabus Template
Rotaract Club of GIT

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To develop knowledge and understanding of the needs, problems and opportunities in the community and worldwide
2.	To provide opportunities for personal and group activities to serve the community and promote understanding and goodwill toward all people.
3.	To develop professional and leadership skills

Pre-requisites :

Activity– I Disease prevention and treatment	**Contact Hours = 4 Hours**
Session of Basic Life Support (BLS)- A session to orient students with the lifesaving skills of Cardiopulmonary restitution (CPR) in order to prevent Heart Attack disease followed by practical demonstration of CPR. Visit to schools/colleges/industry to spread awareness of BLS and help people around to handle such unfortunate situations.	

Activity– II Basic education and Literacy	**Contact Hours = 4 Hours**
Visit to Government schools adopted by the Rotary E Club of District 3170 Belgaum and other local Government schools to educate the students with the basics of Computers, soft skills, personal hygiene etc.	

Activity– III Professional Development	**Contact Hours = 4 Hours**
Professional Development activities – In-house quiz competitions, soft skills development sessions, etc. Tree plantation drives, blood donation drives	

Activity– IV Health awareness campaigns	**Contact Hours =4Hours**
Campaigns on Cancer awareness, diabetes etc. Community Service activities – visit to orphanage, old age homes to celebrate festivals and to do some donations.	

Activity– V Community service	**Contact Hours = 4 Hours**

Collection/ donation of blankets, clothes etc from individuals to be distributed to the needy (workers, homeless people)

Course delivery methods		Assessment methods	
1.	PPT and Videos	1.	Competition
2.	Activity	2.	Activity presentation
4.	Demo/Training	4.	Seminar/Surveys/Assignments

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.	To **understand** the respect for the rights of others, based on recognition of the worth of each individual	L2	6,9,12	1
2.	To **apply** the idea of service above self	L3	6,9,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Activity 1 (Attendance &Report)	Activity 2 (Attendance & Report)	Activity 3 (Attendance & Report)	Activity 4 (Attendance & Report)	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

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															

Prof. Prajakta Patil

Name & Signature of Faculty members members involved in designing the syllabus

Name & Signature of Faculty verifying/approving the syllabus

Shaurya Club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0Hrs; T = 0Hrs;P = 2Hrs Total = 20Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Get Motivated to join the Indian Armed Forces and Law enforcement agencies
2.	Ready to attend competitive exams and SSB interviews
3.	Acquire leadership qualities and Effective Time Management
4.	Sense of responsibility towards Society and Country

Pre-requisites: Students should be ready to sacrifice some of the time and wishes to achieve targets on time.

Activity–Personal Security	**Contact Hours= 4Hours**
Self Defense Workshop Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony. (Use of First Aid, emergency services)	

Activity–II (Personality Development 2)	**Contact Hours= 4Hours**
Develop leadership qualities (Extempore and Public Speaking) SSB Preparation (Mock SSB) Time Management Sports Activity	

Activity– III (Entice)	**Contact Hours= 4Hours**
Helping local schools to motivate and enlighten students for CDS and other competitive exams to opt for the career in security forces and law enforcement agencies. Educating them about Agniveer Scheme.	

Activity– IV (Inspire)	**Contact Hours= 4Hours**
Motivational talks by Eminent People who working/worked in Armed Forces and Law enforcement agencies	

Activity– V (Health and Awareness)	**Contact Hours = 4**

	Hours
yoga/meditation workshop Spreading public awareness both for rural and urban population on Eco-friendly electrical appliances	

	Books
	Text Books:
1.	Ravindra Dhankar, How to face the SSB Interview Successfully, Arihant Publications Pvt.Ltd.1st Edition/2008
2.	Dale Carniage, The Art of Public Speaking, Rupa Publications India, 2018
3.	Swami Vivekanand, Meditation and its methods, Grapevine India, 2018
	Reference Books:
1.	Prakash Iyer, The Secret of leadership,Penguin India ,2013
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.ssbcrack.com/2022/08/crack-ssb-interview-on-first-try.html

	Course delivery methods		Assessment methods
1.	Visits	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Seminar/Surveys/Assignments
4.	Demo/Training	4.	Report Preparation and Submission

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.	Understand the importance of Defense Services and Law enforcement agencies towards Society	2	1,10	1
2.	Apply the leadership qualities and thinking ability to join Defense Services and Law enforcement agencies	3	9,10	1
3.	To understand the importance of health and maintain the same by meditation, yoga and sports	2	1,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Report Submission	Presentation	Organization of event	Participation in Mock SSB	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

