



**ANNA UNIVERSITY, CHENNAI  
NON-AUTONOMOUS AFFILIATED COLLEGES  
REGULATIONS 2021  
CHOICE BASED CREDIT SYSTEM**

**B. E. AEROSPACE ENGINEERING**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

I.	To impart fundamental scientific principles for solving complex engineering problems in different domains of Aerospace engineering
II.	To train the students to have successful career in the field of Aerospace Engineering and allied domains, contributing to the global economy.
III.	To inculcate ethical values and professional integrity, enabling the students to grow and contribute to the world

**PROGRAM OUTCOMES (POs)**

PO#	Graduate Attribute
1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	<b>Design/development of solutions:</b> 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	<b>Conduct investigations of complex problems:</b> 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	<b>Modern tool usage:</b> 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	<b>The engineer and society:</b> 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	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	<b>Communication:</b> 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	<b>Project management and finance:</b> 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	<b>Life-long learning:</b> 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.

**PROGRAM SPECIFIC OUTCOMES (PSOs) - (3 to 4 statements )**

1.	Comprehend and analyze, real life problems and develop innovative solutions
2.	Apply experimental and computational tools to solve problems in the domains of Aerodynamics, Aerospace Structures and Propulsion engineering
3.	Engage professionally, applying engineering, management and entrepreneurial practices

**PEO's – PO's & PSO's MAPPING:**

PEO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I.	3	3	3	3	1	-	-	-	-	-	-	2	3	1	-
II.	2	2	2	1	1	3	3	2	3	3	3	3	3	3	1
III.	-	-	-	-	-	3	3	3	3	3	2	2	1	-	3

**ANNA UNIVERSITY, CHENNAI**  
**NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY**  
**B. E. AEROSPACE ENGINEERING**  
**REGULATIONS 2021**  
**CHOICE BASED CREDIT SYSTEM**  
**CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS I TO IV**  
**SEMESTER I**

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
<b>THEORY</b>								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3152	தமிழர் மரபு/ Heritage of Tamils	HSMC	1	0	0	1	1
<b>PRACTICAL</b>								
7	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
9	GE3172	English Laboratory §		0	0	2	2	1
<b>TOTAL</b>				<b>16</b>	<b>1</b>	<b>10</b>	<b>27</b>	<b>22</b>

§ Skill Based Course

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3251	Materials Science	BSC	3	0	0	3	3
4.	BE3251	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.		NCC Credit Course Level 1 <sup>#</sup>	-	2	0	0	2	2
7.	GE3252	தமிழரும் தொழில்நுட்பமும் / Tamils	HSMC	1	0	0	1	1
<b>PRACTICAL</b>								
8.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	BE3271	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
10.	GE3272	Communication Laboratory / Foreign Language §	EEC	0	0	4	4	2
<b>TOTAL</b>				<b>14</b>	<b>1</b>	<b>16</b>	<b>31</b>	<b>23</b>

<sup>#</sup> NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

§ Skill Based Course

### SEMESTER III

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
<b>THEORY</b>								
1.	MA3351	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	AE3351	Aero Engineering Thermodynamics	PCC	3	0	0	3	3
3.	CE3391	Fluid Mechanics and Machinery	ESC	3	1	0	4	4
4.	AE3352	Solid Mechanics	ESC	4	0	0	4	4
5.	AS3301	Elements of Aerospace Engineering	PCC	3	0	0	3	3
6.	AS3302	Flight Systems	PCC	3	0	0	3	3
<b>PRACTICALS</b>								
7.	AS3361	Thermodynamics and Strength of Materials Laboratory	PCC	0	0	4	4	2
8.	CE3362	Fluid Mechanics and Machinery Laboratory	PCC	0	0	4	4	2
9.	GE3361	Professional Development <sup>§</sup>	EEC	0	0	2	2	1
<b>TOTAL</b>				<b>19</b>	<b>2</b>	<b>10</b>	<b>31</b>	<b>26</b>

§ Skill Based Course

### SEMESTER IV

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
<b>THEORY</b>								
1.	MA3452	Vector Calculus and Complex Functions	BSC	3	1	0	4	4
2.	AS3401	Aerodynamics	PCC	3	0	0	3	3
3.	AS3402	Aerospace Structural Mechanics	PCC	4	0	0	4	4
4.	AS3403	Aerospace Propulsion-I	PCC	3	0	0	3	3
5.	AE3491	Mechanics of Machines	PCC	3	0	0	3	3
6.	GE3451	Environmental Science and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2 <sup>#</sup>		3	0	0	3	3
<b>PRACTICALS</b>								
8.	AS3411	Low And High Speed Aerodynamics Laboratory	PCC	0	0	4	4	2
9.	AS3412	Aerospace Structures Laboratory	PCC	0	0	4	4	2
<b>TOTAL</b>				<b>18</b>	<b>1</b>	<b>8</b>	<b>27</b>	<b>23</b>

<sup>#</sup> NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

**SEMESTER V**

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
<b>THEORY</b>								
1.	AS3501	Aerospace Propulsion-II	PCC	3	0	0	3	3
2.	AE3691	Flight Dynamics	PCC	3	1	0	4	4
3.	AS3502	Space Mechanics	PCC	3	0	0	3	3
4.		Professional Elective I	PEC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	0	3	3
6.		Professional Elective III	PEC	3	0	0	3	3
7.		Mandatory Course-I <sup>&amp;</sup>	MC	3	0	0	3	0
<b>PRACTICALS</b>								
8.	AS3511	Space Propulsion Laboratory	EEC	0	0	2	2	1
<b>TOTAL</b>				<b>21</b>	<b>1</b>	<b>2</b>	<b>24</b>	<b>20</b>

<sup>&</sup> Mandatory Course-I is a Non-credit Course (The candidate shall select one course from the list given under MC- I)

**SEMESTER VI**

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total contact periods	Credits
				L	T	P		
<b>THEORY</b>								
1.	AS3601	Aerospace Control Engineering	PCC	3	0	0	3	3
2.	AS3602	Vibration and Aeroelasticity	PCC	3	0	0	3	3
3.		Open Elective – I <sup>*</sup>	OEC	3	0	0	3	3
4.		Professional Elective IV	PEC	-	-	-	-	3
5.		Professional Elective V	PEC	-	-	-	-	3
6.		Professional Elective VI	PEC	-	-	-	-	3
7.		Mandatory Course-II <sup>&amp;</sup>	MC	3	0	0	3	0
8.		NCC Credit Course Level 3 <sup>#</sup>		3	0	0	3	
<b>PRACTICALS</b>								
9.	AE3581	CAD Laboratory	PCC	0	0	4	4	2
10.	AS3611	Space Launch Vehicle Design Project	EEC	0	0	4	4	2
<b>TOTAL</b>				<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>22</b>

<sup>\*</sup>Open Elective – I shall be chosen from the emerging technologies.

<sup>&</sup> Mandatory Course-II is a Non-credit Course (The candidate shall select one course from the list given under MC- II)

<sup>#</sup> NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

**SEMESTER VII/VIII\***

S. No.	Course Code	Course title	Cate Gory	Periods Per week			Total contact periods	Credits
				L	T	P		
<b>THEORY</b>								
1.	AS3701	Rockets and Launch Vehicles	PCC	3	0	0	3	3
2.	GE3791	Human Values and Ethics	HSMC	2	0	0	2	2
3.		Elective – Management #	HSMC	3	0	0	3	3
4.		Open Elective – II**	OEC	3	0	0	3	3
5.		Open Elective – III***	OEC	3	0	0	3	3
6.		Open Elective – IV***	OEC	3	0	0	3	3
<b>PRACTICALS</b>								
7.	AE3781	Computational Analysis Laboratory	PCC	0	0	2	2	1
8.	AS3711	Avionics Laboratory	PCC	0	0	2	2	1
9.	AS3712	Flight Systems Laboratory	PCC	0	0	2	2	1
<b>TOTAL</b>				<b>17</b>	<b>0</b>	<b>6</b>	<b>23</b>	<b>20</b>

\*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

\*\*Open Elective – II shall be chosen from the emerging technologies.

\*\*\*Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes).

# Elective - Management shall be chosen from the elective Management courses.

**SEMESTER VIII/VII\***

S. No.	Course Code	Course title	Cate Gory	Periods per week			Total Contact Periods	Credits
				L	T	P		
<b>PRACTICALS</b>								
1.	AS3811	Project Work/ Internship	EEC	0	0	20	20	10
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>20</b>	<b>10</b>

\*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**TOTAL CREDIT: 166**

**ELECTIVE - MANAGEMENT**

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

**MANDATORY COURSES I**

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

**MANDATORY COURSES II**

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES:VERTICALS						
Vertical 1	Vertical 2	Vertical 3	Vertical 4	Vertical 5	Vertical 6	Vertical 7
Space Technology	Computational Engineering	Aerodynamics and Propulsion	Aerospace Structures	Satellite Technology	Diversified courses Group 1	Diversified courses Group 2
Cryogenics	Numerical Methods in Fluid Dynamics	Experimental Aerodynamics	Fatigue and Fracture Mechanics	Spacecraft Power Systems	High Temperature Materials	Boundary Layer Theory
High Temperature Gas Dynamics	Computational Heat Transfer	High Speed Aerodynamics	Experimental Stress Analysis	Satellite Navigation and Control	Machining and Precision Manufacturing	Theory of Elasticity
Launch Vehicle Aerodynamics	Finite Element Method	Industrial Aerodynamics	Composite Materials and Structures	Spacecraft Sensors and Instrumentation	Design of Non Air Breathing Engines	Structural Dynamics
Orbital Mechanics	Computational Fluid Dynamics	Rocket Propulsion	Additive Manufacturing	Spacecraft Systems Engineering	Manufacturing Processes	Heat Transfer
Launch Vehicle Configuration Design	Computer Aided Design and Analysis	Advanced Propulsion Systems	Non Destructive Testing and Evaluation	Satellite Architecture	Spacecraft Structures	Advanced Vehicle Technology
Space Missions	Grid Generation Techniques	Hypersonic Aerodynamics	Aerospace Materials	Spacecraft Dynamics	Smart Materials and Structures	Missile Guidance and Control

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E./B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.



