SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

Ooty Main Road, Karamadai, Coimbatore – 641 104

(Affiliated to Anna University & Approved by AICTE, Accredited by NAAC)

B. E (MECHANICAL ENGINEERING)

(CHOICE BASED CREDIT SYSTEM)

CURRICULUM & SYLLABI

REGULATIONS 2024

(For students admitted in 2024 – 2025)

Version 1.0, dated 14.06.2025

SREE SAKTHI ENGINEERING COLLEGE

Vision:

To be recognized as an international leader in engineering education, research and the application of knowledge to benefit society globally.

Mission:

To develop high quality technical education and personnel with a sound footing on basic engineering principles, technical and managerial skills, innovative research capabilities and exemplary professional conduct to lead and to use technology for the progress of mankind, adapting themselves to changing technological environment with the highest ethical values as the inner strength.

DEPARTMENT OF MECHANICAL ENGINEERING

Vision:

To be a globally recognized pivot of innovation and excellence in Mechanical Engineering education, research, and practice, fostering future front-runners and contributing towards sustainable technological developments.

Mission:

- To provide an exceptional learning environment, practicing engineers with cutting-edge knowledge and ethical values.
- To promote interdisciplinary collaborations, engage in continuous research, and cultivate a culture of lifelong learning.
- To harness innovation, meet communal needs, and serve as a vital resource for the broader community, driving impactful change.

B. E (DEPARTMENT OF MECHANICAL ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVE (PEO's)

The 4-year rigorous B. E Mechanical Engineering programme enables a graduate with the following

PEO	OBJECTIVE
I	To excel in careers through design, analysis, experimentation, smart manufacturing, and research using modern engineering tools.
II	To boost skills and ethics to engage with stakeholders and compete globally, focusing on societal and environmental impacts.
III	To advance technology through multidisciplinary research, innovation, entrepreneurship, and lifelong learning to address global challenges.
IV	To share and apply technical knowledge globally, creating new opportunities to advance our society through teamwork and solving challenging technical, environmental, and societal problems.
V	To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

B. E (DEPARTMENT OF MECHANICAL ENGINEERING)

PROGRAMME OUTCOMES (PO's)

On completion of the programme, the engineering graduate shall acquire the following

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

B. E (DEPARTMENT OF MECHANICAL ENGINEERING)

PROGRAMME SPECIFIC OUTCOMES (PSO's)

On successful completion of the Mechanical engineering degree programme, the engineering graduate shall exhibit the following

PSO	OBJECTIVE
1	Utilize Mechanical Engineering knowledge for designing, developing, and manufacturing engineering systems.
2	Investigate research problems in mechanical engineering, considering environmental and social impacts.
3	Employ engineering analysis and data management tools to manage multidisciplinary projects effectively.

Mapping of Programme Educational Objective (PEO) and Programme Outcome (PO):

PEO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
II	3	2	2	2	2	1	1	1	3	-	2	1	2	3	3
III	3	1	2	1	2	2	1	-	1	2	-	3	3	2	2
IV	2	2	2	2	2	-	2	-	-	-	1	2	2	3	3
V	3	2	2	2	1	3	2	2	2	1	1	3	3	2	2

(1 – Low, 2 – Medium, 3 – High)

Mapping of Course Outcome (CO) and Programme Outcome (PO):

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Year	Sem	Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I Year	Semester I	24HSM101	Professional English I	1	2	2	1	1	1	1	1	2	3	1	2	-	-	-
		24BSC101	Matrices and Calculus	3	3	3	1	-	2	-	-	-	-	-	-	3	2	2
		24BSC102	Engineering Physics	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2
		24ESC101	Basic Electrical and Electronics Engineering	3	3	3	3	3	3	2	-	-	-	-	3	3	2	2
		24ESC103	Engineering Graphics	3	1	2	-	2	-	-	-	-	3	-	2	3	3	2
		24HSM102	Heritage of Tamils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24BSC121	Engineering Physics Laboratory	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		24EEN101	Career Development Skills I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24INP101	Induction Programme	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Semester II	24HSM103	Professional English II	1	2	1	1	1	2	1	1	2	2	2	1	-	-	-
		24BSC105	Statistics and Numerical Methods	3	3	1	1	1	-	-	-	2	-	2	-	3	2	3
		24BSC103	Engineering Chemistry	3	2	2	1	-	2	2	-	-	-	-	2	3	3	3
		24ESC111	Problem Solving and Python Programming	3	2	3	1	2	-	-	-	-	-	-	2	-	-	-
		24ESC104	Engineering Mechanics	3	2	3	1	2	-	-	-	-	-	-	2	3	3	2
		24HSM104	Tamils and Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24BSC122	Engineering Chemistry Laboratory	3	3	2	1	-	1	1	-	1	-	-	1	-	-	-
		24ESC121	Engineering Practices Laboratory	3	2	1	-	2	-	-	-	2	1	-	2	2	3	2
		24CDC102	Career Development Skills II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcome (CO) and Programme Outcome (PO):

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Year	Sem	Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
II Year	Semester III	24BSC201	Transforms and Partial Differential Equations	3	3	1	1	-	-	-	-	2	-	-	1	-	-	-
		24MEC201	Engineering Materials and Metallurgy	3	3	1	1	-	-	-	-	2	-	-	1	2	1	-
		24MEC202	Thermodynamics Principles and Applications	3	3	1	1	-	-	-	-	2	-	-	1	2	2	1
		24MEC211	Manufacturing Technology	3	3	1	1	-	-	-	-	2	-	-	1	2	2	1
		24MEC212	Strength of Materials	3	3	1	1	-	-	-	-	2	-	-	1	2	2	1
		24MEC213	Theory Of Machines	3	3	1	1	-	-	-	-	2	-	-	1	2	1	-
		24CDC201	**Career Development Skills III**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24CDC221	Mini Project I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24MAC***	Mandatory Course I*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Semester IV	24BSC205	Complex Variables and Transforms	3	3	1	1	-	-	-	-	2	-	-	1	-	-	-
		24ESC212	Fluid Mechanics And Machinery	3	3	1	1	-	-	-	-	2	-	-	1	-	2	1
		24MEC203	Machine Design	3	3	1		-	-	-	1	-	-	-		1	2	1
		24MEC214	Heat Power Engineering	3	3	1	1	-	-	-	-	2	-	-	1	2	1	-
		24MEC215	Engineering Metrology and Measurements	3	3	1	1	-	-	-	-	2	-	-	1	2	-	1
		24BSC207	Environmental Science and Sustainability	3	1	1	-	-	3	1	-	-	-	-	2	1	-	-
		24CDC202	**Career Development Skills IV**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24CDC222	Mini Project II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24MAC221	Summer Internship I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcome (CO) and Programme Outcome (PO):

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Year	Sem	Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
III Year	Semester V	24MEC301	Industrial Automation system	3	3	1	1	-	-	-	-	2	-	-	1	2	1	-
		24MEC311	CAD/CAM	3	3	1	1	-	-	-	-	2	-	-	1	-	2	-
		24MEC312	Hydraulics And Pneumatics	3	3	1	1	-	-	-	-	2	-	-	1	-	1	-
		24CDC301	**Career Development Skills V**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24CDC321	Mini Project III	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24MAC***	Mandatory Course II*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Semester VI	24MEC302	Operation Research	3	3	1	1	-	-	-	-	2	-	-	1	1	2	1
		24MEC312	Mechatronics and IOT	3	3	1	1	-	-	-	-	2	-	-	1	-	2	-
		24CDC302	**Career Development Skills VI**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24CDC323	Mini Project IV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24MAC321	Summer Internship II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24MAC***	Mandatory Course III*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcome (CO) and Programme Outcome (PO):

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Year	Sem	Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IV Year	Semester VII	24MEC401	Process Planning and Cost Estimation	3	3	1	1	-	-	-	-	2	-	-	1	1	2	-
		24MEC411	Finite Element Analysis	3	3	1	1	-	-	-	-	2	-	-	1	2	2	1
		24HSM401	Professional Ethics and Human Values	1	1	1	-	-	3	2	3	2	1	1	1	1	1	-
		24CDC401	**Career Development Skills VII**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		24CDC422	Project Work Phase I	3	3	3	3	3	2	2	2	-	-	-	3	-	-	-
	Semester VIII	24CDC423	Project Work Phase II	3	3	3	3	3	2	2	2	-	-	-	3	-	-	-

SREE SAKTHI ENGINEERING COLLEGE

B. E (MECHANICAL ENGINEERING)

CURRICULUM STRUCTURE

CATEGORY	PROPOSED MINIMUM CREDITS
Foundation Core Courses (FCC)	
a) Humanities, Social Sciences and Management Courses (HSMC)	12
b) Basic Science Courses (BSC)	28
c) Engineering Science Courses (ESC)	20
Professional Core Courses (PCC)	54
Professional Elective Courses (PEC)	18
Open Elective Courses (OEC)	12
Employability Enhancement Courses (EEC)	21
Mandatory Courses (MC)	No Credit
TOTAL MINIMUM CREDITS	**165**

COURSE TYPOLOGY

REFERENCE	COURSE TYPE
T	Theory
TP	Theory-cum-Practical
P	Practical

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester I

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24HSM101	Professional English I	HSMC	T	3	3	0	0	3
2	24BSC101	Matrices and Calculus	BSC	T	4	3	1	0	4
3	24BSC102	Engineering Physics	BSC	T	3	3	0	0	3
4	24ESC101	Basic Electrical and Electronics Engineering	ESC	T	3	3	0	0	3
5	24ESC103	Engineering Graphics	ESC	T	6	2	0	4	4
6	24HSM102	Heritage of Tamils	HSMC	T	1	1	0	0	1
7	24BSC121	Engineering Physics Laboratory	BSC	P	4	0	0	4	2
8	24CDC101	Career Development Skills I	EEC	T	1	1	0	0	1
9	24INP101	Induction Programme	-	-	-	-	-	-	0
Total					**25**	**16**	**1**	**8**	**21**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester II

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24HSM103	Professional English II	HSMC	T	3	3	0	0	3
2	24BSC105	Statistics and Numerical Methods	BSC	T	4	3	1	0	4
3	24BSC103	Engineering Chemistry	BSC	T	3	3	0	0	3
4	24ESC111	Problem Solving and Python Programming	ESC	TP	5	3	0	2	4
5	24ESC104	Engineering Mechanics	ESC	T	3	3	0	0	3
6	24HSM104	Tamils and Technology	HSMC	T	1	1	0	0	1
7	24BSC122	Engineering Chemistry Laboratory	BSC	P	4	0	0	4	2
8	24ESC121	Engineering Practices Laboratory	ESC	P	4	0	0	4	2
9	24CDC102	Career Development Skills II	EEC	T	1	1	0	0	1
Total					**28**	**17**	**1**	**10**	**23**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester III

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24BSC201	Transforms and Partial Differential Equations	BSC	T	4	3	1	0	4
2	24MEC201	Engineering Materials and Metallurgy	PCC	T	3	3	0	0	3
3	24MEC202	Thermodynamics Principles and Applications	PCC	T	3	3	0	0	3
4	24MEC211	Manufacturing Technology	PCC	TP	5	3	0	2	4
5	24MEC212	Mechanics of Materials	PCC	TP	5	3	0	2	4
6	24MEC213	Theory Of Machines	PCC	TP	5	3	0	2	4
7	24CDC201	Career Development Skills III	EEC	T	1	1	0	0	1
8	24CDC221	Mini Project I	EEC	P	2	0	0	2	1
9	24MAC***	Mandatory Course I*	MC	T	1	1	0	0	0
Total					**29**	**20**	**1**	**8**	**24**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester IV

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24BSC205	Complex Variables and Transforms	BSC	T	4	3	1	0	4
2	24ESC212	Fluid Mechanics And Machinery	ESC	TP	5	3	0	2	4
3	24MEC203	Machine Design	PCC	T	3	3	0	0	3
4	24MEC214	Heat Power Engineering	PCC	TP	5	3	0	2	4
5	24MEC215	Engineering Metrology and Measurements	PCC	TP	5	3	0	2	4
6	24BSC207	Environmental Science and Sustainability	BSC	T	2	2	0	0	2
7	24CDC202	Career Development Skills IV	EEC	T	1	1	0	0	1
8	24CDC222	Mini Project II	EEC	P	2	0	0	2	1
9	24MAC221	Summer Internship I	MC	P	0	0	0	0	0
Total					**27**	**19**	**1**	**08**	**23**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester V

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24MEC301	Industrial Automation system	PCC	T	3	3	0	0	3
2	24MEC311	CAD/CAM	PCC	TP	5	3	0	2	4
3	24MEC312	Hydraulics And Pneumatics	PCC	TP	5	3	0	2	4
4	24MEP***	Professional Elective I*	PEC	T	3	3	0	0	3
5	24MEP***	Professional Elective II*	PEC	T	3	3	0	0	3
6	24MEP***	Professional Elective III*	PEC	T	3	3	0	0	3
7	24CDC301	Career Development Skills V	EEC	T	1	1	0	0	1
8	24CDC321	Mini Project III	EEC	P	2	0	0	2	1
9	24MAC***	Mandatory Course II*	MC	T	1	1	0	0	0
Total					**26**	**20**	**0**	**6**	**22**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester VI

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24MEC302	Operation Research	PCC	T	3	3	0	0	3
2	24MEC312	Mechatronics and IOT	PCC	TP	5	3	0	2	4
3	24MEP***	Professional Elective IV*	PEC	T	3	3	0	0	3
4	24MEP***	Professional Elective V*	PEC	T	3	3	0	0	3
5	24MEO***	Open Elective I*	OEC	T	3	3	0	0	3
6	24HSM3**	Management Elective*	HSMC	T	2	2	0	0	2
7	24CDC302	Career Development Skills VI	EEC	T	1	1	0	0	1
8	24CDC323	Mini Project IV	EEC	P	2	0	0	2	1
9	24MAC321	Summer Internship II	MC	P	0	0	0	0	0
10	24MAC***	Mandatory Course III*	MC	T	1	1	0	0	0
Total					**23**	**19**	**0**	**4**	**20**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester VII

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24MEC401	Process Planning and Cost Estimation	PCC	T	3	3	0	0	3
2	24MEC411	Finite Element Analysis	PCC	TP	5	3	0	2	4
3	24HSM401	Professional Ethics and Human Values	HSMC	T	2	2	0	0	2
4	24MEO***	Open Elective II*	OEC	T	3	3	0	0	3
5	24MEO***	Open Elective III*	OEC	T	3	3	0	0	3
6	24CDC401	Career Development Skills VII	EEC	P	2	0	0	2	1
7	24CDC422	Project Work Phase I	EEC	P	4	0	0	4	2
Total					**22**	**14**	**0**	**8**	**18**

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

Semester VIII

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1	24MEP***	Professional Elective VI*	PEC	T	3	3	0	0	3
2	24MEO***	Open Elective IV*	OEC	T	3	3	0	0	3
3	24CDC423	Project Work Phase II	EEC	P	16	0	0	16	8
Total					**22**	**6**	**0**	**16**	**14**

PROFESSIONAL ELECTIVE COURSES

PROFESSIONAL ELECTIVE I, II, III

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1.	24MEP001	Lean Manufacturing	PEC	T	3	3	0	0	3
2.	24MEP002	Renewable Energy	PEC	T	3	3	0	0	3
3.	24MEP003	Non Traditional Machining Process	PEC	T	3	3	0	0	3
4.	24MEP004	Casting and Welding process	PEC	T	3	3	0	0	3
5.	24MEP005	Ergonomics in Design	PEC	T	3	3	0	0	3
6.	24MEP006	Tool & Die Design	PEC	T	3	3	0	0	3
7.	24MEP007	Composite Materials	PEC	T	3	3	0	0	3
8.	24MEP008	Smart Materials and Structures	PEC	T	3	3	0	0	3
9.	24MEP009	Welding Technology	PEC	T	3	3	0	0	3
10.	24MEP010	Industrial Layout Design and Safety	PEC	T	3	3	0	0	3
11.	24MEP011	Automobile Engineering	PEC	T	3	3	0	0	3
12.	24MEP012	Gas Dynamics And Jet Propulsion	PEC	T	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, V, VI

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1.	24MEP013	Additive Manufacturing	PEC	T	3	3	0	0	3
2.	24MEP014	Design Thinking	PEC	T	3	3	0	0	3
3.	24MEP015	Value Engineering	PEC	T	3	3	0	0	3
4.	24MEP016	Digital Manufacturing	PEC	T	3	3	0	0	3
5.	24MEP017	Power Plant Engineering	PEC	T	3	3	0	0	3
6.	24MEP018	Industry 4.O	PEC	T	3	3	0	0	3
7.	24MEP019	Alternative Fuels in I.C Engines	PEC	T	3	3	0	0	3
8.	24MEP020	Topology Optimization and Generative Design	PEC	T	3	3	0	0	3
9.	24MEP021	Hydrogen Engine Technology	PEC	T	3	3	0	0	3
10.	24MEP022	Refrigeration and Air Conditioning	PEC	T	3	3	0	0	3
11.	24MEP023	Computer Integrated Manufacturing	PEC	T	3	3	0	0	3
12.	24MEP024	Foundation of Robotics	PEC	T	3	3	0	0	3

MANDATORY COURSES (Offered as Non-Credit Courses)