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	√											√			
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus
Dr .Ganesh R. Chate

Name & Signature of Faculty members verifying/approving the syllabus
Dr. Vikas Ginigene

Sports

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	1– 0- 1
Hours/week: L-T-P	2 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 10 Hrs; T =0 Hrs; P = 10 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Students will learn the skills , techniques and rules of the games
2.	It will help the students stay healthy and active

Pre-requisites :

Activity – I (Title)	**Contact Hours = Total 10 hrs** **2 hrs / week Hours**

Details of the Activity

1) KABADDI

A. Fundamental skills

1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.
2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.
3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.
4. Game practice with application of Rules and Regulations.

B. Rules and their interpretations and duties of the officials.

Speed
Strength
Endurance
Agility
Flexibility

2) Athletics:-

Track Events

1.1. Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block.
1.2. Acceleration with proper running techniques.
1.3. Finishing technique: Run Through, Forward Lunging and Shoulder Shrug.

Activity– II (Title)	**Contact Hours = Total 10 hrs** **2 hrs / week Hours**

Details of the Activity 1)Kho kho A. Fundamental skills 1. Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul. 2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play. 3. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials. 2)Athletics Track- 110 and 400 Mtrs Hurdles Jumps- Long jump, High jump Throws- Shot put, Discus Throw, Javelin Throw 110 Mtrs and 400Mtrs: Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles Crouch start (its variations) use of Starting Block. Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. Long Jump: High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. Shot Put: Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Javelin Throw: Holding the javelin, Recovery (Rotation in the circle).

Activity– III (Title)	**Contact Hours = Total 10 hrs 2 hrs / week**
Details of the Activity 1)Volleyball A. Fundamental skills 1. Service: Under arm service, Side arm service, Tennis service, Floating service. 2. Pass: Under arm pass, Overhead pass. 3. Spiking and Blocking. 4. Game practice with application of Rules and Regulations B. Rules and their interpretation and duties of officials. 2)Throw ball A. Fundamental skills: Overhand service, Side arm service, two hand catching, one hand overhead return, side arm return. B. Rules and their interpretations and duties of officials	

Activity– IV (Title)	**Contact Hours = Total 10 hrs 2 hrs / week**
Details of the Activity 1) Football A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.	

2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body. 7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance- kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials. 2) Table Tennis A. Fundamental skills 1. Basic Knowledge: Various parts of the Racket and Grip (Shake Hand & Pen Hold Grip). 2. Stance: Alternate & Parallel. 3. Push and Service: Backhand & Forehand. 4. Chop: Backhand & Forehand. 5. Receive: Push and Chop with both Backhand & Forehand. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of the officials

Activity– V (Title)	**Contact Hours = Total 10 hrs** **2 hrs / week Hours**
Details of the Activity 1)Basketball A. Fundamental Skills 1. Passing: Two hand Chest Pass, Two hands Bounce Pass, One hand Baseball Pass, Side arm Pass, Overhead Pass, Hook Pass. 2. Receiving: Two hand receiving, One hand receiving, Receiving in stationary position, Receiving while Jumping and Receiving while Running. 3. Dribbling: How to start dribble, drop dribble, High Dribble, Low Dribble, Reverse Dribble, Rolling Dribble. 4. Shooting: Lay-up shot and its variations, One hand set shot, Two hands jump shot, Hook shot, Free Throw. 5. Rebounding: Defensive rebound and Offensive rebound. 6. Individual Defense: Guarding the player with the ball and without the ball, Pivoting. 7. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials 3) Handball A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jump shot, Center shot, Dive shot, Reverse shot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials	

Books	
	Text Books:
1.	Sports encyclopedia by om publications
	Reference Books:
1.	1. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani. 2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata. 3. Petipus, et al. Athlete's Guide to Career Planning, Human Kinetics. 4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.

Course delivery methods		**Assessment methods**	
1.	Training & Demo	1.	Competition
2.	Practice	2.	

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 physical skills to excel in sports events	Ap	6	
2.				

Scheme of Continuous Internal Evaluation (CIE):

Components	Activity 1	Activity 2	Activity 3	Activity 4	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

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															

Vayuputra club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Learn about the various types of Drones and its applications.
2.	Understand about the various components of drone design.
3.	Model a simple quad copter in CAD software.
4.	Able to fly the Rotary and fixed wing UAVss

Pre-requisites : Engineering Mechanics , Fundamentals of Flight

Activity– I	**Contact Hours = 04Hours**
Introduction, Types of Drones, Components of UAVs-Types of motors used for Drones.	