**PROFESSIONAL ELECTIVE COURSES: VERTICALS**

**VERTICAL 1: SPACE TECHNOLOGY**

Sl. No.	Course Code	Course title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	AS3001	Cryogenics	PEC	3	0	0	3	3
2.	AS3002	High Temperature Gas Dynamics	PEC	3	0	0	3	3
3.	AS3003	Launch Vehicle Aerodynamics	PEC	3	0	0	3	3
4.	AS3004	Orbital Mechanics	PEC	3	0	0	3	3
5.	AS3005	Launch Vehicle Configuration Design	PEC	3	0	0	3	3
6.	AS3006	Space Missions	PEC	3	0	0	3	3

**VERTICAL 2: COMPUTATIONAL ENGINEERING**

Sl. No.	Course Code	Course title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CAE331	Numerical Methods in Fluid Dynamics	PEC	3	0	0	3	3
2.	CAE332	Computational Heat Transfer	PEC	3	0	0	3	3
3.	CAE333	Finite Element Method	PEC	3	0	0	3	3
4.	CAE334	Computational Fluid Dynamics	PEC	3	0	0	3	3
5.	CAE335	Computer Aided Design and Analysis	PEC	3	0	0	3	3
6.	CAE336	Grid Generation Techniques	PEC	3	0	0	3	3

**VERTICAL3: AERODYNAMICS AND PROPULSION**

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CAE337	Experimental Aerodynamics	PEC	3	0	0	3	3
2.	CAE338	Highspeed Aerodynamics	PEC	3	0	0	3	3
3.	CAE339	Industrial Aerodynamics	PEC	3	0	0	3	3
4.	CAE340	Rocket Propulsion	PEC	3	0	0	3	3
5.	CAE341	Advanced Propulsion Systems	PEC	3	0	0	3	3
6.	CAE342	Hypersonic Aerodynamics	PEC	3	0	0	3	3

**VERTICAL 4: AEROSPACE STRUCTURES**

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CAE343	Fatigue and Fracture Mechanics	PEC	3	0	0	3	3
2.	CAE344	Experimental Stress Analysis	PEC	3	0	0	3	3
3.	CAE345	Composite Materials and Structures	PEC	3	0	0	3	3
4.	CME339	Additive Manufacturing	PEC	2	0	2	4	3
5.	CMF338	Non Destructive Testing and Evaluation	PEC	3	0	0	3	3
6.	CAE346	Aerospace Materials	PEC	3	0	0	3	3

**VERTICAL 5: SATELLITE TECHNOLOGY**

Sl. No.	Course code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	AS3007	Spacecraft Power Systems	PEC	3	0	0	3	3
2.	AS3008	Satellite Navigation and Control	PEC	3	0	0	3	3
3.	AS3009	Spacecraft Sensors and Instrumentation	PEC	3	0	0	3	3
4.	AS3010	Spacecraft Systems Engineering	PEC	3	0	0	3	3
5.	AS3011	Satellite Architecture	PEC	3	0	0	3	3
6.	AS3012	Spacecraft Dynamics	PEC	3	0	0	3	3

**GROUP 6: DIVERSIFIED COURSES GROUP 1**

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CAS331	High Temperature Materials	PEC	3	0	0	3	3
2.	AS3013	Machining and Precision Manufacturing	PEC	3	0	0	3	3
3.	AS3014	Design of Non Air Breathing Engines	PEC	3	0	0	3	3
4.	ME3393	Manufacturing Processes	PEC	3	0	0	3	3
5.	AS3015	Spacecraft Structures	PEC	3	0	0	3	3
6.	CAE345	Smart Materials and Structures	PEC	3	0	0	3	3

**GROUP 7: DIVERSIFIED COURSES GROUP 2**

Sl. No.	Course Code	Course Title	Category	Periods Per week			Total Contact Periods	Credits
				L	T	P		
1.	CAE346	Boundary Layer Theory	PEC	3	0	0	3	3
2.	CAE347	Theory of Elasticity	PEC	3	0	0	3	3
3.	CAE348	Structural Dynamics	PEC	3	0	0	3	3
4.	CAE343	Heat Transfer	PEC	3	0	0	3	3
5.	CME393	Advanced Vehicle Engineering	PEC	3	0	0	3	3
6.	AS3016	Missile Guidance and Control	PEC	3	0	0	3	3

**OPEN ELECTIVES**

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories)

**OPEN ELECTIVE I AND II  
(EMERGING TECHNOLOGIES)**

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

**OPEN ELECTIVES – III**

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
3.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
4.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
5.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3

6.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
7.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
8.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
9.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
25.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
26.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
27.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
28.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
29.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
30.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
31.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
32.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
33.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
34.	OEC351	Signals and Systems	OEC	3	0	0	3	3
35.	OEC352	Fundamentals of	OEC	3	0	0	3	3

		Electronic Devices and Circuits						
36.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
37.	OBM352	Assistive Technology	OEC	3	0	0	3	3
38.	OMA352	Operations Research	OEC	3	0	0	3	3
39.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
40.	OMA354	Linear Algebra	OEC	3	0	0	3	3

#### OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
3.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
4.	OMA356	Random Processes	OEC	3	0	0	3	3
5.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
6.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
7.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
8.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
9.	OME353	New Product Development	OEC	3	0	0	3	3
10.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
11.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
12.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
13.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
14.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3
18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3

21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
25.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
26.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
27.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
28.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
29.	OGI352	Geographical Information System	OEC	3	0	0	3	3
30.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
31.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
32.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
33.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
34.	OCH353	Energy Technology	OEC	3	0	0	3	3
35.	OCH354	Surface Science	OEC	3	0	0	3	3
36.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
37.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
38.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
39.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
40.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
41.	OTT355	Fibre Science	OEC	3	0	0	3	3
42.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
43.	OPE353	Industrial safety	OEC	3	0	0	3	3
44.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
45.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
46.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
47.	OEC353	VLSI Design	OEC	3	0	0	3	3
48.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
49.	OBM353	Wearable devices	OEC	3	0	0	3	3
50.	OBM354	Medical Informatics	OEC	3	0	0	3	3

## SUMMARY

<b>B.E. AEROSPACE ENGINEERING</b>										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1	HSMC	4	3					5		10
2	BSC	12	7	4	6					29
3	ESC	5	11	8						24
4	PCC			13	17	10	8	6		54
5	PEC					9	9	9		27
6	OEC						3			3
7	EEC	1	2	1		1	2		10	17
8	Non-Credit /(Mandatory)					√	√			
<b>Total</b>		<b>22</b>	<b>23</b>	<b>26</b>	<b>23</b>	<b>20</b>	<b>22</b>	<b>20</b>	<b>10</b>	<b>166</b>



### **ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)**

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

#### **VERTICALS FOR MINOR DEGREE (In addition to the all the verticals of other programmes)**

<b>Vertical I Fintech and Block Chain</b>	<b>Vertical II Entrepreneurship</b>	<b>Vertical III Public Administration</b>	<b>Vertical IV Business Data Analytics</b>	<b>Vertical V Environment and Sustainability</b>
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics For Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining For Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing And Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation And Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

**(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)**



### VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

### VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

### VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

**VERTICAL 4: BUSINESS DATA ANALYTICS**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics For Management	PEC	3	0	0	3	3
2.	CMG350	Datamining For Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

**VERTICAL 5: ENVIRONMENTAL SUSTAINABILITY**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. “

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don't's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering /Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

**Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.**

References:

Guide to Induction program from AICTE

**OBJECTIVES :**

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

**UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1**

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

**UNIT 1 INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8**

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

**UNIT II NARRATION AND SUMMATION 9**

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar -Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

**UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9**

Reading - Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

**UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9**

Reading - Newspaper articles; Journal reports -and Non Verbal Communication (tables, pie charts etc.). Writing - Note-making / Note-taking (\*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal ( chart , graph etc, to verbal mode)

Grammar - Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

**UNIT V EXPRESSION 9**

Reading - Reading editorials; and Opinion Blogs; Writing - Essay Writing (Descriptive or narrative). Grammar - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions - Content vs Function words.

**TOTAL : 45 PERIODS**

## LEARNING OUTCOMES :

At the end of the course, learners will be able

- To use appropriate words in a professional context
- To gain understanding of basic grammatic structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics

## TEXT BOOKS :

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.  
Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

## REFERENCE BOOKS:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

## ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

MA3151

MATRICES AND CALCULUS

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3	1	0	4

## COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

## UNIT - I                      MATRICES

9 + 3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

**UNIT - II DIFFERENTIAL CALCULUS 9 + 3**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

**UNIT - III FUNCTIONS OF SEVERAL VARIABLES 9 + 3**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

**UNIT - IV INTEGRAL CALCULUS 9 + 3**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

**UNIT - V MULTIPLE INTEGRALS 9 + 3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

**TOTAL: 60 PERIODS****COURSE OUTCOMES:**

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

**TEXT BOOKS:**

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.
2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44<sup>th</sup> Edition, 2018.
3. James Stewart, "Calculus : Early Transcendentals", Cengage Learning, 8<sup>th</sup> Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

**REFERENCES :**

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10<sup>th</sup> Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5<sup>th</sup> Edition, 2016.
4. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus ", 14<sup>th</sup> Edition, Pearson India, 2018.

**COURSE OBJECTIVES**

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

**UNIT I MECHANICS 9**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

**UNIT II ELECTROMAGNETIC WAVES 9**

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

**UNIT III OSCILLATIONS, OPTICS AND LASERS 9**

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO<sub>2</sub> laser, semiconductor laser –Basic applications of lasers in industry.

**UNIT IV BASIC QUANTUM MECHANICS 9**

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

**UNIT V APPLIED QUANTUM MECHANICS 9**

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

**TOTAL : 45 PERIODS****COURSE OUTCOMES**

After completion of this course, the students should be able to

- Understand the importance of mechanics.
- Express their knowledge in electromagnetic waves.



- Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
- Understand the importance of quantum physics.
- Comprehend and apply quantum mechanical principles towards the formation of energy bands.

#### TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

#### REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

CY3151

ENGINEERING CHEMISTRY

L T P C  
3 0 0 3

#### COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

#### UNIT I WATER AND ITS TREATMENT

9

Water: Sources and impurities, Water quality parameters: Definition and significance of color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

#### UNIT II NANOCHEMISTRY

9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

### **UNIT III PHASE RULE AND COMPOSITES**

**9**

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

### **UNIT IV FUELS AND COMBUSTION**

**9**

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO<sub>2</sub> emission and carbon foot print.

### **UNIT V ENERGY SOURCES AND STORAGE DEVICES**

**9**

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles – working principles; Fuel cells: H<sub>2</sub>-O<sub>2</sub> fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

**TOTAL: 45 PERIODS**

### **COURSE OUTCOMES**

At the end of the course, the students will be able:

- To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To apply the knowledge of phase rule and composites for material selection requirements.
- To recommend suitable fuels for engineering processes and applications.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

### **TEXT BOOKS:**

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17<sup>th</sup> Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12<sup>th</sup> Edition, 2018.

### **REFERENCES:**

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

- O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2<sup>nd</sup> Edition, 2017.
- Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
- Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
- O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

**GE3151                      PROBLEM SOLVING AND PYTHON PROGRAMMING**

**L T P C**  
**3 0 0 3**

**COURSE OBJECTIVES:**

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

**UNIT I                      COMPUTATIONAL THINKING AND PROBLEM SOLVING                      9**

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II                      DATA TYPES, EXPRESSIONS, STATEMENTS                      9**

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III                      CONTROL FLOW, FUNCTIONS, STRINGS                      9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV                      LISTS, TUPLES, DICTIONARIES                      9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

**UNIT V                      FILES, MODULES, PACKAGES                      9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

**TOTAL : 45 PERIODS**

## COURSE OUTCOMES:

Upon completion of the course, students will be able to

- CO1: Develop algorithmic solutions to simple computational problems.
- CO2: Develop and execute simple Python programs.
- CO3: Write simple Python programs using conditionals and looping for solving problems.
- CO4: Decompose a Python program into functions.
- CO5: Represent compound data using Python lists, tuples, dictionaries etc.
- CO6: Read and write data from/to files in Python programs.

## TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2<sup>nd</sup> Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

## REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. <https://www.python.org/>
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

GE3152

தமிழர் மரபு

L T P C  
1 0 0 1

### அலகு I மொழி மற்றும் இலக்கியம்:

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

### அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை:

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

**அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:** 3  
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

**அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்:** 3  
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

**அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:** 3  
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**GE3152**

**HERITAGE OF TAMILS**

**L T P C**

**1 0 0 1**

**UNIT I LANGUAGE AND LITERATURE**

**3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS 3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS 3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சந்திரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**COURSE OBJECTIVES:**

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

**EXPERIMENTS:**

**Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.**

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

On completion of the course, students will be able to:

CO1: Develop algorithmic solutions to simple computational problems

CO2: Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems.

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

**TEXT BOOKS:**

1. Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

**REFERENCES:**

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. <https://www.python.org/>
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

**BS3171****PHYSICS AND CHEMISTRY LABORATORY****L T P C  
0 0 4 2****PHYSICS LABORATORY: (Any Seven Experiments)****COURSE OBJECTIVES:**

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle  
b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

**TOTAL: 30 PERIODS**



**COURSE OUTCOMES:**

Upon completion of the course, the students should be able to

- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)****COURSE OBJECTIVES:**

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
  - To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
  - To demonstrate the analysis of metals and alloys.
  - To demonstrate the synthesis of nanoparticles
1. Preparation of  $\text{Na}_2\text{CO}_3$  as a primary standard and estimation of acidity of a water sample using the primary standard
  2. Determination of types and amount of alkalinity in water sample.
    - Split the first experiment into two
  3. Determination of total, temporary & permanent hardness of water by EDTA method.
  4. Determination of DO content of water sample by Winkler's method.
  5. Determination of chloride content of water sample by Argentometric method.
  6. Estimation of copper content of the given solution by Iodometry.
  7. Estimation of TDS of a water sample by gravimetry.
  8. Determination of strength of given hydrochloric acid using pH meter.
  9. Determination of strength of acids in a mixture of acids using conductivity meter.
  10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
  11. Estimation of iron content of the given solution using potentiometer.
  12. Estimation of sodium /potassium present in water using flame photometer.
  13. Preparation of nanoparticles ( $\text{TiO}_2/\text{ZnO}/\text{CuO}$ ) by Sol-Gel method.
  14. Estimation of Nickel in steel
  15. Proximate analysis of Coal

**TOTAL : 30 PERIODS**

**COURSE OUTCOMES:**

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles
- To quantitatively analyse the impurities in solution by electroanalytical techniques

**TEXT BOOK:**

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

**OBJECTIVES :**

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

**UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION****6**

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions( filling out a bank application for example).

**UNIT II NARRATION AND SUMMATION****6**

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations\* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

**UNIT III DESCRIPTION OF A PROCESS / PRODUCT****6**

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)- talking about precautions.

**UNIT IV CLASSIFICATION AND RECOMMENDATIONS****6**

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress-talking about positions and directions of movement-talking about travel preparations- talking about transportation-

**UNIT V EXPRESSION****6**

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions-understanding a website-describing processes

**TOTAL : 30 PERIODS****LEARNING OUTCOMES:**

At the end of the course, learners will be able

- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

**ASSESSMENT PATTERN**

- One online / app based assessment to test listening /speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

**OBJECTIVES :**

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

**UNIT I MAKING COMPARISONS 6**

Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

**UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6**

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

**UNIT III PROBLEM SOLVING 6**

Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

**UNIT IV REPORTING OF EVENTS AND RESEARCH 6**

Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

**UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 6**

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

**TOTAL : 30 PERIODS****OUTCOMES:**

At the end of the course, learners will be able

- To compare and contrast products and ideas in technical texts.
- To identify cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.
- To report events and the processes of technical and industrial nature.
- To present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

**TEXT BOOKS :**

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Jovani, Department of English, Anna University.

## REFERENCES:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

## ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatical and lexical competence.

MA3251

STATISTICS AND NUMERICAL METHODS

L T P C  
3 1 0 4

## COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

### UNIT I TESTING OF HYPOTHESIS

9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

### UNIT II DESIGN OF EXPERIMENTS

9+3

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design -  $2^2$  factorial design.

### UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS

9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

### UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

## **UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3**

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

**TOTAL: 60 PERIODS**

### **COURSE OUTCOMES:**

Upon successful completion of the course, students will be able to:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

### **TEXT BOOKS:**

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10<sup>th</sup> Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.

### **REFERENCES:**

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7<sup>th</sup> Edition, 2007.
4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12<sup>th</sup> Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4<sup>th</sup> Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9<sup>th</sup> Edition, Pearson Education, Asia, 2010.

**PH3251**

**MATERIALS SCIENCE**

**L T P C**  
**3 0 0 3**

### **COURSE OBJECTIVES:**

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

**UNIT I CRYSTALLOGRAPHY 9**

Crystal structures: BCC, FCC and HCP – directions and planes - linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials - Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation.

**UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9**

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

**UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

**UNIT IV OPTICAL PROPERTIES OF MATERIALS 9**

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonics.

**UNIT V NANOELECTRONIC DEVICES 9**

Quantum confinement – Quantum structures – quantum wells, wires and dots – Zener-Bloch oscillations – Resonant tunneling – quantum interference effects - mesoscopic structures - Single electron phenomena – Single electron Transistor. Semiconductor photonic structures – 1D, 2D and 3D photonic crystal. Active and passive optoelectronic devices – photo processes – spintronics – carbon nanotubes: Properties and applications.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of the course, the students should be able to

- know basics of crystallography and its importance for varied materials properties
- gain knowledge on the electrical and magnetic properties of materials and their applications
- understand clearly of semiconductor physics and functioning of semiconductor devices
- understand the optical properties of materials and working principles of various optical devices
- appreciate the importance of functional nanoelectronic devices.

**TEXT BOOKS:**

1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

## REFERENCES:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

**BE3251                      BASIC ELECTRICAL AND ELECTRONICS ENGINEERING                      L T P C**  
**3 0 0 3**

## COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

### **UNIT I                      ELECTRICAL CIRCUITS                      9**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)  
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

### **UNIT II                      ELECTRICAL MACHINES                      9**

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

### **UNIT III                      ANALOG ELECTRONICS                      9**

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

### **UNIT IV                      DIGITAL ELECTRONICS                      9**

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)

### **UNIT V                      MEASUREMENTS AND INSTRUMENTATION                      9**

Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

**TOTAL: 45 PERIODS**

## **COURSE OUTCOMES:**

After completing this course, the students will be able to

1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

## **TEXT BOOKS:**

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

## **REFERENCES:**

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, 'Digital Fundamentals', 11<sup>th</sup> Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7<sup>th</sup> edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

**GE3251**

**ENGINEERING GRAPHICS**

**L T P C**  
**2 0 4 4**

## **COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students for:

1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

## **CONCEPTS AND CONVENTIONS (Not for Examination)**

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

## **UNIT I PLANE CURVES**

**6+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.



**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12**

Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

**TOTAL: (L=30; P=60) 90 PERIODS**

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

- Use BIS conventions and specifications for engineering drawing.
- Construct the conic curves, involutes and cycloid.
- Solve practical problems involving projection of lines.
- Draw the orthographic, isometric and perspective projections of simple solids.
- Draw the development of simple solids.