MANDATORY COURSES I, II, III

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P
1	24MAC001	Constitution of India	MC	T	1	1	0	0
2	24MAC002	Industrial Safety	MC	T	1	1	0	0
3	24MAC003	Entrepreneurship	MC	T	1	1	0	0
4	24MAC004	Film Appreciation	MC	T	1	1	0	0
5	24MAC005	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	T	1	1	0	0
6	24MAC006	Introduction to Women and Gender Studies	MC	T	1	1	0	0
7	24MAC007	Elements of Literature	MC	T	1	1	0	0

MANDATORY COURSES INTERNSHIP I, II

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P
1	24MAC221	Summer Internship I	MC	P	0	0	0	0
2	24MAC321	Summer Internship II	MC	P	0	0	0	0

MANAGEMENT ELECTIVE COURSES

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P	Credits
1	24HSM301	Principles of Management	HSMC	T	2	2	0	0	2
2	24HSM302	Total Quality Management	HSMC	T	2	2	0	0	2
3	24HSM303	Engineering Economics and Financial Accounting	HSMC	T	2	2	0	0	2
4	24HSM304	Human Resource Management	HSMC	T	2	2	0	0	2
5	24HSM305	Knowledge Management	HSMC	T	2	2	0	0	2
6	24HSM306	Industrial Management	HSMC	T	2	2	0	0	2

OPEN ELECTIVE COURSES

OPEN ELECTIVES OFFERED BY THE PARENT DEPARTMENT: (MECHANICAL ENGINEERING)

Sl. No	Course Code	Course Name	Category	Type (T/P/TP)	Contact Periods / Week	L	T	P	Credits
1.	24MEO001	Drone Technologies	OEC	T	3	3	0	0	3
2.	24MEO002	Introduction to Six Sigma	OEC	T	3	3	0	0	3
3.	24MEO003	Sustainable Engineering	OEC	T	3	3	0	0	3
4.	24MEO004	Foundation Skills in Integrated Product Development	OEC	T	3	3	0	0	3
5.	24MEO005	Maintenance Engineering	OEC	T	3	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF CIVIL ENGINEERING

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P	Credits
1	24CEO001	Environment and Agriculture	OEC	T	3	3	0	0	3
2	24CEO002	Green Building Design	OEC	T	3	3	0	0	3
3	24CEO003	Geographical Information System	OEC	T	3	3	0	0	3
4	24CEO004	Climate Change and its Impacts	OEC	T	3	3	0	0	3
5	24CEO005	Disaster Management	OEC	T	3	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P	Credits
1	24EEO001	Sustainable and Environmental Friendly HV Insulation System	OEC	T	3	3	0	0	3
2	24EEO002	Smart Grids	OEC	T	3	3	0	0	3
3	24EEO003	Hybrid Energy Technology	OEC	T	3	3	0	0	3
4	24EEO004	Introduction to PLC Programming	OEC	T	3	3	0	0	3
5	24EEO005	Flexible AC Transmission Systems	OEC	T	3	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P	Credits
1	24ECO001	Introduction to Control Engineering	OEC	T	3	3	0	0	3
2	24ECO002	Semiconductor Manufacturing	OEC	T	3	3	0	0	3
3	24ECO003	Mechatronics	OEC	TP	4	2	0	2	3
4	24ECO004	Sensors and Actuators	OEC	T	3	3	0	0	3
5	24ECO005	Wireless Network	OEC	T	3	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

Sl. No	Course Code	Course Name	Category	Type	Contact Periods / Week	L	T	P	Credits
1	24CSO001	Generative AI	OEC	T	3	3	0	0	3
2	24CSO002	Game Programming	OEC	T	3	3	0	0	3
3	24CSO003	Neural Networks and Deep Learning	OEC	T	3	3	0	0	3
4	24CSO004	Introduction to Augmented Reality (AR) / Virtual Reality (VR)	OEC	T	3	3	0	0	3
5	24CSO005	High Speed Networks	OEC	T	3	3	0	0	3

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

CREDIT SUMMARY – SEMESTER BASIS

Category / Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
HSMC	4	4	-	-	-	2	2	-	**12**
BSC	9	9	4	6	-	-	-	-	**28**
ESC	7	9	-	4	-	-	-	-	**20**
PCC	-	-	18	11	11	7	7	-	**54**
PEC	-	-	-	-	9	9	-	-	**18**
OEC	-	-	-	-	-	-	6	6	**12**
EEC	1	1	2	2	2	2	3	8	**21**
MC	-	-	✓	✓	✓	✓	✓	-	0
Total Credits	**21**	**23**	**24**	**23**	**22**	**20**	**18**	**14**	**165**

ENROLLMENT FOR (HONOURS) MINOR DEGREE (OPTIONAL)

A student can optionally register for additional courses (18 credits) from semester V onwards and become eligible for the award of B.E / B. Tech (Honours) or Minor degree. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, the student can register for courses from from any one of the other programmes. Moreover, the student can register for courses from any one of the following verticals also.

Verticals for Minor Degree (In addition to all the verticals of other programmes)

Verticals I	Verticals II	Verticals III	Verticals IV	Verticals V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and 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

VERTICAL1: FINTECH AND BLOCKCHAIN

Sl. No	Course Code	Course Name	Type	Contact Periods / Week	L	T	P	Credits
1	24HOF001	Financial Management	T	3	3	0	0	3
2	24HOF002	Fundamentals of Investment	T	3	3	0	0	3
3	24HOF003	Banking Financial Services and Insurance	T	3	3	0	0	3
4	24HOF004	Introduction to Block Chain and its Applications	T	3	3	0	0	3
5	24HOF005	Introduction to Fintech	T	3	3	0	0	3
6	24HOF006	Fintech Personal Finance and Payments	T	3	3	0	0	3

VERTICAL2: ENTREPRENEURSHIP

Sl. No	Course Code	Course Name	Type	Contact Periods / Week	L	T	P	Credits
1	24HOE001	Foundations of Entrepreneurship	T	3	3	0	0	3
2	24HOE002	Team Building and Leadership Management for Business	T	3	3	0	0	3
3	24HOE003	Creativity and Innovation in Entrepreneurship	T	3	3	0	0	3
4	24HOE004	Principles of Marketing Management for Business	T	3	3	0	0	3
5	24HOE005	Human Resource Management for Entrepreneurship	T	3	3	0	0	3
6	24HOE006	Financing New Business Ventures	T	3	3	0	0	3

VERTICAL3: PUBLICADMINISTRATION

Sl. No	Course Code	Course Name	Type	Contact Periods / Week	L	T	P	Credits
1	24HOP001	Principles of Public Administration	T	3	3	0	0	3
2	24HOP002	Constitution of India	T	3	3	0	0	3
3	24HOP003	Public Personnel Administration	T	3	3	0	0	3
4	24HOP004	Administrative Theories	T	3	3	0	0	3
5	24HOP005	Indian Administrative System	T	3	3	0	0	3
6	24HOP006	Public Policy Administration	T	3	3	0	0	3

VERTICAL4: BUSINESS DATA ANALYTICS

Sl. No	Course Code	Course Name	Type	Contact Periods / Week	L	T	P	Credits
1	24HOB001	Statistics for Management	T	3	3	0	0	3
2	24HOB002	Data Mining for Business Intelligence	T	3	3	0	0	3
3	24HOB003	Human Resource Analytics	T	3	3	0	0	3
4	24HOB004	Marketing and Social Media Web Analytics	T	3	3	0	0	3
5	24HOB005	Operation and Supply Chain Analytics	T	3	3	0	0	3
6	24HOB006	Financial Analytics	T	3	3	0	0	3

VERTICAL5: ENVIRONMENTANDSUSTAINABILITY

Sl. No	Course Code	Course Name	Type	Contact Periods / Week	L	T	P	Credits
1	24HOS001	Sustainable infrastructure Development	T	3	3	0	0	3
2	24HOS002	Sustainable Agriculture and Environmental Management	T	3	3	0	0	3
3	24HOS003	Sustainable Bio Materials	T	3	3	0	0	3
4	24HOS004	Materials for Energy Sustainability	T	3	3	0	0	3
5	24HOS005	Green Technology	T	3	3	0	0	3
6	24HOS006	Environmental Quality Monitoring and Analysis	T	3	3	0	0	3

SREE SAKTHI ENGINEERING COLLEGE

(Autonomous)

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

B. E MECHANICAL ENGINEERING

SYLLABI

SEMESTER I:

Course Code : 24HSM101	**Course Title : Professional English I**	
Course Category : HSMC	**Credits : 3**	
L:T:P(Hours/Week) : 3:0:0	**Total Contact Hours : 45**	**Max Marks : 100**

COURSE OBJECTIVES:

- Develop speaking skills to confidently introduce oneself, express preferences, and share opinions in various settings.
- Master reading strategies like skimming and scanning to understand and analyze information from different texts effectively.
- Engage actively in group discussions, present ideas clearly, discuss different perspectives, and participate in role-plays.
- Learn to write clear emails, summaries, and structured paragraphs while comparing and analyzing information from diverse sources.
- Demonstrate proficiency in writing essays, narratives, and dialogues using appropriate grammar and effective sentence transformations.

UNIT I: INTRODUCTIONTOEFFECTIVESPEAKING 9

Listening –short text - formal & informal conversation –telephone conversation, Classroom lectures **Speaking** - Introducing oneself, one's family / friend; Talk about preferences – Agree and Disagree –Giving opinions - **Reading** – Telephone message - Introduction of different kinds of reading materials (Technical and Non-technical) - **Writing** –principles of writing –Word formation–Word expansion (root words/etymology) Hints development, Reading comprehension exercises - **Grammar**-Parts of speech, Questions –WH type, Yes/ No and Tag Questions.

UNIT II: DIFFERENT STRATEGIES OF READING 9

Listening- Listening to travel podcast- travel documentary, Listening and responding to video lectures / Talks- **Speaking**- Strategies for good conversation- Improving fluency and self-expression– Articulation– Accent and intonation - **Reading** - Different reading strategies,

Skimming, Scanning – Newspaper report -**Writing** –Descriptions, Instructions, Recommendations, Definitions –Single sentence definition–**Grammar**-Types of sentences, Prepositions, Modal verbs.

UNIT III: **GROUPINTERACTION** **9**

Listening –Radio and TV advertisements, speeches of great personalities –**Speaking**- Group interaction - Speaking in formal situations (teachers, officials, foreigners), role-play – **Reading** - An article, excerpts from literature – **Writing** - Paragraph writing, Letter writing – Formal – informal **Grammar**- Synonym and antonym, Tenses, Adjectives-Cause and Effect expressions.

UNIT IV: INTRODUCTIONTOEFFECTIVEWRITING **9**

Listening-Listening to announcements, discussions/debates-Speaking- Responding to questions – Different forms of interviews – welcome address, vote of thanks - Reading – Longer technical texts, social media posts and brochures, comparing facts and figures-Writing-Email-etiquette, summarizing and paragraphing – Single word substitutes - Free writing on any given topic (My favorite place/Hobbies/School life, etc.) Grammar– sentence pattern, idioms, Adverbs and Phrasal verbs.

UNIT V: EFFECTIVE WRITING **9**

Listening -Listening to dialogues ,conversations and completing exercises based on them – Listening to longer texts and filling up the table **Speaking** – sharing information of a personal kind – greeting- peer discussion **Reading** - Reading and understanding specific meaning in a text - note making, reviews related to given topic -**Writing–** Types of essays, story writing-dialogue writing, Use of abbreviations and acronyms –**Grammar–** transformation of sentences (simple, compound and complex),Collocations, fixed and semi fixed expressions.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Understand effective speaking skills to introduce themselves, describe preferences, discuss opinions, and engage in both formal and informal conversations confidently.	Understand
CO 2: Analyze different reading strategies such as skimming and scanning to understand information from various texts, including travel podcasts, video lectures, and newspaper reports.	Analyze
CO 3: Constructively engage in group discussions, articulating ideas clearly in formal settings, exploring diverse viewpoints, and effectively analyzing	Understand

speeches and articles.	
CO 4: Apply skills to write clear emails, summarize information effectively, and analyze facts and figures from technical texts and social media posts.	Apply
CO 5: Identify advanced writing abilities to create well-structured essays, stories, and dialogues using expressive language techniques.	Understand

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	1	1	1	1	1	3	-	1	-	-	-
CO2	1	2	1	1	1	1	1	1	1	1	1	2	-	-	-
CO3	1	-	-	1	1	1	1	1	2	2	1	1	-	-	-
CO4	1	2	1	1	1	1	1	1	1	2	1	1	-	-	-
CO5	1	1	2	1	1	1	1	1	1	2	1	1	-	-	-
MAX	1	2	2	1	1	1	1	1	2	3	1	2	-	-	-

High-3; Medium-2;Low-1; No Correlation

Text Book(s) :

T1. Locker, Kitty O., and Stephen KyoKaczmarek. Business Communication: BuildingCritical Skills. 6th ed., McGraw-Hill, 2013.

T2. Singh, Neetu. English for General Competitions: From Plinth to Paramount. n.d.T3. Orient Blackswan. English for Engineers and Technologists.Vol. 1, 2022.

T4. Richards, Jack C. Interchange Student's Book 1. 4th ed., Cambridge University Press, 2015.

Reference Book(s):

R1.Verderber, Rudolph F., and Kathleen S. Verderber.Communicate! A Handbook for Interpersonal Communication.Cengage Learning, 2017.

R2.Wallwork, Adrian.English for Academic Correspondence and Socializing.Springer,2011.

R3. Chaturvedi, P.D., and MukeshChaturvedi.Business Communication: Concepts, Cases, and Applications. n.d.

R4. Raman, Meenakshi, and Sangeetha Sharma.Technical Communication: Principles and Practice. Oxford University Press, 2014.

Course Code : 24BSC101	**Course Title: Matrices and Calculus**	
Course Category: BSC	**Credits: 4**	
L:T:P(Hours/Week) : 3:1:0	**Total Contact Hours:60**	**Max Marks:100**

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques for practical applications in engineering.
- To use derivatives to analyze functions such as maxima / minima, concavity, inflection
- To apply advanced techniques of partial differentiation and Jacobian's matrices.
- To develop a strong understanding of double integral calculus, apply double integrals to solve real world problems.
- To enhance problem solving skills using triple integral calculus.

UNIT- I MATRICES 9 +3

Eigen values and Eigenvectors of a real matrix – Properties of Eigen values and Eigenvectors – Cayley – Hamilton theorem(excluding proof) – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation .

UNIT - IIDIFFERENTIAL CALCULUS 9+3

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules – Applications Maxima and Minima of functions of one variable – Absolute maximum and Absolute minimum – Concave upward, Concave downward.

UNIT- III MULTI VARIABLE CALCULUS 9+3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobian's – 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 DOUBLE INTEGRAL 9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves- Change of variables in double integrals.

UNIT V TRIPLE INTEGRAL AND ITS APPLICATIONS 9+3

Evaluation of Triple integrals –- Simple Problems- Volume as triple integrals - Volume of solids – Change of variables in triple integrals.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Identify and solve algebraic Eigen value problems from the practical areas in the engineering.	Analyze
CO 2: Understand the concepts of derivatives, limit, continuity and to demonstrate the critical thinking, analytical skills in mathematical problem solving.	Understand
CO 3: Apply differentiation to optimize functions of multiple variables using partial derivatives and Lagrange multiplier.	Apply
CO 4: Use double integrals to calculate areas, volumes and surface areas of different regions and objects.	Apply
CO 5: Calculate Volumes of solids using triple integrals in cylindrical and spherical co-ordinates.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	2	-	-	-	-	-	-	3	2	1
2CO2	3	3	3	1	-	2	-	-	-	-	-	-	3	1	2
CO3	3	3	3	1	-	2	-	-	-	-	-	-	2	1	-
CO4	3	3	3	1	-	2	-	-	-	-	-	-	3	2	2
CO5	3	3	3	1	-	2	-	-	-	-	-	-	3	2	1
MAX	3	3	3	1	-	2	-	-	-	-	-	-	3	2	2

High-3; Medium-2; Low-1; No Correlation

Text Book(s):

T1. Kreyszig Erwin, " Advanced Engineering Mathematics", John Wiley And Sons (Asia) Limited, New Delhi, 10th Edition, 2019

T2. James Stewart, " Calculus: Early Transcendentals ", Cengage Learning 9thEdition,New Delhi, 2017.

T3. David C Lay, "Linear Algebra and its Applications", Pearson Publications, 5thEdition, India, 2016.

Reference Book(s):

R1. Jain RK and Iyengar SRK., "Advanced Engineering Mathematics", Narsa Publications, New Delhi, 5th Edition, 2017.

R2. SrimanthaPal and Bhunia S.C, " Engineering Mathematics " Oxford University Press.

R3. Patrick M, Fitz Patrick, " Advanced Calculus"- 2nd Edition , American Mathematical Society (2006).

Course Code : 24BSC102	**Course Title :Engineering Physics**	
Course Category : BSC	**Credits : 3**	
L:T:P(Hours/Week) : 3:0:0	**Total Contact Hours : 45**	**Max Marks : 100**

COURSE OBJECTIVES:

- To apply the knowledge of properties of matter in real world engineering applications.
- To analyze and characterize fiber optics and laser beams.
- To analyze thermal properties of matter and energy transfer processes.
- To analyze and explain the semiconductor materials and its application.
- To understand and apply the fundamental principles and mathematical formalism of quantum physics.