Activity– II	**Contact Hours = 05Hours**
Demonstration of Various Flight Control Systems	

Activity– III	**Contact Hours = Hours**
Fabrication of wings of an unmanned aerial vehicles using 3D printing/Hotwire cutting process.	

Activity– IV	**Contact Hours = Hours**
Hands on Training on Assembling and Manual Flying of UAV.	

Activity– V (Title)	**Contact Hours = Hours**
Hands on Training on Autonomous Flying of 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.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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 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
3.	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):

Components					Total Marks
Marks					100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	Target
1(Low)	60% of the students score Less than 50 % of the total marks.
2(Medium)	60% of the students score 50 – 70 % of the total marks.
3(High)	60% of the students score More than 70 % of the total marks.

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	√	√	√		√			√	√	√		√	√	√	√
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members Involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

Detailed Syllabus Template
IEI(Electrical)

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0- 2
Hours/week: L-T-P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Explain about IEI student chapter.
2.	Understand and apply LED bulb refurbishing.
3.	Understand the energy conservation and rural development concept.
4.	Analyze the technical aspect during industry visit.

Pre-requisites :

Activity– I (Title)	**Contact Hours = 4 Hours**
Brief Introduction to IEI and guest lectures.	

Activity– II (Title)	**Contact Hours = 4 Hours**
Refurbishing of fused out LED bulbs	

Activity– III (Title)	**Contact Hours = 4 Hours**
Awareness of Energy conservation to school students	

Activity– IV (Title)	**Contact Hours = 4 Hours**
Rural development themed model making	

Activity– V (Title)	**Contact Hours = 4 Hours**
Site visit to nearby industries.	

Books	
	Text Books:
1.	S.L. Uppal “Electrical Power” Khanna Publishers.
	Reference Books:
1.	**“BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting”,** Manak Bhavan, New Delhi.

	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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 about IEI student chapter.	Un	1,2	3
2.	Explain and apply LED bulb refurbishing.	App	2,4,12	3
3.	Explain the energy conservation and rural development concept.	App	2,4,12	3
4.	Analyze the technical aspect during industry visit.	App	2,4,12	3

Scheme of Continuous Internal Evaluation (CIE):

Components					Total Marks
Marks					100
Minimum score to pass the course: 40 OUT OF 100					

Rubrics: Levels	**Target**
1(Low)	**60% of the students score Less than 50 % of the total marks.**
2(Medium)	**60% of the students score 50 – 70 % of the total marks.**
3(High)	**60% of the students score More than 70 % of the total marks.**

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		√		√								√			√
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members members involved in designing the syllabus

Name & Signature of Faculty verifying/approving the syllabus

Nano Club

Course Code	**21XXXXX/ 22XXXXX**	**Course type**	**AEC/MC**	**Credits L-T-P**	0 – 0 - 2
Hours/week: L - T- P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	To understand the principles of nano-science engineering, carbon nanotubes and their applications.
2.	To understand the effects of size of nano-materials on various applications.
3.	To study the fabrication techniques of nano particles.
4.	To identify the properties of nanoparticles and their usage in various applications.

Pre-requisites : Basic physics and chemistry

Activity – I Introduction to Nanotechnology	**Contact Hours = 2 Hours**
A talk with demonstration to create awareness about nanotechnology and its applications in various fields.	

Activity – II Awareness Programme on Nano Technology for school students.	**Contact Hours = 2 Hours**
The members of Nano Club will visit a school and illustrate the applications of Nano Technology in various fields.	

Activity – III Student Development Programme for Polytechnic Students	**Contact Hours = 2 Hours**
The members of Nano Club will visit a Polytechnic college and illustrate the emerging applications of Nano Technology and Nano Science in various fields of engineering.	

Activity – IV The skill of writing technical articles related to Nano technology and Nano Science	**Contact Hours = 2 Hours**

A session on the methodology to study and write technical articles related to Nano Technology, Nano Science and its applications.

Activity – V Synthesis of Nano particles and analysis of Ayurvedic mixtures	**Contact Hours = 2 Hours**
The process of synthesizing Nano particles will be demonstrated and the Nano Properties of various Ayurvedic Bhasmas used in medication will be analyzed.	