**TEXT BOOKS:**

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53<sup>rd</sup> Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

**REFERENCES:**

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2<sup>nd</sup> Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27<sup>th</sup> Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2<sup>nd</sup> Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

**Publication of Bureau of Indian Standards:**

1. IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 — 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE3252

**தமிழரும் தொழில்நுட்பமும்**

L T P C

1 0 0 1

**அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3**

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

**அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

**அலகு III உற்பத்தித் தொழில் நுட்பம்: 3**

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

**அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

**அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3**

அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.

**GE3252**

**TAMILS AND TECHNOLOGY**

**L T P C  
1 0 0 1**

**UNIT I WEAVING AND CERAMIC TECHNOLOGY**

**3**

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

**UNIT III MANUFACTURING TECHNOLOGY 3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.)
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies.)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

## NCC CREDIT COURSE LEVEL 1\*

(ARMY WING) NCC CREDIT COURSE LEVEL - I		L	T	P	C
<b>NX3251</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>NCC GENERAL</b>					<b>6</b>
NCC 1	Aims, Objectives & Organization of NCC				1
NCC 2	Incentives				2
NCC 3	Duties of NCC Cadet				1
NCC 4	NCC Camps: Types & Conduct				2
<b>NATIONAL INTEGRATION AND AWARENESS</b>					<b>4</b>
NI 1	National Integration: Importance & Necessity				1
NI 2	Factors Affecting National Integration				1
NI 3	Unity in Diversity & Role of NCC in Nation Building				1
NI 4	Threats to National Security				1
<b>PERSONALITY DEVELOPMENT</b>					<b>7</b>
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving				2
PD 2	Communication Skills				3
PD 3	Group Discussion: Stress & Emotions				2
<b>LEADERSHIP</b>					<b>5</b>
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code				3
L 2	Case Studies: Shivaji, Jhasi Ki Rani				2
<b>SOCIAL SERVICE AND COMMUNITY DEVELOPMENT</b>					<b>8</b>
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth				3
SS 4	Protection of Children and Women Safety				1
SS 5	Road / Rail Travel Safety				1
SS 6	New Initiatives				2
SS 7	Cyber and Mobile Security Awareness				1

**TOTAL: 30 PERIODS**

## NCC CREDIT COURSE LEVEL 1\*

<b>NX3252</b>	<b>(NAVAL WING) NCC CREDIT COURSE LEVEL - I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

### **NCC GENERAL** **6**

NCC 1	Aims, Objectives & Organization of NCC				1
NCC 2	Incentives				2
NCC 3	Duties of NCC Cadet				1
NCC 4	NCC Camps: Types & Conduct				2

### **NATIONAL INTEGRATION AND AWARENESS** **4**

NI 1	National Integration: Importance & Necessity				1
NI 2	Factors Affecting National Integration				1
NI 3	Unity in Diversity & Role of NCC in Nation Building				1
NI 4	Threats to National Security				1

### **PERSONALITY DEVELOPMENT** **7**

PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving				2
PD 2	Communication Skills				3
PD 3	Group Discussion: Stress & Emotions				2

### **LEADERSHIP** **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code				3
L 2	Case Studies: Shivaji, Jhasi Ki Rani				2

### **SOCIAL SERVICE AND COMMUNITY DEVELOPMENT** **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth				3
SS 4	Protection of Children and Women Safety				1
SS 5	Road / Rail Travel Safety				1
SS 6	New Initiatives				2
SS 7	Cyber and Mobile Security Awareness				1

**TOTAL : 30 PERIODS**

## NCC CREDIT COURSE LEVEL 1\*

NX3253	(AIR FORCE WING) NCC CREDIT COURSE LEVEL – I	L	T	P	C
		2	0	0	2
<b>NCC GENERAL</b>					<b>6</b>
NCC 1	Aims, Objectives & Organization of NCC				1
NCC 2	Incentives				2
NCC 3	Duties of NCC Cadet				1
NCC 4	NCC Camps: Types & Conduct				2
<b>NATIONAL INTEGRATION AND AWARENESS</b>					<b>4</b>
NI 1	National Integration: Importance & Necessity				1
NI 2	Factors Affecting National Integration				1
NI 3	Unity in Diversity & Role of NCC in Nation Building				1
NI 4	Threats to National Security				1
<b>PERSONALITY DEVELOPMENT</b>					<b>7</b>
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving				2
PD 2	Communication Skills				3
PD 3	Group Discussion: Stress & Emotions				2
<b>LEADERSHIP</b>					<b>5</b>
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code				3
L 2	Case Studies: Shivaji, Jhasi Ki Rani				2
<b>SOCIAL SERVICE AND COMMUNITY DEVELOPMENT</b>					<b>8</b>
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth				3
SS 4	Protection of Children and Women Safety				1
SS 5	Road / Rail Travel Safety				1
SS 6	New Initiatives				2
SS 7	Cyber and Mobile Security Awareness				1

**TOTAL : 30 PERIODS**

**COURSE OBJECTIVES:**

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

**GROUP – A (CIVIL & ELECTRICAL)****PART I CIVIL ENGINEERING PRACTICES PLUMBING WORK: 15**

- a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- b) Preparing plumbing line sketches.
- c) Laying pipe connection to the suction side of a pump
- d) Laying pipe connection to the delivery side of a pump.
- e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

**WOOD WORK:**

- a) Sawing,
- b) Planing and
- c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

**Wood Work Study:**

- a) Studying joints in door panels and wooden furniture
- b) Studying common industrial trusses using models.

**PART II ELECTRICAL ENGINEERING PRACTICES 15**

- a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- b) Staircase wiring
- c) Fluorescent Lamp wiring with introduction to CFL and LED types.
- d) Energy meter wiring and related calculations/ calibration
- e) Study of Iron Box wiring and assembly
- f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- g) Study of emergency lamp wiring/Water heater



## GROUP – B (MECHANICAL AND ELECTRONICS)

### PART III

### MECHANICAL ENGINEERING PRACTICES

15

#### WELDING WORK:

- a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- b) Practicing gas welding.

#### BASIC MACHINING WORK:

- a) (simple)Turning.
- b) (simple)Drilling.
- c) (simple)Tapping.

#### ASSEMBLY WORK:

- a) Assembling a centrifugal pump.
- b) Assembling a household mixer.
- c) Assembling an airconditioner.

#### SHEET METAL WORK:

- a) Making of a square tray

#### FOUNDRY WORK:

- a) Demonstrating basic foundry operations.

### PART IV

### ELECTRONIC ENGINEERING PRACTICES

15

#### SOLDERING WORK:

- a) Soldering simple electronic circuits and checking continuity.

#### ELECTRONIC ASSEMBLY AND TESTING WORK:

- a) Assembling and testing electronic components on a small PCB.

#### ELECTRONIC EQUIPMENT STUDY:

- a) Study an elements of smart phone..
- b) Assembly and dismantle of LED TV.
- c) Assembly and dismantle of computer/ laptop

**TOTAL = 60 PERIODS**

#### COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

**BE3271 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY****L T P C  
0 0 4 2****COURSE OBJECTIVES:**

- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.

**LIST OF EXPERIMENTS**

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT, SCR and MOSFET
8. Half wave and Full Wave rectifiers
9. Study of Logic Gates
10. Implementation of Binary Adder and Subtractor
11. Study of DSO

**TOTAL: 60 PERIODS****COURSE OUTCOMES:**

After completing this course, the students will be able to

1. Use experimental methods to verify the Ohm's and Kirchhoff's Laws.
2. Analyze experimentally the load characteristics of electrical machines
3. Analyze the characteristics of basic electronic devices
4. Use DSO to measure the various parameters

**GE3272****COMMUNICATION LABORATORY****L T P C  
0 0 4 2****OBJECTIVES**

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

**UNIT I****12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-Writing: writing emails ( formal & semi-formal).

**UNIT II****12**

Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.

**UNIT III****12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes

and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

**UNIT IV**

**12**

Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-( example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.

**UNIT V**

**12**

Speaking: describing things relatively-describing clothing-discussing safety issues( making recommendations) talking about electrical devices-describing controlling actions- Writing: job application( Cover letter + Curriculum vitae)-writing recommendations.

**TOTAL: 60 PERIODS**

**LEARNING OUTCOMES**

- Speak effectively in group discussions held in a formal/semi formal contexts.
- Write emails and effective job applications.

**Assessment Pattern**

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

**MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS** **L T P C**  
**3 1 0 4**

**OBJECTIVES**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

**UNIT II FOURIER SERIES 9+3**

Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

**UNIT IV           FOURIER TRANSFORMS****9+3**

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT V           Z - TRANSFORMS AND DIFFERENCE EQUATIONS****9+3**

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

**TOTAL: 60 PERIODS****OUTCOMES**

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10<sup>th</sup> Edition, John Wiley, New Delhi, India, 2016.

**REFERENCES:**

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett . L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6<sup>th</sup> Edition, New Delhi, 2012.

**COURSE OBJECTIVES:**

- To make the student understand the quantitative analysis of machine and processes for transformation of energy and between work and heat.
- To Make the student understand the Laws of thermodynamics would be able to quantify through measurement of related
- To Apply the thermodynamic properties, energies and their interactions in real time problems
- To develop basic concept of air cycle, gas turbine engines and heat transfer.
- To analyse different types of Heat transfer
- To identify the different components of Jet Engines

**UNIT I FUNDAMENTAL CONCEPT AND FIRST LAW 9**

Concept of continuum, macroscopic approach, thermodynamic systems – closed, open and isolated. Property, state, path and process, quasi-static process, work, internal energy, enthalpy, specific heat capacities and heat transfer, SFEE, application of SFEE to jet engine components, First law of thermodynamics, relation between pressure, volume and temperature for various processes, Zeroth law of thermodynamics.

**UNIT II SECOND LAW AND ENTROPY**

Second law of thermodynamics – Kelvin Planck and Clausius statements of second law. Reversibility and Irreversibility, Thermal reservoir, Carnot theorem. Carnot cycle, Reversed Carnot cycle, efficiency, COP, Thermodynamic temperature scale - Clausius inequality, Concept of entropy, Entropy changes for various processes.