UNIT I: PROPERTIES OF MATTER 9

Introduction-Elasticity-Stress-strain: Types of strain-Hooke's law- Stress - Strain Diagram and uses -Yield point-Elastic limit-Elastic moduli-Types of elastic moduli-Relation between elastic constants-Poisson's Ratio -Factors affecting elasticity- Bending of beam-Expression for bending moment and depression - Cantilever: Theory and Experimental determination-Expression for Young's modulus by Non uniform-Uniform bending and experimental determination-I-shape girders-Other states of matter.

UNIT II: LASER AND FIBER OPTICS 9

LASER: Interaction of radiation with matter (Quantum mechanical view): Principle of spontaneous emission and stimulated emission-Einstein Coefficients-Derivation-Difference between spontaneous emission and stimulated emission-Basic components in Laser-Principle of laser-properties of laser-Types of lasers: Nd-YAG laser,CO_2 laser, Semiconductor laser: Homojunction- Heterojunctions- Application of laser.

FIBER OPTICS: Fiber optics-principle of optical fibers- acceptance angle-total internal reflection-numerical aperture-types of optical fibre-losses in fibres: scattering losses-absorption losses-fiber optics sensors: Displacement sensors-pressure sensor with micro bending concept-application of fiber optic sensors-characteristics advantages of fiber optical sensors.

UNIT III: THERMAL PHYSICS 9

Transfer of heat energy-conduction-convection-radiation- Thermal expansion of solids: Relation between α and β -Thermal expansion of liquids-Thermal Conduction/Conductivity: Heat conduction in solids-Heat Conduction through Compound media Series and Parallel-Radial flow of Heat-Analogy between thermal and electrical conduction-Experimental Measurement of

Thermal Conductivity: Forbes Method (Good Conductor) -Lee's Disc Method for finding Thermal Conductivity (Bad Conductor)-Convection: Thermal insulation-U-values-Radiation: High temperature furnace-Heat Exchangers-Greenhouse effect–Solar power-Refrigerators-Ovens.

UNIT IV: SEMICONDUCTOR AND ITS APPLICATION 9

Introduction-Basics of the band theory of solids-Types of semiconductors-Hall effect-determination of Hall coefficient-P-N junction diode-voltage -current characteristics of a P-N junction diode-Introduction to optoelectronic devices-LED-construction, working and applications- OLED- construction, working and applications-Solar cell-construction, working and applications.

UNIT V: QUANTUM PHYSICS 9

Introduction-Black body radiation –Compton effect: theory and experimental verification – wave particle duality – electron diffraction –concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations –particle in a one-dimensional box –Tunnelling - Scanning tunnelling microscope.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply the knowledge of properties of matter to real world engineering applications	Apply
CO2: Analyze and characterize fiber optics and laser beams.	Analyze
CO3: Analyze the behavior of thermal system.	Analyze
CO4: Analyze and explain the semiconductor materials and its application.	Analyze
CO5 Understand fundamental principles and mathematical formalism of quantum physics.	Understand

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	2	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-	2
MAX	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2

High-3; Medium-2; Low-1; No Correlation

Text Book(s) :

T1. Avathanulu M.N and Kshirsagar P.G, "A text book of Engineering Physics", S. Chand and company, 11th Edition,2014.

T2. Bhattacharya D.K and Poonam T, "Engineering Physics", Oxford University Press, 2017.

T3. Halliday D, Resnick R and Walker J, "Principles of Physics", Wiley, 9th Edition, 2010.

T4. Engineering Physics, Rajendran V., Tata McGraw-Hill Education Pvt. Ltd., 2010 .

Reference Book(s):

R1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill, 9th Edition, 2015.

R2. Engineering Physics, R K Gaur and S L Gupta DhanpatRai Publications.Edition,2014.

R3. "Physics" by David J. Johnson.

R4. Concepts of Physics, H. C. Vermavol 1 and 2, BharatiBhawan Publishers & Distributors; First edition (2017).

Course Code : 24ESC101	**Course Title : Basic Electrical and Electronics Engineering**	
Course Category : ESC	**Credits : 3**	
L:T:P(Hours/Week) : 3:0:0	**Total Contact Hours : 45**	**Max Marks : 100**

COURSE OBJECTIVES:

- To introduce the basics of electrical fundamentals
- To understand about Electrical Safety.
- To understand the concepts of DC machines and Transformer
- To impart the knowledge of various Measuring Instruments
- To study the basics of Electronics and the fundamentals of digital electronics

UNIT I: ELECTRICAL FUNDAMENTALS 9

Current – Voltage – Types – Resistor, Inductor, Capacitor – Ohm's law – Fuse – Characteristics of fuse element – fuse Methods of earthing, Protective devices- Circuit Breaker – Types - Efficient use of electricity- Tariff- Types – Energy calculation materials – Types – Current carrying capacity – A.C fundamentals – single phase and three phase connections –Domestic wiring - Earthing –

UNIT II : ELECTRICAL SAFETY 9

Terms and definitions - objectives of safety and security measures - Hazards associated with electric current and voltage - Primary and secondary electrical shocks- Possibilities of getting electrical shock and its severity - Medical analysis of electric shocks and its effects - Prevention of shocks - Safety precautions against contact shocks- Safety precautions and First Aid - Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT-III: ELECTRICAL MACHINES AND TRANSFORMER 9

DC Generator– Construction, Principle of Operation, EMF equation, Types. DC Motor–Principle of Operation, Types. Single Phase Transformers – Construction, Working Principle, Applications. (Qualitative Treatment only for all topics).

UNIT IV : MEASUREMENTS AND MEASURING INSTRUMENTS 9

Introduction – Analog and Digital instruments – types – PMMC – MI instruments – Measurement of Power - Power in DC and AC circuits – Measurement in single phase circuits – Measurement of Energy – Constructional and working principles of energy meter – Megger – Multimeter – Oscilloscope – Signal generation, signal analysis and fibre optics measurements.

UNIT V: ELECTRONICS FUNDAMENTALS & DIGITAL ELECTRONICS 9

P-N junction diode –VI characteristics- Zener Diode- Half wave and Full wave rectifiers- BJT- PNP and NPN – Filters-– Optoelectronic devices Binary Number System, Logic Gates, Boolean Algebra, Full and Half Adders, A/D Conversion and D/A Conversion.

Total: 45 Hours

COURSE OUTCOMES:

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

CO	OUTCOME
CO1	Understand and apply the basic concepts in Electrical Engineering
CO2	Apply the concept of Electrical Safety
CO3	Understand the basic concepts of DC machines and Transformers
CO4	Understand the fundamental art of measurement in engineering
CO5	Explain the structure and operation of Electronic devices and the basic of digital electronics

MAPPING OF CO – PO & PSO:

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	2	-	-	-	-	-	3	1	2	2
2	2	1	3	2	2	3	2	-	-	-	-	3	2	1	1
3	3	3	2	2	2	2	-	-	-	-	-	3	-	-	-
4	3	3	2	2	1	2	-	-	-	-	-	3	-	1	-
5	3	3	2	2	1	1	-	-	-	-	-	3	3	2	1
Max	3	3	3	3	3	3	2	-	-	-	-	3	3	2	2

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

TEXT BOOKS:

1. D P Kothari and I J Nagrath, "Basic Electrical and Electronics Engineering", Mc Graw Hill Education (India) Private Limited, Third Reprint, 2016.
2. S.K. Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson Education,
3. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.

REFERENCES:

1.V.Jegadeesan, K.Vinoth Kumar and R.Saravanakumar, "Basic Electrical and Electronics Engineering", Wiley Precise India, 2011

2.Sedha R.S., "Applied Electronics", S. Chand and Co., Fourth Edition, 2008.

Course Code: 24ESC103	**Course Title: Engineering Graphics**	
Course Category: ESC	**Credits: 4**	
L:T:P (Hours/Week) 2:0:4	**Total Contact Hours:90**	**Max Marks: 100**

COURSE OBJECTIVES:

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

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and vice versa.

UNIT I: CONCEPTS AND PLANE CURVES 6+12

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections - ellipse, parabola and hyperbola using eccentricity method.Cycloid and involute of circle and square.

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 inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes inclined to both the principal planes by rotating object method (Square, Circle, Polygonal surfaces).

UNIT III: PROJECTION OF SOLIDS AND FREE HAND 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. Layout of views- Freehand sketching of multiple views from pictorial views of objects by free hand sketching.

UNIT IV: PROJECTION OF SECTIONED SOLIDS AND DEVLOPMENT OF SURFACES 6+12

Introduction to 'section of solids'. Section of simple 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 truncated prisms, pyramids, cylinders and cones. Application of sections of solids and development of lateral surfaces.

UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTION 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- Applications of isometric projection. Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method. Applications of perspective projection.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)

Introduction to computer aided drafting and dimensioning using appropriate software. 2D drawing commands: Zoom, Picture editing commands, Dimensioning, Isometric drawing, Isoplanes and 3D drafting. Plotting of drawing. Practice includes drawing the projection of lines and solids. Prepare isometric view of simple solids like prisms, pyramids, cylinders and cones.

Total: 90 Periods

COURSE OUTCOMES		**Cognitive Level**
At the end of this course, students will be able to:		
CO1	Construct the conic curves, involutes and cycloid.	Create
CO2	Construct the projections of points, lines and planes.	Create
CO3	Draw the projections of simple solids.	Create
CO4	Draw the development of simple solids.	Create
CO5	Draw the orthographic, isometric and perspective projections of simple solids.	Create

MAPPING OF CO – PO & PSO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	-	3	-	2	3	2	2
CO2	3	1	2	-	2	-	-	-	-	3	-	2	3	2	2
CO3	3	1	2	-	2	-	-	-	-	3	-	2	2	3	1
CO4	3	1	2	-	2	-	-	-	-	3	-	2	1	3	2
CO5	3	1	2	-	2	-	-	-	-	3	-	2	3	2	2
Max	**3**	**1**	**2**	-	**2**	-	-	-	-	**3**	-	**2**	**3**	**3**	**2**

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Text Book(s):

T1. Venugopal K. And PrabhuRaja V., "Engineering Graphics", New Age International (P) Limited,2019.

T2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai,2019

Reference Book(s):

R1. Bhatt N.D, "Engineeirng Drawing", Charotar Publishing House, 1st Edition, 2010.

R2. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, 1st Edition, 2008.

R3. K Leo Dev Wins., "Engineering Drawing", Pearson (Wins) Publications, Latest Edition, 2019.

R4. Luzzader, Warren.J. andDuff,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

R5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size, lay out of drawing sheet
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

Course Code: 24HSM102	**Course Title: Heritage of Tamils**	
Course Category: HSMC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

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- தமிழ் 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- சிற்பக்கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை-ஐம்பொன் சிலைகள்-பழங்குடியினர் மற்றும்அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள்-தேர் செய்யும்கலை-சுடுமண் சிற்பங்கள்- நாட்டுப்புற தெய்வங்கள்- குமரி முனையில் திருவள்ளுவர் 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,கணியான்கூத்து,ஒயிலாட்டம்,தோல்பாவைக்கூத்து, 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-சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்-சங்க கால நகரங்களும் துறைமுகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி-கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு-இந்தியாவின் பிறப்பகுதிகளில்தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமரியாதை இயக்கம்-இந்திய மருத்துவத்தில், சித்தமருத்துவத்தின் பங்கு-கல்வெட்டுகள், கையெழுத்துப்படிகள்-தமிழ் புத்தகங்களின் அச்சு வரலாறு.

HERITAGE OF TAMILS

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, VilluPattu, KaniyanKoothu, 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

TEXTBOOKS AND REFERENCE :

1. தமிழக வரலாறு - பண்பாடும் மக்களும் -கே தமிழ்நாடு :மீது வெளி பிள்ளை .கே . .(கழகம் பணிகள் கல்வியியல் மற்றும் பாடநூல்
2. கணினித் தமிழ் (பிரசுரம் விகடன்) சுந்தரம் .இல முனைவர் -
3. கீழடி வெளி துறை தொல்லியல்) நாகரிகம் நகர கால சங்க நதிக்கரையில் வைகை -
4. பொருநை வ துறை தொல்லியல்) நாகரிகம் ஆற்றங்கரை -ெளியீடு
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 C ivilization 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) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

    Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code :24BSC121	**Course Title :Engineering Physics Laboratory**	
Course Category : BSC	**Credits : 2**	
L:T:P(Hours/Week) 0:0:4	**Total Contact Hours : 60**	**Max Marks : 100**

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.

LIST OF EXPERIMENTS

1. Determination of Young's modulus – Uniform bending method
2. Determination of Rigidity modulus – Torsion Pendulum.
3. Determination of Young's modulus – Cantilever method.
4. Determination of thickness of a thin wire – Air Wedge
5. Determination of Young's modulus -Non-uniform bending method.
6. Determination of band gap of a semiconductor.
7. Lee's disc – Determination of thermal conductivity of a bad conductor.
8. Determination of the wavelength of the laser using grating–Laser.
9. Determination of acceleration due to gravity-Compound Pendulum.
10. Semiconductor Laser:
    a. Determination of wavelength of laser
    b. Determination acceptance angle and numerical aperture of an optical fibre.

To make the student an active participant in each part of all lab exercises.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Understand the functioning of various physics laboratory equipment.	Understand
CO 2: Use graphical models to analyze laboratory data.	Analyze
CO 3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.	Analyze
CO 4: Access, process and analyze scientific information.	Analyze
CO 5: Solve problems individually and collaboratively	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1; No Correlation - -

Text Book(s):

T1. Practical physics G.L squires Cambridge university plus

T2. Jayaraman: Engineering Physics laboratory manual Edition, 2013,

T3. SeshaSaikumarVemula:" Engineering Physics laboratory Lab manual Edition 2017,

T4. D.K Bhattacharya and PoonamTandon :"Engineering Physics Edition 2015.

Reference Book(s):

R1.Naidu: "Engineering Physics "(Pearson).

R2.Malik and Singh : " Engineering Physics (Tata McGraw-Hill Education Pvt. Ltd.,)

SEMESTER II:

Course Code : 24HSM103	**Course Title : Professional English II**	
Course Category :HSMC	**Credits : 3**	
L:T:P(Hours/Week) : 3:0:0	**Total Contact Hours : 45**	**Max Marks : 100**

COURSE OBJECTIVES:

- Develop skills in understanding and explaining cause and effect relationships through listening, speaking, reading, and writing activities.
- Enhance abilities to compare and contrast information effectively through listening, speaking, reading, and writing tasks.
- Build skills in analyzing problems, proposing solutions, and communicating ideas clearly through various listening, speaking, reading, and writing exercises.
- Acquire proficiency in reporting events and information accurately through listening, speaking, reading, and writing practices.
- Strengthen skills in delivering effective presentations and communicating clearly in professional contexts through listening, speaking, reading, and writing activities.

UNIT I: CAUSE AND EFFECT 9

Listening – Listening to longer technical talks and completing exercises- formal speeches; **Speaking** – Role play exercises based on workplace contexts- asking for and giving directions. **Reading** – an excerpt from a travelogue-Journal articles on issues like Global warming; **Writing** - Instructions; Official letter / email; **Grammar** – If conditionals, Imperatives; Cause and effect expressions, prefix and suffixes, Articles.

UNIT II: COMPARE AND CONTRAST 9

Listening – Product reviews and gap fill exercises, Short Talks (like TED Talks) for specific information; **Speaking** – discussing progress towards goals- talking about experience **Reading** – Graphical content (table / chart / graph) and making inferences, bio-note; **Writing**– Compare and Contrast Essay- writing responses to complaints- Making recommendations; **Grammar**–Degrees of Comparison; infinitives and gerunds, prepositional phrases.

UNIT III: **PROBLEM AND SOLUTION 9**

Listening – online discussions on current issues and role play -situational dialogues; **speaking**– discussing news stories- talking about travel procedures **Reading** – Visual content (Pictures on social issues / natural disasters) for comprehension- business letters;**Writing**- checklists- cause

and effect essays- Problem and Solution Essay; **Grammar** – singular and plural, Reported speech, Relative pronoun;

UNIT IV: REPORTING **9**

Listening – Telephone interview-Oral news report; **Speaking** – discussing forecasts and scenarios – discussing likes and dislikes **Reading** – Newspaper report on survey findings- annual reports; **Writing** – report writing - accident report- Survey report,; **Grammar** – Active and passive voice, conjunction, Homophones & Homonyms

UNIT V: PRESENTATION **9**

Listening – Job interview- music review; **Speaking** – describing natural environment – explaining rules and regulations **Reading** –company profiles- an excerpt of interview with professionals; **Writing** – Job application (cover letter and CV)- transcoding; **Grammar** – Collocations- Numerical adjectives- content and function words.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Identify cause and effect relationships accurately through listening, speaking, reading, and writing activities	Understand
CO 2: Understand the effective use of comparing and contrasting information from various sources using listening, speaking, reading, and writing skills.	Understand
CO 3: Analyze problems, propose solutions, and communicate ideas clearly through listening, speaking, reading, and writing exercises.	Analyze
CO 4: Interpret events and information accurately through listening, speaking, reading, and writing practices.	Understand
CO 5: Apply skills in delivering effective presentations and communicating clearly in professional contexts through listening, speaking, reading, and writing tasks.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	1	1	1	1	2	1	1	-	-	-
CO2	1	2	-	1	1	1	1	1	1	2	1	1	-	-	-
CO3	1	2	1	1	1	1	1	1	2	2	1	1	-	-	-
CO4	1	2	1	1	1	2	1	1	1	2	1	1	-	-	-
CO5	1	1	1	1	1	1	1	1	1	2	2	1	-	-	-
MAX	1	2	1	1	1	2	1	1	2	2	2	1	-	-	-

High-3; Medium-2; Low-1; No Correlation - -

Text Book(s):

T1. Raman, Meenakshi, and Sangeeta Sharma.Technical Communication: Principles and Practice.Oxford University Press, 2014.