	Books
	Text Books:
1.	Robert Kelsall, Ian Hamley, Mark Geoghegan, —Nanoscale Science and Technology, John Wiley, 2007.
2.	Charles P Poole, Jr, Frank J Owens, —Introduction to Nanotechnology, John Wiley, Copyright 2006, Reprint 2011.
3.	T Pradeep, —Nano: The Essentials-Understanding Nanoscience and Nanotechnology, TMH.
4.	**Reference Books:**
	William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, —Hand Book of Nanoscience Engineering and Technology‖, CRC press, 2003.
1.	**E-resourses (NPTEL/SWAYAM.. Any Other)- mention links**
2.	Fundamentals of micro and nanofabrication By Prof. Shankar Selvaraja, Prof. Sushobhan Avasthi, IISc Bangalore https://onlinecourses.nptel.ac.in/noc20_bt37/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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.	Understand the principles of Nano-electronics, properties of Nano-particles and carbon nanotubes	Un	1,9,10,12	1
2.	Apply concepts of nano-electronics in various fields	Ap	1,2,6,9,10,12	1,2
3.	Understand the fabrication techniques and the process flow for sensor design.	Un, An	1,2,8,9,10,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Quiz (Activity 1, Activity 2 and Activity 3)	Report (Activity 4 and Activity 5)	Total Marks
Marks	20 + 20 + 20 = 60	20 + 20 = 40	100
Minimum score to pass the course: 40 OUT OF 100			

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	✓	✓				✓			✓	✓		✓	✓	✓	
3	✓	✓						✓	✓	✓		✓	✓		✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members involved in designing the syllabus

Name & Signature of Faculty members verifying/approving the syllabus

CODECHEF

Course Code		**Course type**		**Credits L-T-P**	0 – 0 - 2
Hours/week: L - T- P	0 – 0 – 2			**Total credits**	1- 21 scheme 0- 22 scheme
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 2 Hrs Total = 20 Hrs			**CIE Marks**	100
				SEE Marks	--

Course learning objectives	
1.	Understand the fundamental concepts and principles of Data Structures and Algorithms (DSA), including data types, data structures, algorithms, and their analysis.
2.	Develop an understanding of the job market and industry requirements: Gain knowledge about the current trends, demands, and expectations of employers in the relevant industry or field of study.
3.	Understand the concept of open-source: Gain a comprehensive understanding of the open-source philosophy, including the principles of transparency, collaboration, and free sharing of source code and resources.
4.	Imparting Industrial exposure and enhancing start-up culture among students

Pre-requisites : nil

Strengthen the DSA skills in students	**Contact Hours = 05 Hours**
Activity 1: 3 days Data Structures and Advanced Algorithms Bootcamp Activity 2: Coding Contest on DSA	

Placement activities	**Contact Hours = 05 Hours**
Activity 1: Placement Preparation - Mock placement sessions that Include Resume Writing Session + Group Discussion and interviews Activity 2: Web development/ App development bootcamp + contest/Hackathon	

Awareness about Open-source	**Contact Hours = 05 Hours**
Activity 1: Session on Git, GitHub and Open Source Contributions Activity 2: Contest on Open Source Contributions	

Industrial exposure and enhancing start-up culture	**Contact Hours = 05 Hours**
Activity 1: Industrial visit/ Industrial Internship program Activity 2: Startup Awareness and Pitch session in collaboration with incubators & entrepreneurs	

Books	
	Text Books:
1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards
	Reference Books:

1.	Name of the author(s), Title of the Book, Publisher, Edition/Year _____ and onwards

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Competition
2.	PPT and Videos	2.	Activity presentation
3.	Activity	3.	Online Quizzes (Surprise and Scheduled)
4.	Demo/Training	4.	Seminar/Surveys/Assignments
		5.	IA tests

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.	**Understand, Analyze and apply** the latest advancements, trends, and concepts in their specific technical domain.	L3	9, 10, 12	1, 3
2.	Effectively **communicate** their ideas, collaborate with others, and articulate their **understanding** of the technical concepts presented.	L5	1, 2, 3 ,4, 6, 8, 12	1, 2, 3
3.	Allows the concrete **deployment** of new ideas to be organized	L3	1, 2, 3, 12	1, 3
4.	**Enhancement** of professional and technical skills of the students	L4	1,2,3,5,9,10, 12	1, 3

Scheme of Continuous Internal Evaluation (CIE):

Components	**Activity– I**	**Activity–II**	**Activity–III**	**Activity– IV**	Total Marks
Marks	25	25	25	25	100
Minimum score to pass the course: 40 OUT OF 100					

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															

Name & Signature of Faculty members involved in designing the syllabus	Name & Signature of Faculty members verifying/approving the syllabus