**UNIT III AIR STANDARD CYCLES 9**

Otto, Diesel, Dual, Ericsson, Atkinson, Stirling and Brayton cycles - Air standard efficiency – Mean effective pressure.

**UNIT IV FUNDAMENTALS OF VAPOUR POWER CYCLES 9**

Properties of pure substances – solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surfaces, thermodynamic properties of steam - calculations of work done and heat transfer in non-flow and flow processes - standard Rankine cycle, Reheat and Regeneration cycle. Heat rate, Specific steam consumption, Tonne of refrigeration.

**UNIT V BASICS OF PROPULSION AND HEAT TRANSFER 9**

Classification of jet engines - basic jet propulsion arrangement – Engine station number, thrust equation – Specific thrust, SFC, TSFC, specific impulse, actual cycles, isentropic efficiencies of jet engine components, polytropic efficiency, conduction in parallel, radial and composite wall, Basics of convective and radiation heat transfer.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

- CO1: Apply the laws of thermodynamics in real time problems.
- CO2: Demonstrate the principal operation of piston engine and jet engines.
- CO3: Demonstrate the efficiency of different air standard cycles.
- CO4: Determine the heat transfer in different conditions of working medium.
- CO5: Solve heat transfer problems in complex systems.
- CO6: Solve problems related to conduction convection and radiation

**TEXT BOOKS:**

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2013.
2. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall India, 2005.

3. Yunus A. Cengel and Michael A. Boles, "Thermodynamics: An Engineering Approach" McGraw-Hill Science/Engineering/Math; 7th edition 2010.

**REFERENCES:**

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 2007.
3. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
4. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006
5. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987

**MAPPING OF COS AND POS:**

CO	Level of correlation of the COs with the relevant POs/PSOs														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	1	-	-		1	2	3	1	-
CO2	3	2	2	1	1	1	1	-	-	1	1	-	3	2	1
CO3	3	2	2	1	1	1	1	1	-	1	-	2	3	2	-
CO4	3	2	2	1	1	-	1	-	-	1	1	1	3	1	-
CO5	3	3	3	2	2	-	1	-	-	1	1	2	3	1	-
CO6	3	2	2	1	1	1	1	-	-	1	1	2	3	3	1
Over all Co-relation	3	2.2	2.2	1.2	1.2	1	1	1	-	1	1	1.8	3	1.2	1



**COURSE OBJECTIVES:**

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

**UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3**

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

**UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3**

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

**UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3**

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

**UNIT IV TURBINES 9+3**

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

**UNIT V PUMPS 9+3**

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies- Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

**TOTAL: 60 PERIODS****OUTCOMES: On completion of the course, the student is expected to be able to**

1. Understand the properties and behaviour in static conditions. Also to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

**TEXT BOOKS:**

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

**REFERENCES:**

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	2	2	1	2	1	1	2	3	2	3
2	3	3	3	2	1	2	2	1	2	1	1	2	3	2	3
3	3	3	3	3	1	2	2	1	2	1	1	2	3	3	3
4	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
5	3	3	3	3	1	2	2	1	2	1	1	3	3	2	2
Low (1) ; Medium (2) ; High (3)															

PROGRESS THROUGH KNOWLEDGE



**COURSE OBJECTIVES:**

1. Ability to think, Analyse and solve Engineering Problems expected from the course.
2. Ability to understand stress and strain concepts related to deformable bodies.
3. To enable understanding of the behaviour and response of materials and to allow the student to carry out easy and moderate level structural analysis of basic structural members.
4. To familiarize with the different methods used for beam deflection analysis.
5. To impart knowledge to the students on how structural elements are sized and to enable the student to gain knowledge in how stresses are developed and distributed internally.

**UNIT I CONCURRENT AND NON-CONCURRENT 12**

Introduction, Concept of FBD, Coplanar Concurrent force system, Moments, Coplanar Non-Concurrent force system and Support Reactions – Application Problems.

**UNIT II SHEAR FORCE AND BENDING MOMENT, SECOND AREA MOMENT PROBLEMS 12**

Analysis of Simple Truss, Shear Force and Bending Moment Diagrams, C.G. and M.I of Plane areas.

**UNIT III AXIAL BAR AND MATERIAL MODULUS 12**

Simple stress and Strain, Mechanical Properties of Materials, Statically Determinate Problems and Elastic Constants, Tension, Compression, and Shear, Elasticity, Plasticity and Creep, Hooke's Law. Allowable stresses.

**UNIT IV BEAM BENDING AND TORSION 12**

Axially loaded members, Statically indeterminate structures, Thermal effects, misfits, and Pre-strains. Torsion of circular bar, Transmission of power by circular shafts. Stresses in beams, Pure bending and Nonuniform bending, Design of beams for bending stresses, Shear stresses in beams of rectangular cross section.

**UNIT V STRESS TRANSFORMATION, DEFLECTION OF BEAM AND BUCKLING OF COLUMN 12**

Plane stress, Principal stresses, Mohr's circle and Hooke's law for plane stresses. Spherical and Cylindrical pressure vessels. Deflection of beams, Column buckling.

**TOTAL: 60 PERIODS****COURSE OUTCOMES:**

- Upon completion of the course, Students will be able to
- CO1: Clear understanding of mechanical behaviour of materials.
  - CO2: Knowledge of different structural members and load types.
  - CO3: Design members under axial loading.
  - CO4: Design member under torsion loading.
  - CO5: Calculate beams deflections.

**TEXT BOOKS:**

1. Egor P Popov, Mechanics of Materials, Pearson, 2015.
2. James M. Gere, Mechanics of Materials, Sixth Edition, Thomson Learning, 2004.
3. Ferdinand Beer, E. Russell Johnston Jr., John Dewolf, David Mazurek, Mechanics of Materials, McGraw Hill Education, 2014.
4. Russell C Hibbeler, Mechanics of Materials, Pearson, 2013.

**REFERENCES:**

1. William F. Riley, Leroy D. Sturges, Don H. Morris, Mechanics of Materials, John Wiley & Sons, 1998.
2. Advanced Mechanics of Materials, 6<sup>th</sup> Edition, authored by Arthur P. Boresi, Richard J. Schmidt, bearing ISBN: 978-81-947263-9-5, Published by Wiley India Pvt. Limited.
3. Mechanics of Materials, 5<sup>th</sup> Edition, authored by Timothy A. Philpot, Jeffery S. Thomas, bearing ISBN: 978-1-119-85997-0, Published by Wiley India Pvt. Limited.

**MAPPING OF COS AND POS:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO1</b>	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	1	1
<b>CO2</b>	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	1	1
<b>CO3</b>	3	2.5	2	2.5	-	-	-	-	-	-	1	3	3	1	1
<b>CO4</b>	3	2.5	2	3	-	-	-	-	-	-	1	3	3	1	1
<b>CO5</b>	3	3	2.5	3	-	-	-	-	-	-	1	3	3	1	1
<b>Avg.</b>	3	2.6	2.1	2.7	-	-	-	-	-	-	1	3	3	1	1

Low (1) ; Medium (2) ; High (3)

**AS3301****ELEMENTS OF AEROSPACE ENGINEERING****L T P C****3 0 0 3****OBJECTIVES:**

- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young's modulus, Poisson's ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.
- 

**UNIT I STANDARD ATMOSPHERE****6**

History of aviation – standard atmosphere - pressure, temperature and density altitude.

**UNIT II AERODYNAMICS****10**

Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

**UNIT III PERFORMANCE AND PROPULSION****9**

Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -Thrust /power available and thrust/power required.

**UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY****10**

Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke's Law- brittle and ductile materials - moment of inertia – section modulus.

**UNIT V SPACE APPLICATIONS****10**

History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler's laws of orbits - Newtons law of gravitation.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Illustrate the history of aviation & developments over the years
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket

**TEXT BOOKS:**

1. John D. Anderson, Introduction to Flight, 8 th Ed., McGraw-Hill Education, New York,2015.
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021.
3. Stephen. A. Brandt, "Introduction to Aeronautics: A design perspective " American Institute of Aeronautics & Astronautics,1997.

**REFERENCE:**

1. Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	2	2	2	-	-	-	-	-	-	-	1	2	-
CO2	1	2	2	2	2	-	-	-	-	-	1	-	1	2	-
CO3	1	2	2	2	2	-	-	-	-	-	1	-	1	2	-
CO4	1	2	2	2	2	-	-	-	-	-	1	-	1	2	-
CO5	1	2	2	2	2	-	-	-	-	-	1	-	1	2	-
AVG	1	2	2	2	2	-	-	-	-	-	1	-	1	2	-

AS3302

FLIGHT SYSTEMS

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To describe the principle and working of flight systems and instruments.
- To interpret the basics of guided missile systems.
- To outline the basics of spacecraft systems.
- To learn the concepts of engine systems
- To make students aware of flight control systems

**UNIT I FLIGHT CONTROL SYSTEMS****9**

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – flexible push full rod system – Components – Modern control systems – Digital fly by wire systems – Auto pilot system active control Technology – Communication and Navigation systems – Instrument landing systems.

**UNIT II FLIGHT SYSTEMS 9**

Hydraulic systems, Components – Hydraulic system controllers – Modes of operation – Pneumatic systems – Working principles – Typical Air pressure system – Brake system – Typical Pneumatic power system, Components – Landing Gear systems – Classification – Shock absorbers – Retractive mechanism – Rocket Separation mechanism.

**UNIT III ENGINE SYSTEMS 9**

Fuel systems for Piston and jet engines – Components of multi engines – Lubricating systems for piston and jet engines – Starting and Ignition systems – Typical examples for piston and jet engines.

**UNIT IV GUIDED MISSILE SYSTEMS 9**

Introduction – Airframe – Propulsion System – Types of Control Systems – Gyroscope and its types – Roll and Lateral Control System – Fin Actuation Servos – Roll and Lateral Autopilot – Guidance System.

**UNIT V SPACECRAFT SYSTEMS 9**

Basics: Structure – Power – Thermal - Communications and Data Handling - Propulsion System - Attitude Stabilisation and Control.