T2. Guffey, Mary Ellen, and Dana Loewy.Business Communication: Process and Product. 10th ed., Cengage Learning, 2021.

T3. English for Science & Technology - II.Cambridge University Press, 2023.

T4. English for Engineers and Technologists.Vol. 2, Orient Blackswan, 2022.

Reference Book(s):

R1. Laplante, Phillip A. Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals.

R2. Wallwork, Adrian. English for Academic Correspondence and Socializing.Springer, 2011.

R3. Chaturvedi, P.D., and MukeshChaturvedi.Business Communication: Concepts, Cases, and Applications.

R4. Anderson, Paul V. Technical Communication: A Reader-Centered Approach.

Course Code: 24BSC105		**Course Title: Statistics and Numerical Methods**	
Course Category: ESC		**Credits: 4**	
L:T:P (Hours/Week) **3:1:0**		**Total Contact Hours:60**	**Max Marks: 100**

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 explore the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
- To interpret the basic concepts of solving algebraic and transcendental equations.
- To analyze 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 acquire 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 forgoodness 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.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (9+3)

Solution of algebraic and transcendental equations - Fixed point iteration method – NewtonRaphson method- Solution of linear system of equations - Gauss elimination method – Iterative methods of Gauss Seidal– Eigenvalues of a matrix by Power method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICALINTEGRATION (9+3)

Lagrange's and Newton's divided difference interpolations – Newton's forward and backwarddifference interpolation – Numerical single integration's 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 predictor corrector methods for solving first order differentialequations.

Total: 45 Periods

COURSE OUTCOMES		**Cognitive Level**
At the end of this course, students will be able to:		
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.	Apply
CO2	Analyze and compare different experimental designs.	Analyze
CO3	Analyze and compare the accuracy and efficiency of different numerical methods.	Analyze
CO4	Understand the knowledge of various techniques and methods for interpolation and numerical integration.	Understand
CO5	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.	Analyze

MAPPING OF CO – PO & PSO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	2	-	2	-	3	2	2
CO2	3	3	1	1	1	-	-	-	2	-	2	-	2	1	3
CO3	3	3	1	1	1	-	-	-	2	-	2	-	2	2	2
CO4	3	3	1	1	1	-	-	-	2	-	2	-	-	1	2
CO5	3	3	1	1	1	-	-	-	2	-	2	-	2	-	2
Max	3	3	1	1	1	-	-	-	2	-	2	-	3	2	3

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Text Book(s):

T1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 11th Edition, New Delhi , 2022.

T2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2021.

Reference Book(s):

R1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, CengageLearning , 2019.

R2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2016.

R3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia ,New Delhi, 7th Edition, 2017.

R4. Gupta S.C. and Kapoor V. K., " Fundamentals of Mathematical Statistics", Sultan Chand &Sons, New Delhi, 12th Edition, 2022.

R5. Spiegel. M.R., Schiller. J. and Srinivasan .R.A., " Schaum' s Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2018.

R6. Walpole. R.E., Myers. R.H., Myers.S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9 thEdition , Pearson Education, Asia, 2016.

R7. Veerarajan.T, " probability statistics and random processes ".4th edition, Tata McGraw -Hill,2016

Course Code : 24BSC103		**Course Title : Engineering Chemistry**	
Course Category : BSC		**Credits : 3**	
L:T:P(Hours/Week) 3:0:0		**Total Contact Hours : 45**	**Max Marks : 100**

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparation methods of nano materials.
- To familiarize the students by relating the principles and preventive methods of corrosion and to inculcate the working process and application of storage devices.
- To acquire knowledge in synthetic methods of fuels and understanding the combustion characteristics of different fuels.
- To gain knowledge in science of polymer and polymer reactions.

UNIT I : WATER TECHNOLOGY 9

Water: Sources and impurities, Water Quality Parameters: Definition and Significance of- Colour, Odour, Turbidity, pH, Hardness, Alkalinity, TDS, COD and BOD, Flouride and Arsenic. Domestic water treatment: Sedimentation with Coagulant- Sand Filtration –Disinfection methods (UV, Ozonation, Break-point Chlorination). Desalination of Brackish water: Reverse Osmosis. Boiler troubles: Scale and Sludge, Boiler Corrosion, Caustic Embrittlement, Priming and Foaming. Treatment of Boiler Feed Water: Internal Treatment (Phosphate, Colloidal, Sodium Aluminate and Calgon Conditioning) and External Treatment – Ion Exchange demineralisation and Zeolite process.

UNIT II : NANO CHEMISTRY 9

Basics: Distinction between Molecules, Nano materials 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. Main applicationsof nanomaterial's in Medicine, Agriculture, Energy, Electronics and Catalysis.

UNIT III : BATTERIES AND CORROSION 9

Batteries: Introduction - Types of Batteries – Primary battery (Dry Cell) - Secondary battery (Lead Acid battery, Lithium-Ion-battery) - Fuel cells H_2-O_2 Fuel cell, Microbial fuel cell. Corrosion – Causes- Factors- Types – Chemical , Electrochemical Corrosion (Galvanic, Differential Aeration Theory) – corrosion control- material selection and design aspects – Electrochemical protection- Sacrificial anode method and Impressed current cathodic method. Paints- constituents and function.Electroplating of copper and electroless plating of nickel.

UNIT IV : FUELS AND COMBUSTION 9

Fuels -Solid Fuel: Coal – analysis of coal (Proximate analysis only)- Carbonization,Manufacture of Metallurgical Coke (Otto Hoffmann Method) - Liqud fuel- Manufacture of synthetic Petrol (Bergius process)- Octane Number, Cetane Number , Knocking in Engines- Anti Knocking Agents, Gasoline Additives, Gaseous fuel: Compressed Natural Gas(CNG) – Liquefied Petroleum Gases(LPG)-composition only - Liquid Hydrogen fuel. Combustion: Calorific value-higher and lower calorific values- Flue gas analysis (ORSAT method).

UNIT V : POLYMER TECHNOLOGY 9

Introduction-Terminologies- Thermoplastics and Thermosetting Plastics- Types and mechanism of Polymerization: Addition (free radical)- Condensation and Copolymerization- Properties and applications of polymers-some commercial thermosetting resin-Phenol Formaldehyde resin, Amino resins, Silicone resins-some thermoplastics- Polyethylene, PVC, Polyvinyl acetate-Conducting polymer – application - LED and Liquid crystals.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: To Understand the quality of water, and its treatment methods.	Understand
CO 2: To Understand the basic principles and preparatory methods of nanomaterials	Apply
CO 3: To Apply the principles of electro chemistry and corrosion in engineering.	Understand
CO 4: To Understand the different types of fuels, their preparation, properties and combustion characteristics.	Understand
CO.5: To Apply the science of polymer and its application	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	1	1	-	-	-	-	2	3	2	-
CO2	3	2	2	1	-	2	2	-	-	-	-	1	2	-	1
CO3	3	2	2	-	-	2	1	-	-	-	-	1	3	2	2
CO4	3	2	2	-	-	1	2	-	-	-	-	1	2	3	3
CO5	3	2	2	1	-	2	-	-	-	-	-	1	1	-	-
MAX	3	2	2	1	-	2	2	-	-	-	-	2	3	3	3

High-3; Medium-2; Low-1; No Correlation - -

Text Book(s) :

T1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.

T2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

T3. S.S.Dara,"AtextbookofEngineeringChemistry",S.ChandPublishing,12thEdition, 2018.

T4. John O'M Bockris, Amulya K. N Reddy,"Modern Electrochemistry Vol.1 : Ionics", Kluwar Academic Publishers, London, 2nd Edition, 2002.

T5. John O'M Bockris, Amulya K. N Reddy,"Modern Electrochemistry Vol.2 **:**Fundamentals of Electrodics", Kluwar Academic Publishers, London, 2nd Edition, 2002.

Reference Book(s) :

R1. 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.

R2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

R3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.

R4. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge Universit Press, Delhi, Second Edition, 2019.

R5. 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.

Course Code: 24ESC111	**Course Title: Problem Solving and Python Programming**	
Course Category: ESC	**Credits: 4**	
L:T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditional sand 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 exceptions: 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).

EXPERIMENTS 30 Periods

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 steelbar, 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. ImplementingprogramsusingFunctions.(Factorial,largestnumberinalist,areaofshape)
7. ImplementingprogramsusingStrings.(reverse,palindrome,charactercount,replacing characters)

Total: 75 Periods

COURSE OUTCOMES		**Cognitive Level**
At the end of this course, students will be able to:		
CO1	Develop algorithmic solutions to simple computational problems.	Apply
CO2	Develop and execute simple Python programs.	Apply
CO3	Decompose a Python program using conditionals and loops for problem solving and into functions.	Analyze
CO4	Represent compound data using Python lists, tuples, and dictionaries.	Understand
CO5	Execute data from/to files in Python programs	Apply

MAPPING OF CO – PO & PSO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	-	-	-
CO2	3	3	3	3	2	-	-	-	-	-	2	2	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	-
CO4	2	2	-	-	1	-	-	-	-	-	1	-	-	-	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-
Max	**3**	**2**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Text Book(s):

T1. AllenB.Downey,"ThinkPython:HowtoThinklikeaComputerScientist",2ndEdition,O' Reilly Publishers, 2016.

T2. KarlBeecher,"ComputationalThinking:ABeginner'sGuidetoProblemSolvingand Programming", 1st Edition, BCS Learning & Development Limited, 2017.

Reference Book(s):

R1. Paul Deiteland Harvey Deitel, "Python for Programmers", Pearson Education, 1stEdition, 2021.

R2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

R3. JohnVGuttag,"IntroductiontoComputationandProgrammingUsingPython:With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.

R4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

R5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018

Course Code: 24ESC104		**Course Title: Engineering Mechanics**	
Course Category: ESC		**Credits: 3**	
L:T:P (Hours/Week) **3:0:0**		**Total Contact Hours:45**	**Max Marks: 100**

COURSE OBJECTIVES:

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

- To make the students to apply static equilibrium of rigid bodies both in two dimensions and also in three dimensions.
- To comprehend the effect of friction on equilibrium.
- To understand the geometrical properties of surfaces and solids.
- To understand various terms involved in Projectiles.
- To apply dynamic equilibrium of particles in solving basic problems.

UNIT I: INTRODUCTION TO MECHANICS AND FORCE SYSTEM 9

Principles and Concepts - Laws of mechanics - system of forces - resultant of a force system – Lamis theorem - moment of a force –Varignon's theorem - resolution of a force into force and couple – forcein space - equilibrium of a particle in space.

UNIT II: EQUILIBRIUM OF RIGID BODIES 9

Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III: PROPERTIES OF SURFACES AND SOLIDS 9

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV: FRICTION **9**

The Laws of Dry Friction – Coefficients of Friction – Static and Dynamic Friction – Angles of Friction – Wedge friction – Wheel Friction – Body on inclined planes – Rolling Resistance – Ladder friction – Sliding friction and wear abrasion test.

UNIT V: DYNAMICS OF PARTICLES **9**

Newton's second law of motion – D-Alembert's principle, dynamics equilibrium - work energy equation of particles - law of conservation of energy - principle of work and energy. Principles of impulse and momentum - equations of momentum - laws of conservation of momentum. Impact - time of compression, restitution, collision - co-efficient of restitution - collision of elastic bodies by directcentral impact and oblique impact - collision of small body with a massive body - kinetic energy of aparticle-kinetics of rigid body rotation.

Total: 45 Periods

COURSE OUTCOMES		**Cognitive Level**
At the end of this course, students will be able to:		
CO1	Understand the different principles of mechanics and to solve engineering problems dealing with forces.	Create
CO2	Solve the problems in equilibrium of rigid bodies, vector methods and free body diagram.	Create
CO3	Understand the different geometrical properties of various sections.	Create
CO4	Apply the concepts of friction to solve various problems dealing with friction.	Create
CO5	Develop basic dynamics concepts – force, momentum, work and energy.	Create

MAPPING OF CO – PO & PSO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	-	-	-	-	-	-	2	3	2	2
CO2	3	2	2	1	2	-	-	-	-	-	-	2	2	3	2
CO3	3	2	3	1	2	-	-	-	-	-	-	2	2	1	2
CO4	3	2	3	1	2	-	-	-	-	-	-	2	3	2	1
CO5	3	2	3	1	2	-	-	-	-	-	-	2	2	2	1
Max	**3**	**2**	**3**	**1**	**2**	-	-	-	-	-	-	**2**	**3**	**3**	**2**

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Text Book(s):

T1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.

T2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

Reference Book(s):

R1. Bores i P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.

R2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.

R3. Irving H. Shames, Krishna MohanaRao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.

R4. Meria m J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.

R5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

Course Code: 24HSM104	**Course Title: Tamils and Technology**	
Course Category: HSMC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

அலகு I நெசவு மற்றும் பானைத் தொழில் நுட்பம்: 3

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

அலகு IIவடிவமைப்பு 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 பெருங்கோவில்கள் மற்றும் பிற வழிப்பாட்டுத் தலங்கள்- நாயக்கர் காலக் கோயில்கள்- மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால்- செட்டி நாட்டு வீடுகள்- பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக்கலை.

அலகு IIIஉற்பத்தித் தொழில் நுட்பம்: 3

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

அலகு IV வேளாண்மை மற்றும் நீர்ப் பாசனத் தொழில் நுட்பம்: 3

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

அலகுV அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்: 3

அறிவியல் தமிழ் வளர்ச்சி- கணினித்தமிழ் வளர்ச்சி- தமிழ் நூல்களை மின் பதிப்பு செய்தல்- தமிழ் மென்பொருட்கள் உருவாக்கம்- தமிழ் இணையக் கல்விக்கழகம்- தமிழ் மின் நூலகம்-இணையத்தில் தமிழ் அகராதிகள்- சொற் குவைத் திட்டம்.

TAMILS AND TECHNOLOGY

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)- ThirumalaiNayakarMahal - 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 KumizhiThoompu 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

TEXTBOOKS AND REFERENCE:

1. தமிழக வரலாறு :மீது வெளி பிள்ளை .கே .கே - பண்பாடும் மக்களும் - பாடநூல் தமிழ்நாடு மற்றும் கல்வியியல் பணிகள் கழகம்
2. கணினித் தமிழ் பிரசுரம் விகடன்) சுந்தரம் .இல முனைவர் -

3. கீழடி தொல்லியல்) நாகரிகம் நகர கால சங்க நதிக்கரையில் வைகை - யீ வெளி துறை
4. பொருநை (வெளியீடு துறை தொல்லியல்) நாகரிகம் ஆற்றங்கரை -
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.

Course Code: 24BSC122		**Course Title : Engineering Chemistry Laboratory**	
Course Category: BSC		**Credits : 2**	
L:T:P(Hours/Week) 0:0:4		**Total Contact Hours : 60**	**Max Marks : 100**

COURSE OBJECTIVES:

- To gain experimental knowledge of water quality parameters, such as acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of ions in aqueous solutions.
- To gain knowledge about the synthesis of nano particles and to understand the influence of rate of corrosion of materials depending on various factors.
- Students infer the quality of some solid and liquid fuels.

LIST OF EXPERIMENTS

1. Determination of Total, Permanent and Temporary hardness of water by EDTA method.
2. Estimation of Chloride content in water by Argentometric method and Determination of strength of given Hydrochloric acid by pH meter
3. Determination of strength of Acid by Conductometric titration (Strong acid vs Strong base / Strong base vs Mixture of acids).
4. Preparation of Gold / ZnO Nano particles by Sol- Gel Method
5. Estimation of ferrous ion content of the given solution using Potentiometer.
6. Determination of DO content of water sample by Winkler Method.
7. Determination of Rate of Corrosion of Mild steel by Weight Loss Method.
8. Determination of Efficiency of Corrosion in Mild steel.
9. Determination of calorific value of fuel using Bomb Calorimeter.
10. Determination of viscosity of oil using Redwood Viscometer.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: To analyse the quality of water samples i.e., acidity, alkalinity, chlorine content, hardness, DO and the amount of ions in solutions through volumetric techniques.	Analyse
CO2: To gain knowledge in designing the engineering materials against	Apply

corrosion.	
CO3: To know the preparation of nano particles by sol- gel method.	Understand
CO4: To recognize the property and characteristics of solid and liquid fuels.	Understand
CO5: To quantitatively analyse the impurities in solution by electro analytical techniques	Analyse

Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	1	-	1	-	-	1	-	-	-
CO2	3	3	1	1	-	1	1	-	1	-	-	1	-	-	-
CO3	3	3	1	-	-	1	1	-	1	-	-	1	-	-	-
CO4	3	3	1	-	-	1	1	-	1	-	-	1	-	-	-
CO5	3	3	1	1	-	1	1	-	1	-	-	1	-	-	-
MAX	3	3	2	1	-	1	1	-	1	-	-	1	-	-	-

High-3; Medium-2; Low-1; No Correlation – '-'

Text Book(s):

T1. Vogel's, "Text Book of Quantitative Chemical Analysis", Pearson Publications, 2014.

Reference Book(s):

R1. Daniel C. Harris, "Quantitative Chemical Analysis", W. H. Freeman and Company, New York, 7th Edition 2007.

Course Code: 24ESC121		**Course Title: Engineering Practices Laboratory**	
Course Category: ESC		**Credits: 2**	
L:T:P (Hours/Week) **0:0:4**		**Total Contact Hours: 60**	**Max Marks: 100**

COURSE OBJECTIVES:

- Develop practical skills in plumbing, woodwork, welding, machining, and sheet metal work.
- Understand and apply techniques for various household and industrial fittings and connections.
- Study and demonstrate the assembly and operation of common mechanical systems and components.
- Wiring various electrical joints in common household electrical wire work
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP-A (CIVIL AND MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Plumbing Works:

a) Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

b) Laying pipe connection to the suction & delivery side of a pump – inlet & outlet

c) Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

Carpentry Works :

a) Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

Study

a) Study of joints in door panels, wooden furniture.

b) Study of common industrial trusses using models.

II MECHANICAL ENGINEERING PRACTICE

Welding:

a) Arc welding of butt joints, lap joints, tee joints.

b) Gas welding Practice.

Basic Machining:

a) Simple turning, drilling and tapping operations.

Sheet Metal Work:

a) Forming & Bending.

b) Model making – Trays, funnels, etc.

c) Different type of joints.

Demonstration only:

Study and assembling the following:

a) Centrifugal pump.

b) Submersible pump sets.

Demonstration only:

a) Basics of Smithy operations.

b) Foundry operation like mould preparation for grooved pulley.

c) Refrigeration and Air-Conditioning System.

Total: 30 Periods

GROUP-B (ELECTRICAL AND ELECTRONICS)

I ELECTRICAL ENGINEERING PRACTICE

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with

b) lamp, fan and three pin socket.

c) Staircase wiring.

d) Fluorescent Lamp wiring with introduction to CFL and LED types.

e) Energy meter wiring and related calculations/ calibration.

f) Study of Iron Box wiring and assembly.

g) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)

h) Study of emergency lamp wiring/Water heater.

II ELECTRONICS ENGINEERING PRACTICE

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: 30+30 = 60 Periods

COURSE OUTCOMES		**Cognitive Level**
At the end of this course, students will be able to:		
CO1	Perform basic plumbing, carpentry, welding, machining, and sheet metal tasks.	Understand
CO2	Create and interpret technical sketches for plumbing and carpentry.	Create
CO3	Execute basic electrical and electronics wiring and soldering.	Understand
CO4	Analyze and assemble mechanical systems like pumps and HVAC.	Analyze
CO5	Apply safety protocols in civil, mechanical, electrical, and electronics tasks.	Apply

MAPPING OF CO – PO & PSO:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	-	1	-	-	-	1	1	-	2	1	-	2
CO2	3	2	1	-	1	-	-	-	1	1	-	2	2	2	1
CO3	3	2	1	-	2	-	-	-	2	1	-	2	-	-	-
CO4	3	2	1	-	1	-	-	-	1	1	-	2	1	2	2
CO5	3	2	1	-	1	-	-	-	1	1	-	2	2	3	1
Max	**3**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**1**	**-**	**2**	**2**	**3**	**2**

(1 – Low, 2 – Medium, 3 – High, "-" – No Correlation)

Course Code: 24BSC201	**Course Title: Transforms and Partial Differential Equations**	
Course Category: BSC	**Credits: 4**	
L:T:P (Hours/Week) 3:1:0	**Total Contact Hours: 60**	**Max Marks: 100**

COURSE OBJECTIVES
• To introduce the foundational concepts of partial differential equations and their solutions for standard types.
• To present Fourier series analysis in different intervals.
• To familiarize students with the use of Fourier series methods for solving wave and heat flow problems in various contexts.
• To provide students with a solid foundation in Laplace and Fourier Transform techniques, focusing on their mathematical formulation, properties, and applications.
• 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 - 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.		
UNIT IV	**FOURIER AND LAPLACE 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-Laplace transform- Existence Criterion for the Laplace Transform -Laplace transform of basic functions- Fundamental properties.		

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.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Recognize and solve higher order partial differential equations.
CO2: Express the given function and data in terms of Fourier series.
CO3: Understand how to solve one- and two-dimensional heat flow issues as well as one-dimensional wave equations by using Fourier series techniques.
CO4: Illustrate Fourier and Laplace transforms to solve engineering problems, including signal analysis and linear differential equations with constant coefficients.
CO5: Possess the knowledge of Z transforms to analyze linear time invariant systems.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Veerarajan T ., " Transforms and Partial Diffrential Equations ", 3rd Reprint published in 2016by Tata McGraw Hill Education Pvt.Ltd, New Delhi.
T2.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
T2.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, 2018.

REFERENCE BOOK(S)	
R1.	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
R2.	James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
R3.	Narayanan. S., Manicavachagom Pillay, T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students Vol. II & III ", S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

Course Code: 24MEC201	Course Title: Engineering Materials and Metallurgy	
Course Category: PCC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To construct the phase diagram for microstructure formation.
• To select and apply the various heat treatment processes and its microstructure formation.
• To apply the different types of ferrous and non-ferrous alloys and their uses in engineering field.
• To apply the different polymer, ceramics and composites and their uses in engineering field.
• To apply the various testing procedures and failure mechanism in engineering field.

UNIT I	CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS	9
Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron - Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.		
UNIT II	**HEAT TREATMENT**	**9**
Definition - Full annealing, stress relief, recrystallisation and spheroidising - normalizing, hardening and tempering of steel - Isothermal transformation diagrams - cooling curves superimposed on I.T. diagram - Continuous Cooling Transformation (CCT) diagram - Hardenability, Jominy end quench test - case hardening, carburizing, Nitriding, cyaniding - Flame and Induction hardening.		
UNIT III	**FERROUS AND NON- FERROUS METALS**	**9**
Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V, & Ti) - stainless and tool steels - HSLA - Maraging steels - Grey, white, malleable, spheroidal - alloy cast irons, Copper and its alloys - Brass, Bronze and Cupronickel - Aluminium and its alloys, Al-Cu - precipitation strengthening treatment - Properties and Applications.		
UNIT IV	**NON- METALLIC MATERIALS**	**9**
Polymers - types of polymer, commodity and engineering polymers - Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, ABS, Thermoset polymers - Urea and Phenol formaldehydes - Nylon - Engineering Ceramics - Properties and applications of		

Al2O3, SiC, Si3N4, PSZ and SIALON - Composites - Matrix and reinforcement Materials - applications of Composites - Nano composites – Smart materials and Shape memory alloys.		
UNIT V	**MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS**	**9**
Mechanisms of plastic deformation, slip and twinning - Types of fracture - fracture mechanics - Griffith's theory - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell), Impact test lzod and charpy.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the iron-iron carbide phase diagram for microstructure formation.
CO2: Analyse the various heat treatment processes and its microstructure formation.
CO3: Illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
CO4: Apply the different polymer, ceramics and composites and their uses in engineering field.
CO5: Summarize the various testing procedures and failure mechanism in engineering field.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	RK Rajput "Engineering Materials and Metallurgy", S Chand and Company Limited, Edition 2014, Reprint on 2020.
T2.	Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 2010.

REFERENCE BOOK(S)	
R1.	A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, "A Textbook of Engineering Materials and Metallurgy", Laxmi Publications, 2006.
R2.	Amandeep Singh Wadhwa, and Harvinder Singh Dhaliwal, "A Textbook of Engineering Material and Metallurgy", University Sciences Press, 2008.
R3.	G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd, New Delhi, 2020.

Course Code: 24MEC202	**Course Title: Thermodynamics Principles And Applications**	
Course Category: PCC	**Credits: 3**	
L: T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To impart knowledge on the basics and application of zeroth and first law of thermodynamics.
• To applying knowledge on the second law of thermodynamics.
• To analyze various thermodynamic processes involving pure substances.
• To evaluating the performance of steam nozzles and turbines through velocity triangles.
• To apply knowledge on the psychrometry and its various processes.

UNIT I	**BASICS, ZEROTH AND FIRST LAW**	**9**
Review of Basics - Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - p-V diagram. Thermal equilibrium - Zeroth law - Concept of temperature and Temperature Scales. First law - application to closed and open systems - steady flow processes.		
UNIT II	**SECOND LAW AND ENTROPY**	**9**
Heat Engine - Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality - Concept of entropy - T-S diagram - Entropy change for a pure substance.		
UNIT III	**PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE**	**9**
Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles.		
UNIT IV	**STEAM NOZZLES AND TURBINES**	**9**
Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, Super saturated flow. Impulse and Reaction principles, compounding, velocity diagram for single stage turbine.		
UNIT V	**PSYCHROMETRY**	**9**
Psychrometric properties, Psychrometric charts - Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing - Simple Applications.		

	Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the fundamental concepts in Thermodynamics and classify the thermodynamic processes around them.
CO2: Classify and apply Laws of Thermodynamics in practical situations.
CO3: Evaluate the performance of ideal and actual Rankine cycles and calculate thermal efficiency and specific work output.
CO4: Analyze the flow in steam turbines, draw velocity diagrams and performance of steam nozzle.
CO5: Apply different psychometric process and adapt the same for computing the properties of air-vapour mixture.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
T2.	Michael A. Boles and Yunus A Çengel "Thermodynamics: An Engineering Approach" 10th Edition, Tata McGraw Hill (2015), New Delhi.

REFERENCE BOOK(S)

R1.	Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
R2.	Domkundwar, Kothandaraman, &Domkundwar, "A Course in Thermal Engineering", 6th Edition, DhanpatRai & Sons, 2011.
R3.	Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai

Course Code: 24MEC211	Course Title: Manufacturing Technology	
Course Category: PCC	Credits: 4	
L: T:P (Hours/Week): 3:0:2	Total Contact Hours: 75	Max Marks: 100

COURSE OBJECTIVES
• To provide knowledge about casting process and its applications.
• To learn different welding methods, their equipment, uses, and common defects
• To know metal forming processes like forging, rolling, drawing, and extrusion
• To understand the characteristics, operations, and advanced processes in sheet metal forming.
• To analyze various tool materials, cutting tools, and machining operations.

UNIT I	METAL CASTING PROCESSES	9
Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Mouldingsand Properties and testing – Cores –Types and applications – Moulding machines– Types andapplications; Melting furnaces : Blast and Cupola Furnaces; Principle of specialcastingprocesses : Shell - investment – Ceramic mould – Pressure die casting – Centrifugal Casting -CO2 process – Stir casting; Defects in Sand casting		
UNIT II	**JOINING PROCESSES**	**9**
Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gaswelding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding- Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle andapplications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beamwelding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types,causes and cure.		
UNIT III	**METAL FORMING PROCESSES**	**9**
Hot working and cold working of metals – Forging processes – Open, impression and closed dieforging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rollingoperations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principlesof Extrusion – Types – Hot and Cold extrusion.		
UNIT IV	**SHEET METAL PROCESSES**	**9**
Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-		

Workingprinciple and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming.		
UNIT V	**CENTRE LATHE, SPECIAL PURPOSE LATHES AND RECIPROCATING MACHINE TOOLS**	**9**
Tool Materials - Cutting Tool - Lathe Machines - Capstan Lathe - Turret Lathe - Shaper - Planning Machine- Milling Machine - Slotter - Grinding - Internal Machining operations, Drilling and Boring - Surface finish, lapping		

LIST OF EXPERIMENTS

1.	Prepare a mould for the different types of pattern.
2.	Perform the knurling operation on the given work piece.
3.	Perform the External thread cutting on the given work piece.
4.	Perform the contour milling process using vertical milling machine.
5.	Perform the Plain surface grinding process using the abrasive tools.
6.	To machine the given circular block in the shaping machine
7.	To perform drilling, reaming and tapping operation.
8	To perform key way cutting in slotting machine.

Total: 75 Hours

COURSE OUTCOMES

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

CO1: Understand the basic concepts and applications of casting process.

CO2: Analyze suitable welding methods and detect weld defects for different applications..

CO3: Evaluate various hot and cold working processes, operations, types, and defects in metal forming applications.

CO4: Explain conventional and special sheet metal forming processes and their applications

CO5: Evaluate the working principles, tools, an techniques used in machining operations

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
T2.	Nagendra Parashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hallof India Private Limited, 2007.

REFERENCE BOOK(S)	
R1.	Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", Fourth Edition, Pearson Education, Inc. 2007.
R2.	Jain. R.K. and S.C. Gupta, "Production Technology", Khanna Publishers. 16th Edition,2001.
R3	S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House, New Delhi, Fourth edition, 2023.

Course Code: 24MEC212	**Course Title: Strength Of Materials**	
Course Category: PCC	**Credits: 4**	
L: T:P (Hours/Week): 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
• To provide knowledge about structures subjected to axial and thermal loads.
• To familiarize about two-dimensional stress systems and theories of failure.
• To construct shear force, bending moment diagrams and evaluates the bending stress in beams under transverse loading.
• To impart knowledge on finding slope, deflection of beams and buckling of columns for different boundary conditions.
• To familiarize about stresses on shafts and helical springs based on theory of torsion.

UNIT I	**SIMPLE STRESS AND STRAIN**	**9**
Mechanical properties of Materials- Stress - strain curve - Factor of safety- Strain Energy and Impact Loading - Stepped and Composite bars - Axial Stresses, Thermal Stress and Volumetric Stresses - Elastic constants and their relationship.		
UNIT II	**COMPOUND STRESSES AND THIN CYLINDER**	**9**
State of stresses at a point - 2D Stress System - Plane Stress Condition - Mohr's circle - Thin Cylinders - Stresses, Strain, Maximum Shear stress - Changes in dimensions and volume - Theories of Failure - Significance and Graphical Representations.		
UNIT III	**SHEAR FORCE, BENDING MOMENT AND STRESSES IN BEAMS**	**9**
Beams - Types of supports, loads and beams - Shear force and Bending Moment in Cantilever - simply supported and overhanging beams - Point of contra flexure - Theory of Simple Bending - Section modulus - Bending stress and stress variation along the length and section of the beam.		
UNIT IV	**DEFLECTION OF BEAMS AND COLUMNS**	**9**
Slope and Deflection of cantilever and simply supported beams by Double integration method and Macaulay's method - Theory of Columns - Slenderness ratio - End Conditions, Equivalent length, Euler and Rankine's formula.		

UNIT V	TORSION IN SHAFT AND HELICAL SPRING	9

Theory of Torsion - Stresses and Deformations in Solid and Hollow Circular Shafts - combined bending moment and torsion of shafts - Power transmitted to shaft - Shaft in series and parallel - Close coiled helical spring - Stresses, deflection, Maximum shear stress in spring section including Wahl's Factor - Springs in series and parallel.

LIST OF EXPERIMENTS

1.	Determination of Tensile Strength through Tension Test on Mild Steel Rod.
2.	Determination of Hardness Evaluation using Rockwell Hardness Test.
3.	Determination of Hardness Determination using Brinell Hardness Test.
4.	Experimental Measurement of Impact Toughness using Izod Impact Test.
5.	Experimental Measurement of Impact Resistance using Charpy Impact Test.
6.	Experimental Tension Test on Open Coiled Helical Spring.
7.	Experimental Compression Test on Closed Coil Helical Spring.
8.	Experimental Analysis of Torsional Behaviour in Mild Steel Rod through Torsion Test.

Total: 75 Hours

COURSE OUTCOMES

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

CO1: Analyze the stress distribution & strains in regular & composite structures subjected to axial load.

CO2: Evaluate the compound stresses in two dimensional systems and thin cylinder.

CO3: Formulate the shear force, bending moment, bending stresses in beams under transverse loading.

CO4: Evaluate the slope and deflection of beams and buckling loads of columns under different boundary conditions.

CO5: Apply torsion equation in design of circular shafts and helical springs.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	K. Bansal, "Strength of Materials", Laxmi Publications (P). ltd, New Delhi, 2024.
T2.	R K Rajput, "A text book of strength of materials", Chand publishers, 2020.

REFERENCE BOOK(S)	
R1.	S. S. Rattan, "Strength of Materials", Third Edition, McGraw Hill Education Private Limited, Chennai, 2022.
R2.	F. P. Beer and R. Johnston, Seventh Edition, McGraw Hill Education India Private Limited, 2020.
R3	S. S. Bhavikatti, "Strength of Materials", Fourth edition, Vikas Publishing House, New Delhi, 2023.

Course Code: 24MEC213	**Course Title: Theory of Machines**	
Course Category: PCC	**Credits: 4**	
L:T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks : 100**

COURSE OBJECTIVES
• To calculate kinematic parameters of simple mechanisms.
• To calculate static and dynamic forces for the given mechanism.
• To calculate the balance masses required in revolving & reciprocating applications.
• To calculate the kinematic parameters of spur gear and gear trains.
• To analyze single degree of freedom free and forced vibration system.