**TOTAL = 45 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- Describe the controls and operation of an aircraft.
- Interpret how the aircraft systems are maintained.
- Explain the systems available in the aircraft engines.
- Classify the systems available in a missile.
- Describe the basics of systems available in a spacecraft.

**TEXT BOOKS:**

1. Mohan S. R., "Fundamentals of Guided Missiles", Cataloguing-in-Publication, 2016.
2. Pallet, E.H.J., "Aircraft Instruments: Principles and Applications", Pearson, 2009.

**REFERENCES:**

1. David Harris, "Flight Instruments and Automatic Flight Control", Blackwell, Sixth Ed., 2004.
2. "General Hand Books of Airframe and Powerplant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi, 1995.
3. McKinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
4. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.
5. Vincent L. Pisacane, "Fundamentals of Space Systems", 2<sup>nd</sup> Ed., Oxford University Press, Inc., 2005.

CO/POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	2	3	2	2	2	2	1	2	3	1	2	3	1	1
2	3	3	2	2	1	2	1	1	2	3	1	1	3	1	1
3	3	3	2	2	3	1	2	1	2	3	1	1	3	1	1
4	3	3	2	2	3	3	3	1	2	3	1	1	3	1	1
5	3	3	3	2	2	1	2	1	1	3	1	1	3	1	1
	3	2.8	2.4	2	2.2	1.8	2	1	1.8	3	1	1.2	3	1	1

**AS3361 THERMODYNAMICS AND STRENGTH OF MATERIALS  
LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To study the mechanical properties of materials when subjected to different types of loading.
- To study how to improve the material properties.
- To understand the nature of materials under microscopic Examination

**STRENGTH OF MATERIALS**

**30**

**LIST OF EXPERIMENTS**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminum rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
  - (i) Unhardened specimen
  - (ii) Quenched Specimen and
  - (iii) Quenched and tempered specimen.
11. Microscopic Examination of
  - (i) Hardened samples and
  - (ii) Hardened and tempered samples

**OUTCOMES:**

- Analyse the Hardness and Tensile strength of the given material
- Examine the deformation and torsion strength of the given material
- Analyse the compression and shear strength of given materials

**LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS**

<b>S.No.</b>	<b>NAME OF THE EQUIPMENT</b>	<b>Qty.</b>
1	Universal Tensile Testing machine with double 1 shear attachment –	1
2	Torsion Testing Machine(60 NM Capacity)	1
3	Impact Testing Machine (300J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500N)	1
7	Metallurgical Microscopes	3
8	Muffle Furnace(800C)	1

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	1	2	3	3	2	2	3	2	2
CO2	3	2	2	-	2	1	1	2	3	3	2	2	3	2	2
CO3	3	3	2	1	2	1	-	2	3	1	1	1	2	1	2
	3.00	2.33	2.00	1.00	2.00	1.00	1.00	2.00	3.00	2.33	1.67	1.67	2.67	1.67	2.00

## THERMODYNAMICS LABORATORY

### OBJECTIVE:

- To study the engine types and its performance
- To understand the importance of heat transfer and its application.
- To understand the fuel properties.

### LIST OF EXPERIMENTS

1. Performance test on a 4-stroke engine
2. Valve timing of a 4 – stroke engine and port timing of a 2 stroke engine
3. Determination of effectiveness of a parallel flow heat exchanger
4. Determination of effectiveness of a counter flow heat exchanger
5. Determination of heating value of a fuel
6. Determination of specific heat of solid
7. Determination of thermal conductivity of solid.
8. Determination of thermal resistance of a composite wall.
9. COP test on a vapour compression refrigeration test rig
10. COP test on a vapour compression air-conditioning test rig

**TOTAL: 60 PERIODS**

### OUTCOMES:

- Perform test on diesel/petrol engine
- Determine the properties of the fuels.
- Analyze the heat transfer properties of solid and composite walls

### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Details of Equipments	Qty Req.	Experiment No.
1.	4 stroke twin cylinder diesel engine	1	1
2.	Cut section model of 4 stroke diesel engine and cut section model of 2 stroke petrol engine	1	2
3.	Parallel and counter flow heat exchanger test rig	1	3,4
4.	Bomb Calorimeter	1	5
5.	Vapour compression refrigeration test rig	1	9
6.	Vapour compression air-conditioning test rig	1	10
7.	Conductive heat transfer set up	1	7
8.	Composite wall	1	8

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	-	-	1	1	1	1	1	3	1	1
CO2	3	2	2	-	2	-	-	1	2	2	1	1	2	1	2
CO3	3	2	2	1	2	1	1	2	3	3	2	2	3	2	1
	3.00	2.00	2.00	1.00	2.00	1.00	1.00	1.33	2.00	2.00	1.33	1.33	2.67	1.33	1.33

**COURSE OBJECTIVE:**

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices.
- Also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

**LIST OF EXPERIMENTS****A. FLOW MEASUREMENT**

1. Verification of Bernoulli's theorem
2. Flow through Orifice/Venturi meter
3. Friction factor for flow through pipes
4. Impact of jet on fixed plate

**B. METACENTRE**

5. Determination of metacentric height

**C. PUMPS**

6. Characteristics of Centrifugal pump
7. Characteristics of Gear pump
8. Characteristics of Submersible pump
9. Characteristics of Reciprocating pump

**D. TURBINES**

10. Characteristics of Pelton wheel turbine
11. Characteristics of Francis turbine

**TOTAL : 60 PERIODS****COURSE OUTCOMES:**

On completion of the course, the student is expected to be able to

- CO1 Verify and apply Bernoulli equation for flow measurement like Orifice/Venturi meter.
- CO2 Measure friction factor in pipes and compare with Moody diagram and verify momentum conservation law.
- CO3 Determine the performance characteristics of Rotodynamic pumps.
- CO4 Determine the performance characteristics of positive displacement pumps.
- CO5 Determine the performance characteristics of turbines.

**REFERENCES:**

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd., 2011

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	H	H	H	H	H
PO2	Problem analysis	M	M	H	H	H	H
PO3	Design / development of solutions	L	L	M	M	M	M
PO4	Investigation	H	H	H	H	H	H

PO5	Modern Tool Usage	L	L	L	L	L	L
PO6	Individual and Team work	M	M	H	H	H	H
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Civil Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Civil Engineering problems and innovation	L	L	M	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues	L	L	L	L	L	L

L - Low, M – Medium, H – High

**GE3361**

**PROFESSIONAL DEVELOPMENT**

**L T P C**  
**0 0 2 1**

**OBJECTIVES:**

To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

**MS WORD:**

**10**

**Hours**

Create and format a document  
Working with tables  
Working with Bullets and Lists  
Working with styles, shapes, smart art, charts  
Inserting objects, charts and importing objects from other office tools  
Creating and Using document templates  
Inserting equations, symbols and special characters  
Working with Table of contents and References, citations  
Insert and review comments  
Create bookmarks, hyperlinks, endnotes footnote  
Viewing document in different modes  
Working with document protection and security  
Inspect document for accessibility

**MS EXCEL:**

**10**

**Hours**

Create worksheets, insert and format data  
Work with different types of data: text, currency, date, numeric etc.  
Split, validate, consolidate, Convert data  
Sort and filter data  
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)



Work with Lookup and reference formulae  
Create and Work with different types of charts  
Use pivot tables to summarize and analyse data  
Perform data analysis using own formulae and functions  
Combine data from multiple worksheets using own formulae and built-in functions to generate results  
Export data and sheets to other file formats  
Working with macros  
Protecting data and Securing the workbook

## **MS POWERPOINT:**

**10**

### **Hours**

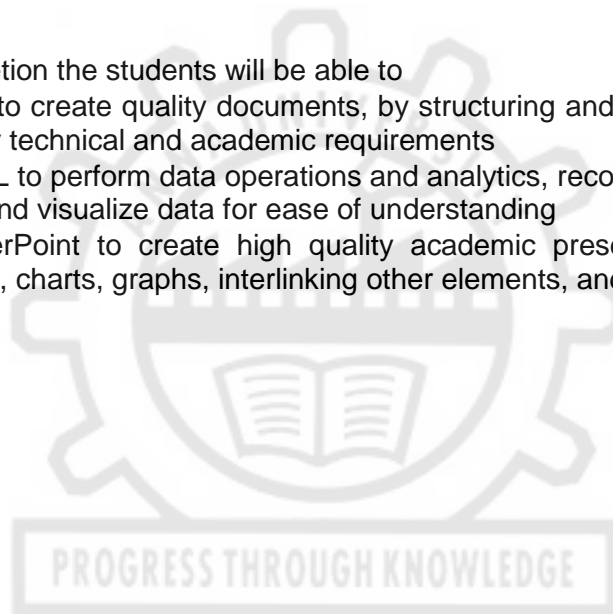
Select slide templates, layout and themes  
Formatting slide content and using bullets and numbering  
Insert and format images, smart art, tables, charts  
Using Slide master, notes and handout master  
Working with animation and transitions  
Organize and Group slides  
Import or create and use media objects: audio, video, animation  
Perform slideshow recording and Record narration and create presentable videos

**TOTAL: 30 PERIODS**

### **OUTCOMES:**

On successful completion the students will be able to

- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.



**OBJECTIVES**

- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

**UNIT I VECTOR CALCULUS****9+3**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT II ANALYTIC FUNCTION****9+3**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions  $w = z+c$ ,  $az$ ,  $\frac{1}{z}$ ,  $z^2$  - Bilinear transformation.

**UNIT III COMPLEX INTEGRATION****9+3**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

**UNIT IV LAPLACE TRANSFORMS****9+3**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

**UNIT V ORDINARY DIFFERENTIAL EQUATIONS****9+3**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL: 60 PERIODS****OUTCOMES:**

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

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem.
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems.
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities.
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

## TEXT BOOKS

1. Erwin Kreyszig , " Advanced Engineering Mathematics ", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.
2. Grewal B.S., " Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.

## REFERENCES

1. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3<sup>rd</sup> Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics ", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
5. Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd, 6<sup>th</sup> Edition, New Delhi, 2012.

AS3401

AERODYNAMICS

L T P C

3 0 0 3

## OBJECTIVES:

- To recall the governing equations of fluid mechanics.
- To understand the behaviour of airflow over bodies with particular emphasis on aerofoil sections in the incompressible and compressible flow regime.
- To introduce the Navier Stroke equations and its application
- To make the student understand the concept of vorticity, irrotationality, theory of airfoil and wing sections.
- To illustrate the conformal transformation and to extend the wing theory.
- To compare the interactions of shocks and expansion waves in fluid flow.

## UNIT I INTRODUCTION TO LOW-SPEED FLOW 9

Incompressible Bernoulli's equation – circulation and vorticity – Green's lemma and Stoke's theorem – barotropic flow – Kelvin's theorem.

## UNIT II TWO DIMENSIONAL FLOWS 9

Basic flows – Source, Sink, Free and Forced Vortex, Uniform, and Parallel Flow and their combinations – Pressure and velocity distributions on bodies with and without circulation in ideal and real fluid flows.

## UNIT III CONFORMAL TRANSFORMATION 9

Kutta Joukowski's theorem – Joukowski transformation and its application to fluid flow problems – Schwartz-Christoffer transformation – Kutta condition – Blasius theorem.

## UNIT IV AIRFOIL AND WING THEORY 9

Joukowski, Karman – Trefftz, Profiles – Thin aerofoil theory and its applications – Vortex line – Horse shoe vortex – Biot and Savart law – Lifting line theory and its limitations.

**UNIT V SHOCKS AND EXPANSION WAVES****9**

Mach number and its importance in compressible flows – Equation of motion for compressible flow in 1D – Normal shock – Rankine Hugoniot relations – oblique shock relations – strong, weak and detached shocks – isentropic flows – Prandtl Meyer expansion and expansion fans

**TOTAL = 45 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- Calculate the airspeed, static and dynamic pressure of the flow at any point using Continuity and Bernoulli equations.
- Illustrate the effect of airflow on an aircraft and its components using the laws of physics and fundamental mathematical methods
- Solve lift generation problems using aerofoil theories
- Apply the conformal transformation and its application to fluid flow problems
- Examine the fluid flow characteristics over aerofoils, wings, and airplanes.
- Examine the shock phenomenon and fluid waves.

**TEXT BOOKS:**

1. Anderson J. D., "Fundamentals of Aerodynamics", 5<sup>th</sup> Ed., McGraw-Hill, 2010.
2. Anderson J. D., "Modern Compressible Flow with Historical Perspective", TMH, 3rd Ed., 2012.
3. Clancy L. J., "Aerodynamics", Reprint Ed., Himalayan Books, 2006.
4. E Rathakrishnan, "Theoretical Aerodynamics", John Wiley, NJ, 2013

**REFERENCES:**

1. Bertin, J. J. and Cummings, R. M., "Aerodynamics for Engineers", 6<sup>th</sup> Ed., Prentice Hall, 2013.
2. Drela, M., "Flight Vehicle Aerodynamics", MIT Press, 2014.
3. Houghton, E. L., Carpenter, P. W., Collicott, S. H., and Valentine, D. T., "Aerodynamics for Engineering Students", 6<sup>th</sup> Ed., Butterworth-Heinemann, 2012.
4. Kuethe, A. M. and Chow, C. Y., "Foundations of Aerodynamics", 5<sup>th</sup> Ed., John Wiley, 1998.
5. Milne Thomson, L.H., "Theoretical aerodynamics", Dover Publications, 2011.

CO	Level of correlation of the COs with the relevant POs/PSOs														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	1	1	1	3	2	-
CO2	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-
CO3	3	3	2	-	2	-	-	-	-	1	1	2	3	1	-
CO4	3	2	1	1	2	-	-	-	-	1	1	1	3	1	-
CO5	3	2	1	1	2	-	-	-	-	1	1	1	3	2	-
CO6	3	3	2	-	3	1	1	2	-	1	1	2	1	3	2
Over all Co-relation	3	2.3	1.3	1	2	1	1	2	-	1	1	1.5	2.7	1.8	2

**COURSE OBJECTIVES:**

Of this course are

1. To provide the students an understanding of linear static analysis of determinate and indeterminate aircraft structural components.
2. To introduce the advanced concepts in the stress analysis of beams.
3. To impart knowledge and enable the student work out a variety of problems in structural analysis applying energy principles.
4. To impart knowledge on column theory and practical column design.
5. To allow the student to differentiate between various failures theories and appropriately apply a failure theory in design.

<b>UNIT I</b>	<b>BEAM &amp; TRUSS ANALYSIS</b>	<b>9</b>
Built-Up Beams – Composite Beams – Transformed-Section Method – Types of Statically Indeterminate Beams – Use of The Principle of Superposition – Analysis of Continuous Beams – Clapeyron's 3-Moment equation – Plane Frame Analysis – Truss Analysis in 2-D & 3-D.		
<b>UNIT II</b>	<b>ENERGY METHODS</b>	<b>9</b>
Energy methods – Determination of Strain Energy and Complementary Energy in a Structural Member – Castigliano's Theorems – Unit Load Method – Dummy Load Method – Application to Deflection Problems in Statically Determinate and Statically Indeterminate Systems – Beams, Trusses, Frames and Rings.		
<b>UNIT III</b>	<b>BUCKLING OF COLUMNS</b>	<b>9</b>
Buckling and Stability – Columns with Pinned Ends – Columns with Other Support Conditions – Euler's Curve – Columns with Eccentric Axial Loads – The Secant Formula for Columns – Elastic and Inelastic Column Behavior – Inelastic Buckling – Design Formulas for Columns – Ideal Column Section.		
<b>UNIT IV</b>	<b>FAILURE ANALYSIS</b>	<b>9</b>
Failure of Ductile and Brittle Materials – Theories of Failure – Maximum Normal Stress & Maximum Shear Stress Failure Envelopes – Distortion Energy Failure Theory – Octahedral Shear Stress Failure Theory – Material Fatigue – Introduction to Fatigue Failure and Fracture – Repeated Loading – The S-N Curve		
<b>UNIT V</b>	<b>DESIGN OF JOINTS</b>	<b>9</b>
Type of Joints – Bolted Joints – Determination of Stresses & Design of a Bolted Joint for Axial, Shear, and Combined Loading – Basic Design of a Welded Joint – Strength of Welding – Different Types of Rivets and Riveted Joints – Loading on a Riveted Joint – Failure Modes – Strength and Efficiency of Joints.		

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

Upon completion of the course, Students will be able to

**CO1:** Solve problems in Beam & Frame Analysis.

**CO2:** Solve problems using Energy Methods.

**CO3:** Solve problems in column buckling and carry out stability analysis.

**CO4:** Use appropriate failure theories for structural mechanics problems.

**CO5:** Design different types of Joint under different loading conditions.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	1	-	-	-	1	3	3	1	1
CO2	3	3	2	1	1	-	1	-	-	-	1	3	3	1	1
CO3	3	3	2	2	2	-	1	-	-	-	1	3	3	1	1
CO4	3	3	2	3	1	-	2	-	-	-	1	3	3	1	1
CO5	3	3	2	3	2	1	1	-	-	-	1	3	3	1	1
Avg.	3	3	2	2.4	1.6	0.2	1.2	-	-	-	1	3	3	1	1

**TEXT BOOKS:**

1. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.
2. R.K. Rajput 'Strength of Materials', S.Chand Ltd, 4th, Edition, 2006.

**REFERENCES:**

1. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985.
2. Donaldson, B.K., 'Analysis of Aircraft Structures – An Introduction' Cambridge University Press publishers, 2nd edition, 2008

AS3403

**AEROSPACE PROPULSION - I**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the principles of operation of aircraft propulsion systems.
- To extend the performances of aircraft propulsion systems.
- To introduce the working of different types of compressors and solve complex problems
- To introduce the working of different types of turbines and solve complex problems
- To understand the combustion process in Jet Engines
- To understand the basics of integral ram-rocket and its performance.

**UNIT I SUBSONIC AND SUPERSONIC INTAKES 9**  
Performance of subsonic and supersonic intakes – Performance parameters – Sources of losses – Starting problem in supersonic intakes – Modes of operation of an external compression intake.

**UNIT II CENTRIFUGAL AND AXIAL FLOW COMPRESSORS 9**  
Principle of operation – Work done and pressure rise – diffuser – Compressibility effects – non-dimensional quantities for plotting compressor characteristics – Centrifugal compressor characteristics.  
Basic operation – Elementary theory – Factors affecting stage pressure ratio – Blockage in the compressor annulus – Degree of reaction – Three-dimensional flow – Calculation of stage performance – Compressibility effects – Axial compressor characteristics.

**UNIT III AXIAL AND RADIAL FLOW TURBINES 9**  
Elementary theory of axial flow turbine – Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance – Overall turbine performance – Turbine Blade Cooling– Radial flow turbine – Operating Principle – Velocity Diagram and Applications.

**UNIT IV COMBUSTION CHAMBERS AND NOZZLES 9**

Operational requirements – Types of combustion system – Gas Turbine Combustors – Afterburners – Fuel injection in combustion chamber – Important factors affecting combustor design – Combustion chamber performance – Exhaust Nozzles – Fixed and variable geometry nozzles – Functions of nozzles – Thrust vector control – Thrust reversal.

**UNIT V RAMJET PROPULSION 9**

Thermodynamic cycle – performance parameters – Performance variation – Components – combustors – Solid and liquid ramjets – Design of a Ramjet – basics of integral ram-rocket and its performance.

**TOTAL = 45 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- Calculate the forces produced by aircraft propulsion systems using control volume and momentum equation.
- Solve complex problems in compressors used in aircraft.
- Solve complex problems in turbines used in aircraft
- Determine the phenomena which characterize the fluid dynamic behaviour of air-breathing propulsion systems.
- Determine the approximate use parameters of an existing gas turbine engine.
- Model ramjet operations, features, and problems associated with it.