UNIT I	**KINEMATICS OF MECHANISMS**	**9**
Mechanisms - Terminology and definitions - kinematics inversions of 4 bar and slide crank chain - kinematics analysis in simple mechanisms - velocity and acceleration polygons- Analytical methods - computer approach - cams - classifications - displacement diagrams - layout of plate cam profiles - derivatives of followers motion.		
UNIT II	**FORCE ANALYSIS IN MECHANISMS**	**9**
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – Superposition principle – Dynamic Force Analysis in simple machine members.		
UNIT III	**BALANCING OF ROTATING AND RECIPROCATING MASSES**	**9**
Static and dynamic balancing - balancing of rotating masses - balancing of single rotating mass by a single mass in the same plane. Balancing of single rotating mass by two masses in different plane and balancing of several rotating masses in the same plane, balancing of several masses in different planes - balancing of reciprocating masses-balancing of primary and secondary unbalanced forces of reciprocating masses.		
UNIT IV	**KINEMATICS OF SPUR GEAR AND GEAR TRAINS**	**9**
Types of gears - spur gear terminology - law of gearing - conjugate profile - cycloidal and involute tooth profile - length of path of contact - length of arc of contact - contact ratio - Interference - number of teeth on pinion to avoid interference. Classification of gear trains - calculation of velocity ratio of simple, compound and epicyclic (tabular column method) gear		

trains.		
UNIT V	**FREE AND FORCED VIBRATIONS**	**9**
Basic features of vibratory systems - Degrees of freedom - single degree of freedom - Free vibration - Equations of motion - Natural frequency - Types of Damping - Damped vibration- Torsional vibration of shaft - Critical speeds of shafts - Torsional vibration - Two and three rotor torsional systems. Forced vibration - Response of one degree freedom systems to periodic forcing - Support motion - transmissibility.		

LIST OF EXPERIMENTS	
1.	Dynamic analysis of cam mechanism.
2.	Determination of the value of 'g' by means of a compound pendulum.
3.	Determine the natural frequency of Torsional vibration - one rotor system.
4.	Determine the natural frequency of Torsional vibration - two rotor system.
5.	Undamped free vibrations of a single degree freedom spring-mass system.
6.	Undamped forced vibrations of a single degree freedom spring-mass system.
7.	Determination of critical speed of shafts.
8.	Balancing of rotating mass.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Calculate position, velocity and acceleration of four bar and slider crank mechanisms using algebraic method and graphical method.
CO2: Calculate the static and dynamic forces for equilibrium of the given a slider crank or a four bar mechanism.
CO3: Calculate the balance masses required and its location in revolving & reciprocating applications.
CO4: Calculate the kinematic parameters of spur gear and velocity ratio of simple, compound and epicyclic gear trains.
CO5: Analyze single degree of freedom longitudinally vibrating systems for free and forced vibrations with undamped and damped conditions.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	1					2			1	2	1	
CO2	3	3	1	1					2			1	2	1	
CO3	3	3	1	1					2			1	2	1	
CO4	3	3	1	1					2			1	2	1	
CO5	3	3	1	1					2			1	2	1	

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	S.S. Rattan, "Theory of Machines", 4th Edition, McGraw Hill Education, 2017.
T2.	Norton, R.L., "Kinematics and Dynamics of Machinery", SI Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2014.

REFERENCE BOOK(S)	
R1.	Gordon R. Pennock & Joseph E. Shigley John J. Uicker, "Theory of Machine and Mechanisms SI Edition", 4th Edition, Oxford University Press, 2014.
R2.	Sadhu Singh, "Theory of Machines: Kinematics and Dynamics", 3rd Edition, Pearson Education India, 2011.

Course Code: 24BSC205	**Course Title: Complex variables and transforms**	
Course Category: BSC	**Credits: 4**	
L:T:P (Hours/Week) 3:1:0	**Total Contact Hours: 60**	**Max Marks: 100**

COURSE OBJECTIVES
• Understand the concept of analytic functions and its properties
• Study the techniques of residues and Contour integration
• know the basics of vector calculus and its applications
• Solve ordinary differential equations using Laplace Transform
• Solve ordinary differential equations using Inverse Laplace Transform

UNIT I	**ANALYTICAL FUNCTION**	**9+3**
Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy – Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function (excluding proofs) – Harmonic conjugate – Construction of analytic functions –Conformal mapping: $w = z + k$, kz , $1/z$ and bilinear transformation.		
UNIT II	**COMPLEX INTEGRATION**	**9+3**
Cauchy's integral theorem (Statement) and Cauchy's integral formula – Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle.		
UNIT III	**VECTOR CALCULUS**	**9+3**
Gradient, divergence and curl – Irrotational and solenoidal vector fields (Definition only) – Vector integration – Green's theorem in a plane , Gauss divergence theorem and Stoke's theorem (excluding proofs) .		
UNIT IV	**LAPLACE TRANSFORMS**	**9+3**
Laplace transform – Sufficient condition for existence – Transform of elementary functions- Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms – Transforms of unit-step function and impulse function – Transform of periodic functions.		

UNIT V	INVERSE LAPLACE TRANSFORMS	9+3
Inverse Laplace transform – Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Examine the standard techniques of complex variable, analytic function and conformal mapping.
CO2:Illustrate a contour integral with an integrand which has singularities in the closed region .
CO3: Interpret the line, surface and volume integral.
CO4: Apply the concept of Laplace transform to find the solution of linear ordinary differential equations with constant coefficients.
CO5: Apply the concept of Laplace transform to find the solution of linear ordinary differential equations with constant coefficients.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	2	-	-	-
CO4	2	3	2	-	-	-	-	-	-	-	-	2	-	-	-
CO5	2	3	2	-	-	-	-	-	-	-	-	2	-	-	-
MAX	2	3	1.4	-	-	-	-	-	-	-	-	2	-	-	-

(1–Low, 2–Medium, 3–High,"-"–No Correlation)

TEXT BOOK(S)	
T2.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
T2.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, 2018.

REFERENCE BOOK(S)	
R1.	Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Company Limited, New Delhi, 11th Reprint 2018.
R2.	Bali N, Goyal M and Watkins C, "Advanced Engineering Mathematics", Fire wall Media(An imprint of Lakshmi Publications Private Limited), NewDelhi, 7th Edition, 2015.

Course Code: 24ESC212	**Course Title: Fluid Mechanics and Machinery**	
Course Category: ESC	**Credits: 4**	
L: T:P (Hours/Week): 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
• To introduce properties of the fluids, behavior of fluids under static conditions.
• To impart basic knowledge of the fluid friction.
• To analyze the principles of dimensional analysis and similitude to simple problems and use dimensionless parameters.
• To apply basic principles of working of hydraulic turbine.
• To provide basic principles of working of hydraulic pumps and to design types of pumps.

UNIT I	**FLUID PROPERTIES AND FLOW CHARACTERISTICS**	**9**
Units and dimensions - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity - Flow characteristics - concept of control volume - application of continuity equation, energy equation and momentum equation.		
UNIT II	**FLOW THROUGH CIRCULAR CONDUITS**	**12**
Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts (Descriptive) - Darcy Weisbach equation - friction factor- Moody diagram- commercial pipes - minor losses - Flow through pipes in series and parallel.		
UNIT III	**DIMENSIONAL ANALYSIS AND MODEL STUDIES**	**7**
Fundamental dimensions - Dimensional homogeneity - Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.		
UNIT IV	**TURBINES**	**9**
Classification of turbines - Velocity triangles - Working principles - Pelton wheel - Francis turbine - Kaplan turbine - Work done - Efficiencies - Specific speed - Performance curves for turbines.		
UNIT V	**PUMPS**	**8**
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies- Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Rotary pumps.		

LIST OF EXPERIMENTS	
1.	Determination of the Coefficient of discharge of given Orifice meter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Determination of friction factor for a given set of pipes.
4.	Conducting performance test on Pelton wheel turbine.
5.	Conducting performance test on Kaplan turbine.
6.	Conducting performance test on Francis turbine.
7.	Conducting performance test & the characteristic curves of Reciprocating pump.
8.	Conducting performance test & drawing the characteristic curves of Centrifugal pump.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the properties and behavior of fluid.
CO2: Summarize the various types of fluid friction.
CO3: Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.
CO4: Apply the working principles of various turbines and design the various types of turbines.
CO5: Apply the working principles of centrifugal, reciprocating and rotary pumps.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	R. K. Bansal, “Fluid Mechanics and Hydraulic Machines”, Lakshmi Publications. 2024.
T2.	Jain A. K, “Fluid Mechanics and Hydraulic Machines”, Khanna Publishers, New Delhi, 2014.

REFERENCE BOOK(S)	
R1.	Fox W.R. and McDonald A.T., “Introduction to Fluid Mechanics”, Singapore, 2011.
R2.	Pani B S, “A Concise Introduction”, Prentice Hall of India Private Ltd, 2016.

Course Code: 24MEC203	**Course Title: Machine Design**	
Course Category: PCC	**Credits: 3**	
L: T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the fundamental principles and factors influencing machine design.
• To apply the principles of design to select and design of permanent joints and coupling.
• To gain knowledge on the principles and procedure for the design of mechanical power transmission components.
• To understand the standard procedure available for design of transmission of mechanical elements spur gears and parallel axis helical and bevel gears.
• To learn the design and worm gears and gear box transmission system.

UNIT I	**FUNDAMENTAL CONCEPTS IN DESIGN**	**9**
Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers-Modes of failure - Factor of safety -Combined loads - Principal stresses - Eccentric loading theories of failure - Design based on strength and stiffness - stress concentration - Fluctuating stresses - Endurance limit.		
UNIT II	**DESIGN OF COUPLING AND PERMANENT JOINTS**	**9**
Coupling - Types - Requirements - Rigid Coupling Design of sleeve or muff coupling - Design of Clamp coupling - Design of Flange coupling - Welded joints - Types merits and demerits - Strength of transverse and parallel fillet welded joints - stress concentration factors - Eccentrically loaded welded joints.		
UNIT III	**DESIGN OF FLEXIBLE ELEMENTS AND BEARING**	**9**
Types of belts - Belt materials - Tensions in a belt drive - Stresses in the belt - Design of Flat belts and V belts - Types of chain drives, - Design of Transmission chains and Sprockets - Sliding contact and rolling contact bearings — Hydrodynamic journal bearings, Sommerfeld Number, Selection of Rolling Contact bearings.		
UNIT IV	**DESIGN OF SPUR, HELICAL & BEVEL GEARS**	**9**
Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears – Design of straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.		

UNIT V	DESIGN OF WORM GEARS AND GEAR BOX	9
Worm Gear: Merits and demerits, Terminology, Thermal capacity, Materials - Forces and stresses, Efficiency, Estimating the size of the worm gear pair - Geometric progression – Standard step ratio – Ray diagram, kinematics layout -Design of sliding mesh gear box – Design of multi speed gear box for machine tool applications – Constant mesh gear box – Speed reducer unit. – Variable speed gear box.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the combined loads and eccentric loading in real-world scenarios.
CO2: Apply the concepts of design to permanent joints and couplings.
CO3: Design the belt, chain drives and Bearings.
CO4: Design the spur, helical and bevel gears
CO5: Design worm gears and Gear box design

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Bhandari V, “Design of Machine Elements”, Fourth Edition, Tata McGraw-Hill Book Co, 2016.
T2.	R.S. Khurmi, “Machine Design”, S. Chand, 25th Revised edition, 2005.

REFERENCE BOOK(S)	
R1.	Alfred Hall, Haloenol A, and Laughlin H, “Machine Design”, Tata McGraw-Hill Book Co. 2020.
R2.	Ansel C, Ugural, “Mechanical Engineering Design”, Third Edition, CRC Press, 2021.

Course Code: 24MEC214	**Course Title: Heat Power Engineering**	
Course Category: PCC	**Credits: 4**	
L: T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
• To study the working principles of air standard cycles and IC Engines.
• . To understand the physical mechanisms of free and forced convection.
• To learn the theory of phase change heat transfer and design of heat exchangers.
• To apply the concepts of radiation laws and properties.
• To analyze steady-state diffusion problems in various systems.

UNIT I	**INTERNAL COMBUSTION ENGINES**	**9**
Classification and Main components of IC Engines - air standard efficiency of Otto, diesel and dual cycle, Performance parameters and calculations and Heat Balance test and morse test.		
UNIT II	**CONDUCTION & CONVECTION**	**9**
General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems. Free and Forced Convection - Free and Forced Convection during external flow over Plates and Cylinders.		
UNIT III	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**	**9**
Nusselt theory of condensation - Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient - Fouling Factors. LMTD and NTU methods.		
UNIT IV	**RADIATIVE HEAT TRANSFER**	**9**
Introduction to radiation - Radiation laws and Radiative properties - Black Body & Gray body Radiation - Radiosity - Radiation shield		
UNIT V	**MASS TRANSFER**	**9**
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.		

LIST OF EXPERIMENTS	
1.	Performance of single cylinder four stroke diesel engine.
2.	Draw a heat balance sheet on four stroke Compression Ignition engine.
3.	Determination of emissivity of a grey surface.
4.	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
5.	Determination of heat transfer coefficient of air under natural convection.
6.	Determination of heat transfer coefficient of air under forced convection.
7.	Heat transfer from pin-fin under forced convection.
8.	Determination of heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyze the thermodynamic concepts in different air standard cycles and IC Engines.
CO2: Analyze convective heat transfer for external flow over plates and cylinders using empirical correlations.
CO3: Determine the performance of heat transfer rate in boiling process and in different types of heat exchanger using NTU and LMTD methods.
CO4: Evaluate emissive and spectral emissive power for a black and grey surface, and determine radiation heat transfer between enclosures.
CO5: Apply Fick's Law to determine diffusion flux in steady-state systems.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2019.
T2.	P.K.Nag, "Heat And Mass Transfer", 3rd Edition, Tata McGraw Hill (2011), New Delhi.

REFERENCE BOOK(S)	
R1.	Yunus A Cengel, "Heat Transfer a Practical Approach", Tata McGraw Hill, 5th Edition,2020.
R2.	GaneHolman, J.P, "Heat and Mass Transfer", Tata McGraw Hill, 2020.

Course Code: 24MEC215	**Course Title: Engineering Metrology and Measurements**	
Course Category: PCC	**Credits: 4**	
L:T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
• To understand the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
• To interpret the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
• To apply the principles and methods of form and surface metrology for the intended applications.
• To use advanced measurements for quality control in manufacturing industries.

UNIT I	**BASICS OF METROLOGY**	**9**
Introduction to Metrology - Need - Elements -Work piece - Instruments - Persons - Environment - their effect on Precision and Accuracy - Errors - Errors in Measurements - Types - Control - Types of standards.		
UNIT II	**MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS**	**9**
Linear Measuring Instruments - Evolution - Types - Classification - Limit gauges - gauge design - terminology - procedure - concepts of interchange ability and selective assembly - Angular measuring instruments - Types - Bevel protractor clinometers angle gauges, spirit levels sine bar - Angle alignment telescope - Autocollimator - Applications.		
UNIT III	**TOLERANCE ANALYSIS**	**9**
Tolerance - Interchangeability - Selective assembly - Tolerance representation - Terminology - Limits and Fits - Design of Limit gauges - Problems - Tolerance analysis in manufacturing - Process capability - tolerance stack up - tolerance charting.		
UNIT IV	**METROLOGY OF SURFACES**	**9**
Fundamentals of GD & T- Conventional vs Geometric tolerance - Datums - Inspection of geometric deviations like straightness, flatness, roundness deviations - Simple problems -		

Measurement of Surface finish - Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques.		
UNIT V	**ADVANCES IN METROLOGY**	**9**
Lasers in metrology - Advantages of lasers - Laser scan micrometers - Laser interferometers - Applications - Straightness, Alignment - Ball bar tests - Computer Aided Metrology - Basic concept of CMM - Types of CMM - Constructional features - Probes - Accessories - Software - Applications - Multi-sensor CMMs - Machine Vision - Basic concepts of Machine Vision System.		

LIST OF EXPERIMENTS	
1.	Calibrate use of linear measuring instruments -Vernier Caliper, Micrometer.
2.	Calibrate use of linear measuring instruments -Vernier height gauge, depth micrometer.
3.	Calibration and use of linear measuring instruments -Bore gauge and comparator.
4.	Measurement of angles using bevel protractor and sine bar.
5.	Calibration and Testing of a Light-Based 3D Scanner for Precision Measurement.
6.	Calibration and use of linear measuring instruments -Telescopic gauge.
7.	Measurement of Gear Tooth Vernier Caliper and depth vernier.
8.	Measurement of Surface finish in components manufactured using various processes.
	Total: 75 Hours

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2022.
T2.	Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2023.

REFERENCE BOOK(S)	
R1.	Ammar Grous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2021.
R2.	Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", 5th revised edition, Cengage Learning EMEA, 2020.

Course Code : 24BSC206	**Course Title : Environmental Science and Sustainability**	
Course Category : BSC	**Credits: 2**	
L:T:P(Hours/Week) : 2:0:0	**Total Contact Hours: 30**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand and appreciate the unity of life in all its forms, the implications of life style on the environment.
• To understand the various causes for environmental degradation.
• To understand the various energy resources and importance of energy efficiency.
• To understand individuals contribution in the environmental pollution.
• To understand the impact of pollution at the global level and also in the local environment.

UNIT I	**ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**6**
Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch -Importance, types, mega-biodiversity -Threats due to natural and anthropogenic activities and Conservation methods.		
UNIT II	**SUSTAINING NATURAL RESOURCES AND ENVIRONMENTAL QUALITY**	**6**
Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods. Sustainable Development Goals (SDG).		
UNIT III	**ENERGY RESOURCES**	**6**
Renewable –Nonrenewable energy resources- Advantages and disadvantages - Oil, Natural Gas, Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from Biomass, solar- Hydrogen revolution.		
UNIT IV	**ENVIRONMENTAL IMPACT ASSESSMENT**	**6**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life).Impact assessment		

Methodologies. Public awareness. Environmental priorities in India.		
UNIT V	**GLOBAL CLIMATIC CHANGE AND MITIGATI**	**6**
Climate disruption, Greenhouse effect, Ozone layer depletion and Acid rain. Kyoto protocol, Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.-Guest lecture by Industry Experts or R&D organization		

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Understand the interrelationship between living organism and environment.
CO 2: Identify various environmental hazards and waste management techniques.
CO 3: Design various methods for the conservation of resources.
CO 4: Understand the importance of environment by assessing its impact on the human world.
CO 5: Understand the Global climatic changes and its mitigation procedures.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	T1. G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.
T2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.

REFERENCE BOOK(S)	
R1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), VisualizingEnvironmental Science, 4thEdition, John Wiley & Sons, USA.

Course Code: 24MEC301	**Course Title: Industrial Automation Systems**	
Course Category: PCC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To introduce the communication buses used in automation industries.
• To introduce signal transmission techniques and their design.
• To understand the use in data acquisition systems interface techniques
• To develop the ladder diagram using PLC programming.
• To educate on the components used in distributed control systems

UNIT I	**BASICS OF AUTOMATION**	**9**
Automation overview - Requirement of automation systems, Architecture of Industrial Automation system - Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems - Modbus & Profibus.		
UNIT II	**AUTOMATION COMPONENTS**	**9**
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement - Actuators, process control valves - power electronics devices DIAC, TRIAC, power MOSFET and IGBT - Introduction of DC and AC servo drives for motion control.		
UNIT III	**COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS**	**9**
Role of computers in measurement and control - Elements of computer aided measurement and control - man-machine interface - computer aided process control hardware, process related interfaces - Communication and networking - Industrial communication systems - Data transfer techniques - Computer aided process control software - Computer based data acquisition system - Internet of things (IoT) for plant automation.		
UNIT IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**9**
Programmable controllers - Programmable logic controllers - Analog digital input and output modules - PLC programming, Ladder diagram - Sequential flow chart, PLC Communication and networking - PLC selection - PLC Installation - Advantage of using PLC for Industrial automation - Application of PLC to process control industries.		

UNIT V	DISTRIBUTED CONTROL SYSTEM	9
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers - Features of DCS - Advantages.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the basics and Importance of communication buses in applied automation Engineering.
CO2: Remember to develop PLC logic for a specific application on real world problem.
CO3: Design a signal conditioning circuits for various application
CO4: Understand to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.
CO5: Analyze a detail knowledge on data acquisition system interface and DCS system

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	S.K.Singh, "Industrial Instrumentation", 2nd edition, Tata McGraw Hill, 2003.
T2.	C D Johnson, "Process Control Instrumentation Technology", 8th Edition, Prentice Hall India, 2016.

REFERENCE BOOK(S)	
R1.	John W. Webb and Ronald A. Reis, "Programmable Logic Controllers Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
R2.	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2020.
R3.	Mikell P. Groover "Automation, Production Systems, and Computer-Integrated Manufacturing" 4th edition, Pearson India, 2016.

Course Code: 24MEC311	**Course Title: CAD/CAM**	
Course Category: PCC	**Credits: 4**	
L:T:P 3:0:2	**Total Contact Hours: 75**	**Max Marks : 100**

COURSE OBJECTIVES
• To introduce and understand the Basics of Design.
• To study the two dimensional drafting and bill of material creation.
• To learn three dimensional modeling and its advantages.
• To study the basic and purpose of assembling modeling.
• To study the basics of computer aided machining and part programming

UNIT I	**DESIGN CONCEPTS**	**9**
Understanding of Projections, Scales, units, GD & T; its 14 symbols - Special characteristics - Title Block readings. Revision / ECN status of drawings - Customer Specific requirements - Drawing Grid reading		
UNIT II	**2D DRAFTING**	**9**
Projection views - Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view - Title Block creation - BOM Creation - Notes creation - Ballooning of 2D drawing and its features for Inspection reporting		
UNIT III	**3D MODELING**	**9**
Conversion of Views - 2D to 3D & 3D to 2D - Parametric and Non-Parametric Modeling - Tree features of 3D Modeling and its advantages - Surface Modeling - BIW (Body In White) - Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.		
UNIT IV	**ASSEMBLY MODELING**	**9**
Basics of Assembly modeling, Purpose of Assembly modeling - its advantages - Top to Down & Bottom Up modeling approaches - Analysis of Clearances - Undercuts - Interferences - Stack up analysis - Cumulative effect of Tolerances in after assembly conditions.- motion analysis		
UNIT V	**COMPUTER AIDED MANUFACTURING**	**9**
Basics of CNC Machining - 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D - Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation -Machining Stocks, Roughing, Re-roughing, Semi Finishing		

& Finishing - Tool Path Generation, and Milling Programming - Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. - Post Process NC Code conversion and Setup Sheet Preparation.
LIST OF EXPERIMENTS
1. 2D drawing of a Flange Coupling.
2. 2D drawing of a Plummer Block.
3. 3D assembly model of Universal Joint.
4. 3D assembly model of Stuffing box.
5. 3D assembly model of Non-return valves.
6. CNC Machining Centre for Linear Cutting & Circular cutting.
7. CNC Machining Centre for Canned Cycle Operations.
8. CNC Turning Centre – Rough, Finishing, Drilling and Tapping Cycle.
Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explore the basics of the design and concepts.
CO2: Develop the two dimensional drafting and projection views.
CO3: Examine the three dimensional modeling, parametric and Non-parametric modeling.
CO4: Analyze the assembly modeling and top down, bottom up approaches.
CO5: Develop the computer aided machining and writing part programming.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Jacob Moses and Ruchi Agarwal, "Computer Aided Design & Manufacturing", 8th Edition Technical publication, 2010.

T2.	J. Srinivas, "CAD / CAM Principles & Application", Second Edition, Oxford publication, 2023.

Reference Book(S)	
R1.	Ibrahim Zaid, "CAD / CAM", 6th Edition, TMH Publishers**,** 2024.
R2.	Chandandeep Grewal, "CAD / CAM", 5th Edition, PHI Publishers**,** 2020.
R3	Sham Tickoo, "**SolidWorks 2015 for Designers**", 13th Edition, CADCIM Technologies, USA, 2015.

Course Code: 24MEC312	**Course Title: Hydraulics and Pneumatics**	
Course Category: PCC	**Credits: 4**	
L: T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
● To provide the knowledge on the working principles of fluid power systems.
● To study the fluids and components used in modern industrial fluid power system.
● To develop the design, construction and operation of fluid power circuits.
● To learn the working principles of pneumatic power system and its components.
● To provide the knowledge of trouble shooting methods in fluid power systems.

UNIT I	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS**	**9**
Introduction to Fluid power - Advantages and Applications - Fluid power systems - Types of fluids -Properties of fluids and selection - Basics of Hydraulics - Pascal's Law - Principles of flow - Friction loss - Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory - Pump Classification - Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps - Fixed and Variable displacement pumps.		
UNIT II	**HYDRAULICS ACTUATORS AND CONTROL COMPONENTS**	**9**
Hydraulic Actuators: Cylinders - Types and construction, Application, Hydraulic cushioning - Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves - Types, Construction and Operation – Accessories - Reservoirs, Pressure Switches - Filters - types and selection- Applications - Fluid Power ANSI Symbols.		
UNIT III	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9**
Accumulators, Intensifiers, Industrial hydraulic circuits - Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, -Servo and Proportional valves – Applications - Mechanical, hydraulic servo systems.		
UNIT IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9**
Properties of air -Air preparation and distribution - Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit - classification- single cylinder and multi cylinder circuits-Cascade method - Integration of		

fringe circuits, Electro Pneumatic System - Elements - Ladder diagram - Timer circuits- Problems, Introduction to fluidics and pneumatic logic circuits.		
UNIT V	**TROUBLE SHOOTING AND APPLICATIONS**	**9**
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning - Shaping, Surface grinding, Press and Forklift applications - mobile hydraulics - Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits.		

PRACTICALS	
1.	Actuation of single acting pneumatic cylinder using a pressure valve.
2.	Actuation of double acting pneumatic cylinder using a solenoid valve.
3.	Actuation of double acting cylinder using direction control valve.
4.	Simulation of double acting cylinder in the sequence of A+ B+ B- A-.
5.	Simulate the actuation of single acting cylinder with PLC using OFF delay timer.
6.	Actuation of single acting cylinder with PLC using AND gate and OR gate.
7.	Sequencing of Hydraulic and Pneumatic circuits using Simulation Software.
8.	Sequencing of Electro-pneumatic circuits using Simulation Software.
	Total: 75 Hours

COURSE OUTCOMES

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

CO1: Apply the working principles of fluid power systems and hydraulic pumps.

CO2: Understand the working principles of hydraulic actuators and control components.

CO3: Design and develop hydraulic circuits and systems

CO4: Apply the working principles of pneumatic circuits and power system & its component

CO5: Identify the various troubles shooting methods in fluid power systems.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
T2.	James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997.

REFERENCE BOOK(S)	
R1.	Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
R2.	Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.
R3.	Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2018.

Course Code: 24MEC302	**Course Title: Operation Research**	
Course Category: PCC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours:45**	**Max Marks : 100**

COURSE OBJECTIVES
• To provide knowledge in finding optimal solutions for engineering.
• To understand the Engineering and Managerial situations in Transportation.
• To study and acquire knowledge on engineering in assignment and scheduling problems.
• To give exposure to inventory in industry.
• Acquire knowledge on sequences to perform operation among various replacement.

UNIT I	**INTRODUCTION TO OPERATIONS RESEARCH**	**9**
Operations Research and Decision - making - Types of Mathematical Models and Constructing the Model - Role of Computers in Operations Research - Linear Programming Techniques: Formulation of Linear Programming Problem -Applications and Limitations - Graphical Method - Simplex Method -The Big -M Method - The Two-Phase Method.		
UNIT II	**TRANSPORTATION PROBLEMS**	**9**
Least Cost Method - North West Corner Rule -Vogel's Approximation Method - Modified Distribution Method - Unbalance and Degeneracy in Transportation Model -Shortest Route Algorithm -Dijkestra Algorithm.		
UNIT III	**ASSIGNMENT MODELS AND SCHEDULING**	**9**
Assignment Models - Hungarian Algorithm -Unbalanced Assignment Problems - Maximization Case in Assignment Problems, Traveling Salesman Problem -Scheduling - Processing N Jobs Through Two Machines - Processing N Jobs Through Three Machines - Processing Two Jobs Through 'M' Machines - Processing N Jobs Through M Machines.		
UNIT IV	**INVENTORY CONTROL AND QUEUING THEORY**	**9**
Variables in Inventory Problems, Inventory Models with Penalty -Shortage and Quantity Discount -Safety Stock - Multi Item Deterministic Model - Queuing Models: Queues - Notation of Queues -Performance Measures -T he M/M/1 Queue - The M/M/M Queue - Batch Arrival Queuing System - Queues with Breakdowns.		
UNIT V	**PROJECT MANAGEMENT AND REPLACEMENT MODELS**	**9**
Basic Terminologies - Constructing A Project Network - Network Computations in CPM and		

PERT - Cost Crashing - Replacement Models - Replacement of Items due to deterioration with and Without Time Value of Money - Group Replacement Policy - Staff Replacement
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the concepts of Linear programming technique.
CO2: Apply LPP technique of Transportation models.
CO3: Understand the techniques of scheduling and sequencing.
CO4: Acquire knowledge in Inventory control and Queuing theory.
CO5: Understand the concept of replacement models.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)

T1.	Kanti Swarup, "Operations Research", 12th edition, Sultan Chand and Sons, New Delhi,2010.
T2.	Hamdy A. Taha, "Operations Research-An Introduction", 9th Edition, Prentice Hall, 2010.

REFERENCE BOOK(S)

R1.	F.S. Hillier and G.J. Lieberman, "Introduction to Operations Research- Concepts and Cases", 9th Edition, Tata Mc-Graw Hill, 2010.
R2.	Premkumar Gupta and Hira D.S, "Operation Research", 1st edition, S Chand and Company Limited, New Delhi, 2017.

Course Code: 24MEC312	**Course Title: Mechatronics and IOT**	
Course Category: PCC	**Credits: 4**	
L: T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks: 100**

COURSE OBJECTIVES
• To make students get acquainted with the sensors and the actuators.
• To provide insight into the signal conditioning circuits, and also to develop competency in PLC programming and control.
• To make students familiarize with the fundamentals of IoT and Embedded systems.
• To impart knowledge about the arduino and the Raspberry Pi.
• To understand skills in the design and development of mechatronics and IoT based systems.

UNIT I	**SENSORS AND ACTUATORS**	**9**
Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and DynamicCharacteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors -Photodetectors - Vision Systems -Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators -Brushless Permanent Magnet DC Motor - PM, VR and Hybrid Stepper motors - DC and AC Servo Motors		
UNIT II	**SIGNAL CONDITIONING CIRCUITS AND PLC**	**9**
Operational Amplifiers - Inverting and Non-Inverting Amplifier - Wheatstone bridge Amplifier - Instrumentation Amplifier -PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System - Switching Loads by Power Semiconductor Devices Circuits - Thyristors -TRIAC -Darlington Pair - MOSFET and Relays. PLC - Architecture -Input / Output Processing - Logic Ladder Programming - Functional Block Programming using Timers and Counters -Applications		
UNIT III	**FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS**	**9**
The Internet of Things (IoT) - Introduction to the IoT Framework - IoT Enabling Technologies- The Effective Implementation of IoT - The Detailed Procedure - Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems.		

UNIT IV	**CONTROLLERS**	**9**
Foundation topics: Programming Languages: C++ and Python - The Linux Operating System. Arduino - The Arduino Boards - Arduino Peripherals - Arduino IDE - ESP8266 Wi-Fi module. Raspberry Pi - The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. (typical peripherals) Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Push buttons - Light intensity sensor - Ultrasonic distance sensor -Temperature sensor- Humidity sensor - Sensor and Actuator interactions.		
UNIT V	**MECHATRONICS AND IoT CASE STUDIES**	**9**
Mechatronics systems - Drone actuation and Control - Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.		

LIST OF EXPERIMENTS	
1.	Write a program to turn ON/OFF motor using microcontroller/SBC through internet.
2.	Write a program to interface sensors to display the data on the screen through internet.
3.	Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.
4.	Measurement of Pressure, Temperature using Transducers.
5.	Addition, Subtraction and Multiplication Programming in 8051.
6.	Electro-pneumatic/hydraulic control using PLC.
7.	Familiarization with concept of IoT and its open source microcontroller/SBC.
8.	To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear/Rotary Actuator through IoT when sensor data is detected.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Select suitable sensors and actuators to develop mechatronics systems.
CO2: Understand the proper signal conditioning circuit for mechatronics systems.
CO3: Apply the fundamentals of IoT and Embedded Systems in real-time application.
CO4: Discuss the various Control I/O devices through Arduino and Raspberry Pi.

CO5: Design and develop a mechatronics/IoT based system for the given real-time application.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)

T1.	Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
T2.	Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCE BOOK(S)

R1.	Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013
R2.	David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018.
R3	Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005

.

Course Code: 24MEC401	**Course Title: Process Planning and Cost Estimation**	
Course Category: PCC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To introduce the process planning concepts to make cost estimation for various products.
• To learn the various Process Planning Activities.
• To provide the knowledge of importance of costing and estimation.
• To provide the knowledge of estimation of production costing.
• To learn the knowledge of various Machining time calculations.

UNIT I	**INTRODUCTION TO PROCESS PLANNING**	**9**
Introduction- methods of process planning - Drawing Interpretation - Material evaluation - steps in process selection - Production equipment and tooling selection.		
UNIT II	**PROCESS PLANNING ACTIVITIES**	**9**
Process parameters calculation for various production processes - Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning - Economics of process planning - case studies.		
UNIT III	**INTRODUCTION TO COST ESTIMATION**	**9**
Importance of costing and estimation - methods of costing-elements of cost estimation - Types of estimates - Estimating procedure - Estimation labour cost, material cost - allocation of overhead charges - Calculation of depreciation cost.		
UNIT IV	**PRODUCTION COST ESTIMATION**	**9**
Estimation of Different Types of Jobs - Estimation of Forging Shop - Estimation of Welding Shop - Estimation of Foundry Shop.		
UNIT V	**MACHINING TIME CALCULATION**	**9**
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning - Machining Time Calculation for Grinding.		
		Total:45 hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Evaluate the process, equipment and tools for various industrial products.
CO2: Understand the process planning activity chart.
CO3: Remember the concept of cost estimation.
CO4: Evaluate the job order cost for different type of shop floor.
CO5: Analyze the machining time for various machining operations.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Peter Scalon, "Process planning and cost estimation", Elsevier science technology Books, 2002.
T2.	Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 2015.

REFERENCE BOOK(S)	
R1.	Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
R2.	Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education, 2001.

Course Code: 24MEC411	**Course Title: Finite Element Analysis**	
Course Category: PCC	**Credits: 4**	
L:T:P (Hours/Week) 3:0:2	**Total Contact Hours: 75**	**Max Marks : 100**

COURSE OBJECTIVES
• To impart basic knowledge in finite element method.
• To provide knowledge in 1D elements.
• To provide knowledge in 2D elements.
• To study heat conduction problems using finite element method.
• To provide knowledge in higher order and isoparametric elements.