**TEXT BOOKS:**

1. Farokhi, S., "Air Craft Propulsion", Wiley, 2<sup>nd</sup> Ed., 2014.
2. Hill P. G., and Peterson C. R., "Mechanics and Thermodynamics of Propulsion", Pearson Education, 2<sup>nd</sup> Ed., 2009.

**REFERENCES:**

1. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2<sup>nd</sup> Ed., 2014.
2. Oates G. C., "Aerothermodynamics of Aircraft Engine Components", AIAA Education Series, 1985.
3. Rolls Royce, "The Jet Engine", Hand Book, Wiley – 5<sup>th</sup> Ed., 2015.
4. Saravanamuttoo, H.I.H., Rogers, and G.F.C., Cohen, H., "Gas Turbine Theory", Pearson, 7<sup>th</sup> Ed., 2017.

CO	Level of correlation of the COs with the relevant POs/PSOs														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	-	-	1	1	-	2	1	1
CO2	3	3	2	1	2	1	1	-	-	-	1	-	3	2	1
CO3	2	2	1	1	1	1	1	1	-	-	1	1	3	2	1
CO4	3	3	2	1	2	-	-	-	-	-	1	1	3	2	1
CO5	3	3	2	1	2	-	-	-	-	-	1	1	3	2	1
CO6	3	3	2	1	2	-	-	1	-	1	1	2	3	2	1
Over all Co-relation	3	2.8	1.8	1	1.7	1	1	1	-	1	1	1.3	2.8	1.8	1

**COURSE OBJECTIVES:**

1. To understand the principles in the formation of mechanisms and their kinematics.
2. To learn the basic concepts of toothed gearing and kinematics of gear trains.
3. To study the effect of friction in different machine elements.
4. To analyse the forces and torque acting on simple mechanical systems
5. To understand the importance of balancing and vibration

**UNIT I KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS 9**

Mechanisms – Terminology and definitions – kinematics inversions and analysis of 4 bar and slide crank chain – velocity and acceleration polygons – cams – classifications – displacement diagrams - layout of plate cam profiles.

**UNIT II TOOTHED GEARING AND GEAR TRAINS 9**

Gear terminology – law of toothed gearing – involute gearing – Gear tooth action - Interference and undercutting – gear trains – parallel axis gear trains – epicyclic gear trains.

**UNIT III FRICTION ASPECTS IN MACHINE COMPONENTS 9**

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt drives – Friction aspects in brakes.

**UNIT IV STATIC AND DYNAMIC FORCE ANALYSIS 9**

Applied and Constrained Forces – Free body diagrams – Static equilibrium conditions – Static Force analysis in simple mechanisms – Dynamic Force Analysis in simple machine members – Inertia Forces and Inertia Torque – D'Alembert's principle.

**UNIT V BALANCING OF ROTATING MASSES AND VIBRATION 9**

Static and Dynamic balancing – Balancing of revolving masses – Balancing machines – Free vibrations – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Forced vibration – harmonic Forcing – Vibration isolation.

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

Upon completion of this course, the students will be able to:

- CO1: Design the linkages and the cam mechanisms for specified output motions.
- CO2: Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.
- CO3: Evaluate the frictional torque in screw threads, clutches, brakes and belt drives.
- CO4: Determine the forces on members of mechanisms during static and dynamic equilibrium conditions.
- CO5: Determine the balancing masses on rotating machineries and the natural frequencies of free and forced vibratory systems

**TEXT BOOK**

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.

**REFERENCES**

1. Cleghorn. W. L., Nikolai Dechev, "Mechanisms of Machines", Oxford University Press, 2015.
2. Rao.J.S. and Dukkupati.R.V. "Mechanism and Machine Theory", New Age International Pvt.Ltd., 2006.



3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
5. Thomas Bevan, "The Theory of Machines", Pearson Education Ltd., 2010

#### MAPPING OF COS AND POS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2.5	2	-	1	-	-	-	-	3	3	1	1
CO2	3	3	3	3	2	-	1	-	-	-	1	3	3	1	1
CO3	3	2.5	2.5	2.5	2	2	1	-	-	-	1	3	3	1	1
CO4	3	3	3	2.5	2	-	1	-	-	-	1	3	3	1	1
CO5	3	3	3	3	2	2	1	-	-	-	1	3	3	1	1
Avg	3	2.7	2.9	2.7	2	0.8	1	-	-	-	0.8	3	3	1	1

**GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C**  
**2 0 0 2**

#### UNIT I ENVIRONMENT AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

#### UNIT II ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

#### UNIT III RENEWABLE SOURCES OF ENERGY .

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

#### UNIT IV SUSTAINABILITY AND MANAGEMENT

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

#### UNIT V SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

**TOTAL: 30 PERIODS**

**TEXT BOOKS:**

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

**REFERENCE BOOKS :**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

**AS3411****LOW AND HIGH SPEED AERODYNAMICS LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**OBJECTIVES:**

- To study experimentally the aerodynamic forces on different bodies at low and high speeds.
- To predict different aerodynamic propulsion used in aero application
- To study airfoil and wing characteristics

**LIST OF EXPERIMENTS:**

1. Calibration of subsonic wind tunnel.
2. Illustrate the Pressure distribution over smooth and rough cylinder.
3. Illustrate the Pressure distribution over symmetric aerofoils.
4. Illustrate the Pressure distribution over cambered aerofoils & thin aerofoils.
5. Measure the forces acting on a model using wind tunnel balance.
6. Demonstrate the flow over a flat plate at different angles of incidence.
7. Show the flow visualisation studies in low speed flows over cylinders.
8. Show the flow visualisation studies in low speed flows over aerofoil with different angle of incidence.
9. Calibration of supersonic wind tunnel.
10. Show the Supersonic flow visualization with Schlieren system.

**TOTAL: 60 PERIODS**

## OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Experiment with the wind tunnel for wall effect, blockage and support interference on the measurements as well as determining the uncertainty in the measurement technique.

CO2: Determine the pressure distribution and forces acting over aerodynamical models.

CO3: Explain flow over the aerodynamical model through flow visualisation.

CO4: Illustrate the limits and usefulness of the experimental approach.

CO5: Demonstrate the experimental findings in clear oral and concise report

CO/PO	PO's												PSO's		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
CO2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
CO3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
CO4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
CO5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
	3	3	2.4	1.4	1.6	1.0	1.2	1.8	2.8	2.8	1.8	1.6	3	1.8	2

## LIST OF EQUIPMENTS

(For a batch of 30 students)

S. No	Details of Equipment	Qty Req.	Experiment No.
1	Wind Tunnel	1 No.	1, 2,3,4,5
2	Wings of various aerofoil sections (Symmetrical & cambered aerofoils)	2 Nos. each	3, 4
3	Angle of incidence changing mechanism	1 No.	3, 4
4	Multiple Manometer stands	4 Nos.	2,3,4
5	U-Tube Manometer	1 No.	1,2,3,4
6	Static Pressure Probes	4 Nos.	1,2,3,4
7	Total Pressure Probes	4 Nos.	1,2,3,4
8	Pitot-Static Tubes	4 Nos.	1,2,3,4
9	Wooden Models of Three-Dimensional bodies	2 Nos. each	2
10	Wind Tunnel balances (3 or 5 or 6 components)	1 No.	5
11	Pressure Transducers with digital display	1 No.	1,2,3,4
12	Hele-Shaw apparatus, Smoke Tunnel, Water flow channel	1 each	6,7,8
13	Supersonic Wind tunnel	1 No.	9,10
14	Wooden models of cone, wedge and blunt body configurations of suitable size for flow visualization in a supersonic wind tunnel test section	1 No.	9,10
15	Schlieren System	1 No.	10

**OBJECTIVE:**

- To experimentally study the unsymmetrical bending of beams,
- To find the location of shear centre
- To obtain the stresses in circular discs and beams using photo elastic techniques
- To calibration of photo-elastic materials and study on vibration of beams.

**LIST OF EXPERIMENTS:**

1. Unsymmetrical bending of beams.
2. Find the shear centre location for open sections.
3. Find the shear centre location for closed sections.
4. Experiment the constant strength beam.
5. Draw the flexibility matrix for cantilever beam.
6. Beam with combined loading.
7. Calibration of Photo-elastic materials.
8. Stresses in circular discs and beams using photo-elastic techniques.
9. Vibrations of beams.
10. Experiment with the Wagner beam – Tension field beam.

**TOTAL: 60 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- Evaluate the effects of bending in the aerospace structures.
- Explain the shear centre of the aerospace structures.
- Compare the photo-elastic techniques on the aerospace structures.
- Justify the experimental findings in clear oral and concise report.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	1	1	-	-	-	-	-	2	1	1
CO2	3	2	3	-	-	-	-	-	-	-	1	-	2	1	1
CO3	3	3	3	1	-	-	1	1	-	1	-	1	2	-	-
CO4	3	2	2	1	-	-	1	1	-	1	-	1	2	-	-
	3	2.3	2.3	1	1	1	1	1.00		1	1	1	2	1	1

**LIST OF EQUIPMENTS**  
(For a batch of 30 students)

S. No	Details of Equipment	Qty Req.	Experiment No.
1	Beam Test set –up	2	1, 2, 3,4
2	Unsymmetrical sections like 'Z' sections	2	1, 2, 3
3	Channel section and angle section	2	1, 2, 3
4	Dial gauges	12	1, 2, 3
5	Weights 1 Kg	10	1, 2, 3
6	Weights 2 Kg	10	1, 2, 3
7	Strain indicator and strain gauges	One set	4,5,6
8	Photo – elastic apparatus	1	7,8
9	Amplifier	2	9
10	Exciter	2	9
11	Pick – up	2	9
12	Oscilloscope	2	9
13	Wagner beam	1	10
14	Hydraulic Jack	1	10