UNIT I	**INTRODUCTION TO FEM**	**9**
Relevance and scope of finite element methods - strain Vs displacement relations - stresses and Equilibrium - natural and essential boundary conditions - Rayleigh-Ritz - Galerkin method- FEM procedure - Discretization of domain-element shapes, types, size, location, and numbers.		
UNIT II	**ONE-DIMENSIONAL(1D) ELEMENTS**	**9**
Coordinate system types-global, local and natural - shape function of 1D bar element - Finite element formulation - stiffness matrix, load vector, boundary condition and assembly of global equation - 1D bar element and two node truss element- problems in the 2D truss - Introduction to beam element.		
UNIT III	**TWO-DIMENSIONAL(2D) ELEMENTS**	**9**
Shape function for linear triangular element - Finite element formulation - Constant Strain Triangular (CST) element - plane stress, plane strain - axisymmetric elements - problems.		
UNIT IV	**HEAT TRANSFER APPLICATIONS**	**9**
Shape function for 1D and 2D triangular element heat conduction - stiffness matrix, load vector and assembly of the global equation for 1D and 2D triangular element heat conduction - heat generation with convective boundary conditions for the linear element.		
UNIT V	**HIGHER ORDER AND ISOPARAMETRIC ELEMENT**	**9**
Selection of order of polynomial-linear, simplex, complex and multiplex elements - Mesh refinement methods and convergence requirements - ISO, Sub and Super parametric element - Shape functions for a 2-D four noded and eight noded isoperimetric rectangular element using		

the natural coordinate system problems - Gaussian quadrature method-problems.	
LIST OF EXPERIMENTS	
1.	Force and Stress analysis using link elements in Trusses, cables etc.
2.	Stress and deflection analysis in beams with different support conditions.
3.	Stress analysis of flat plates and simple shells.
4.	Stress analysis of axi -symmetric components.
5.	Thermal stress analysis of plates.
6.	Vibration analysis of spring-mass systems.
7.	Model analysis of Beams.
8.	Harmonic analysis of simple systems.
	Total: 75 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the numerical methods to formulate the simple finite element problems.
CO2: Apply one dimensional finite element method to solve bar, beam and truss type problem
CO3: Apply finite element method for plane stress, plane strain and axi-symmetric conditions.
CO4: Determine temperature distribution of one- and two-dimensional heat transfer problems.
CO5: Apply the numerical methods to formulate the higher order and iso-parametric problems

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	S. S. Rao, “Finite Element Method in Engineering”, Elsevier India, 2020.
T2.	David V Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2019.

REFERENCE BOOK(S)	
R1.	Robert D Cook, S David and Malkucs Michael E Plesha, "Concepts and Applications of Finite Element Analysis", New Delhi, 2021.
R2.	T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements Engineering", Pearson Education, New Delhi, 2021.
R3.	S. S. Bhavikati, "Finite Element Analysis", New Age International Publishers, 2019.
R4.	Sham Tickoo, "**ANSYS Workbench 2024 R2**: A Tutorial Approach", 7th Edition, CADCIM Technologies, USA, 2024.

Course Code: 24HSM401	**Course Title: Professional Ethics and Human Values**	
Course Category: HSMC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks : 100**

COURSE OBJECTIVES
• To learn about morals, values & work ethics and how to live peacefully.
• To create awareness about the customs and religions and learn different professional roles.
• To provide depth knowledge on framing of the problem and determining the facts.
• To create awareness about safety, risk & risk benefit analysis.
• To develop knowledge about global issues.

UNIT I	**HUMAN VALUES**	**6**
Morals, Values and Ethics - Integrity - Work Ethic - Service learning - Civic Virtue - Respect for others - Living Peacefully - Caring - Sharing - Honesty - Courage - Cooperation - Commitment - Empathy - Self Confidence Character - Spirituality - Case Study.		
UNIT II	**ENGINEERING ETHICS**	**6**
Senses of Engineering Ethics-Variety of moral issued - Types of inquiry - Moral dilemmas - Moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy - Models of professional roles - Theories about right action - Self-interest - Customs and religion - Uses of Ethical theories - Valuing time - Cooperation -Commitment - Case Study.		
UNIT III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**6**
Engineering As Social Experimentation - Framing the problem - Determining the facts - Codes of Ethics - Clarifying Concepts - Application issues - Common Ground - General Principles - Utilitarian thinking respect for persons - Case study.		
UNIT IV	**ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK**	**6**
Safety and risk - Assessment of safety and risk - Risk benefit analysis and reducing risk - Safety and the Engineer - Designing for the safety - Intellectual Property Rights (IPR).		
UNIT V	**GLOBAL ISSUES**	**6**
Globalization - Cross culture issues - Environmental Ethics - Computer Ethics - Computers as the instrument of Unethical behavior - Computers as the object of Unethical acts - Autonomous Computers-Computer codes of Ethics - Weapons Development - Ethics and Research - Analyzing Ethical Problems in research - Case Study.		
Total: 30 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand and analyze the essentials of human values and skills, self-exploration, happiness and prosperity.
CO2: Recognize the theories and principles of professional ethics.
CO3: Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
CO4: Analyze Safety and Risk benefit analysis and acquire knowledge on professional rights and responsibilities of an engineer.
CO5: Provide the sensitivity and global outlook in the contemporary world to fulfill the professional obligations effectively.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Fourth Edition, McGraw-Hill Education, Delhi, 2005.
T2.	M. Govindarajan, S. Natarajan and V. S. Senthilkumar, "Professional Ethics and Human Values", PHI Learning Private Limited, 2013.

REFERENCE BOOK(S)	
R1.	Jayshree Suresh and B.S. Raghavan, "Human Values and Professional Ethics", Fourth Revised Edition, S.Chand & Company Limited, New Delhi, 2012.
R2.	S. B. Gogate, "Human Values and Professional Ethics", First Reprint, Vikas Publishing House Pvt. Ltd., Noida, 2014.
R3.	Charles E. Harris, Michael S. Pritchard, Ray W. James, Michael Jerome Rabins and Elaine E. Englehardt, "Engineering Ethics Concepts and Cases", Fifth Edition, Wadsworth Cengage Learning, 2014.

Course Code: 24MEP001	**Course Title: Lean Manufacturing**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To introduce the basics of 6 SIGMA.
• To learning about the lean manufacturing tools.
• To study about the deeper understanding methodologies of lean manufacturing.
• To study the lean concepts and its elements.
• To learn implementation and challenges of lean manufacturing.

UNIT I	**INTRODUCTION TO 6 SIGMA**	**9**
Introduction to 6 Sigma - basic tools of six sigma like problem solving approach - standard deviation - normal distribution - various sigma levels with some examples - value for the enterprise, Variation, and sources of variation - Mean and moving the mean - Various quality costs - cost of poor quality.		
UNIT II	**LEAN MANUFACTURING TOOLS**	**9**
Process Capability Indices - Cause and Effect diagram - Control Charts - Introduction to FMEA, APQP, PPAP - 3 foundational 6 Sigma methodologies - DMAIC, DMEDI and Process Management - DMEDI for process creation - DMAIC for process improvement and PDCA for sustaining improvements.		
UNIT III	**DEEPER UNDERSTADING METHODOLOGIES**	**9**
Process management - Keys to process management - Difference between process management and 6 Sigma - Introduction to Deming cycle, PDCA, DMAIC and continuous improvement - DMEDI for creation process - DMAIC Vs DMEDI with examples - Introduction to Toyota Production System, Six Sigma and Production System integration.		
UNIT IV	**LEAN ELEMENTS**	**9**
UNIT V	**IMPLEMENTATION AND CHALLENGES**	**9**
Implementing Checks and Balances in the process - Robust Information Systems - Dashboard follow up, robust corrective and preventive mechanism - Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the basics of 6 SIGMA.
CO2: Understand the lean manufacturing tools.
CO3: Illustrate about the deeper understanding methodologies of Lean manufacturing
CO4: Understand the lean concepts and its elements.
CO5: Analyze the implementation and challenges of lean manufacturing.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	JM Juran and FM Gryna, “Quality Planning and Analysis”, Tata Mc Graw Hill, 2014.
T2.	Akhilesh N. Singh, “Lean Manufacturing Principles to Practice”, Bibliophile South Asia, 2020.

REFERENCE BOOK(S)	
R1.	Erick C Jones, “Quality Management for Organizations Using Lean Six Sigma Techniques”, CRC press, Taylor & Fransis group, 2020.
R2.	Prof. Jitesh J Thakkar, “Six Sigma”, Emerald Publisher, 2018.

Course Code: 24MEP002	**Course Title: Renewable Energy**	
Course Category : PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To know the Indian and global energy scenario.
• To learn the various solar energy technologies and its applications.
• To educate the various wind energy technologies.
• To explore the various bio-energy technologies.
• To study the ocean and geothermal technologies.

UNIT I	**ENERGY SCENARIO**	**9**
Indian energy scenario in various sectors - domestic, industrial, commercial, agriculture, transportation and others - Present conventional energy status - Present renewable energy status Potential of various renewable energy sources - Global energy status - Percapita energy consumption - Future energy plans.		
UNIT II	**SOLAR ENERGY**	**9**
Solar radiation - Measurements of solar radiation and sunshine - Solar spectrum - Solar thermal collectors - Flat plate and concentrating collectors - Solar thermal applications - Solar thermal energy storage - Fundamentals of solar photo voltaic conversion - Solar cells - Solar PV Systems - Solar PV applications.		
UNIT III	**WIND ENERGY**	**9**
Wind data and energy estimation - Betz limit - Site selection for wind farms - characteristics - Wind resource assessment - Horizontal axis wind turbine - components - Vertical axis wind turbine - Wind turbine generators and its performance - Hybrid systems - Environmental issues - Applications.		
UNIT IV	**BIO-ENERGY**	**9**
Bio resources - Biomass direct combustion - thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration - Carbonization - Pyrolysis - Biogas plants - Digesters - Biodiesel production - Ethanol production - Applications.		

UNIT V	OCEAN AND GEOTHERMAL ENERGY	9
Small hydro - Tidal energy - Wave energy - Open and closed OTEC Cycles - Limitations - Geothermal energy - Geothermal energy sources - Types of geothermal power plants - Applications - Environmental impact.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the Indian and global energy scenario.
CO2: Analyze the various solar energy technologies and its applications.
CO3: Clarify the various wind energy technologies.
CO4: Understand the various bio-energy technologies.
CO5: Analyze the ocean and geothermal technologies

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Mehmet Kanoglu, Yunus A. Cengel and John M. Cimbala, "Fundamentals and Applications of Renewable Energy", First edition, McGraw Hill, 2020.
T2.	Kothari, "Renewable Energy Sources and Emerging Technologies", 2nd edition Prentice Hall India Learning Private Limited, 2021.

REFERENCE BOOK(S)	
R1.	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2022.
R2.	Rai.G.D, "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2024.

Course Code: 24MEP003	Course Title: Non-Traditional Machining Processes	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To classify non-traditional machining processes and describe mechanical energy based processes.
• To differentiate chemical and electro chemical energy-based processes.
• To describe thermo-electric energy-based processes.
• To explain nano finishing processes.
• To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes.

UNIT I	MECHANICAL ENERGY BASED PROCESSES	9
Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining - Abrasive water jet machining - Ultrasonic machining their principles - equipment - effect of process parameters, applications, advantages and limitations.		
UNIT II	**CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES**	**9**
Principles, equipments, effect of process parameters - applications, advantages and limitations of Chemical machining - Electro-chemical machining - Electro-chemical honing - Electro-chemical grinding - Electro chemical deburring.		
UNIT III	**THERMO-ELECTRIC ENERGY BASED PROCESSES**	**9**
Principles - equipments, effect of process parameters - applications, advantages and limitations of Electric discharge machining - Wire electric discharge machining - Laser beam machining, Plasma arc machining - Electron beam machining - Ion beam machining.		
UNIT IV	**NANO FINISHING PROCESSES**	**9**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining - Chemo mechanical polishing - Magnetic abrasive finishing - Magneto rheological finishing - Magneto rheological abrasive flow finishing.		

UNIT V	HYBRID NON-TRADITIONAL MACHINING PROCESSES	9
Introduction - Various hybrid non-traditional machining processes - their working principles - equipments - effect of process parameters - applications, advantages and limitations - Selection and comparison of different nontraditional machining processes.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
CO2: Illustrate chemical and electro chemical energy based processes.
CO3: Evaluate thermo-electric energy based processes.
CO4: Interpret nano finishing processes.
CO5: Analyse hybrid non-traditional machining and differentiate non- traditional processes.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Adithan. M., "Unconventional Machining Processes", Second Edition, Atlantic, New Delhi, India, 2009.
T2.	Anand Pandey, "Modern Machining Processes", First Edition, Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCE BOOK(S)

R1.	Benedict, G.F., "Non-traditional Manufacturing Processes", First Edition Marcel Dekker Inc., New York, 2007.
R2.	Carl Sommer, "Non-Traditional Machining Handbook", Second Edition Advance Publishing., United States, 2000.

Course Code: 24MEP004	**Course Title: Casting and Welding Processes**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To study the ferrous casting metallurgy and its applications.
• To study the nonferrous casting metallurgy and its applications.
• To study the ferrous welding metallurgy and its applications.
• To study the welding metallurgy of alloy steels and nonferrous metals and its applications.
• To Identifying the causes and remedies of various welding defects, applying welding standards and codes.

UNIT I	**FERROUS CAST ALLOYS**	**9**
Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size - Super cooling- Niyama Criterion - G/R ratio-Cell - Dendritic - Random dendritic structure - Segregation and Coring- Eutectics - Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions - Structure and Section sensitivity Cast irons- family & microstructures - Alloying effects - Malleable Iron, ADI, Charge calculations - Effect of normal elements and alloying elements in steels - Compositional aspects and properties of alloy steels - melting procedure and composition control for carbon steels - low alloy steels - stainless steels- composition control - slag-metal reactions - desulphurization dephosphorization, specifications for carbon steels - low alloy steels and stainless steels		
UNIT II	**NON-FERROUS CAST ALLOYS**	**9**
Copper- Aluminium - Magnesium- zinc - Nickel base alloys - melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys - problems in composition control - degassing techniques - heat treatment of aluminium alloys - basics of solution and precipitation process - applications of aluminium alloy castings in various fields. residual stresses - defects in castings.		
UNIT III	**PHYSICAL METALLURGY OF WELDING**	**9**
Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different micro-structural zones in welded plain-carbon steels.		

Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.		
UNIT IV	**WELDING OF ALLOY STEELS AND NON-FERROUS METALS**	**9**
Welding of stainless steels, types of stainless steels - overview of joining ferritic and martensitic types - welding of austenitic stainless steels - Sensitisation, hot cracking - sigma phase and chromium carbide formation - ways of overcoming these difficulties - welding of cast iron - Welding of non-ferrous materials - Joining of aluminium, copper, nickel and titanium alloys - problems encountered and solutions.		
UNIT V	**DEFECTS, WELDABILITY AND STANDARDS**	**9**
Defects in welded joints - Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking - causes and remedies in each case - Joining of dissimilar materials - weldability and testing of weldments - Introduction to International Standards and Codes.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the ferrous casting metallurgy and its applications.
CO2: Analyze the non-ferrous casting metallurgy and its applications.
CO3: Evaluate the ferrous welding metallurgy and its applications.
CO4: Interpret the welding metallurgy of alloy steels and non ferrous metals.
CO5: Formulate the causes and remedies of various welding defects.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Heine R W, Loper C R and Rosenthal P C, “Principles of Metal Castings”, Second Edition, Tata McGraw Hill, 2017.

T2.	A.K.Chakrabarthi, “Casting Technology and Cast Alloys”, Prentice Hall, 2005.

REFERENCE BOOK(S)	
R2.	Baldev Raj, Shankar V, Bhaduri A K, “Welding Technology for Engineers”, Narosa Publications, 2019.
R3.	Beeley P, “Foundry Technology" Butterworth-Heinemann, 2001.
R4.	R.S.Parmar, “Welding Engineering and Technology”, Khanna Publishers, 2010.
R5.	John Campbell, “Casting", Butterworth-Heinemann, 2003.

Course Code: 24MEP005	**Course Title: Ergonomics in Design**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To introduce to industrial design based on ergonomics.
• To consider ergonomics concept in manufacturing.
• To apply ergonomics in design of controls and display.
• To apply environmental factors in ergonomics design.
• To develop aesthetics applicable to manufacturing and product.

UNIT I	**INTRODUCTION TO ERGONOMICS IN DESIGN**	**9**
An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems - Ergonomics and Industrial Design - Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment - light, Heat and Sound.		
UNIT II	**ERGONOMICS AND PRODUCTION**	**9**
Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design - Visual Effects of Line and Form - The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness - Optical illusions, Influences of line and form.		
UNIT III	**DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS**	**9**
Displays - Design Principles of visual Displays - Classification, Quantitative displays, Qualitative displays - check readings - Situational awareness - Representative displays - Design of pointers - Signal and warning lights, colour coding of displays - Design of multiple displays Controls - Design considerations, Controls with little efforts - Push button, Switches, rotating Knobs. Controls with muscular effort - Hand wheel, Crank, Heavy lever, Pedals - Design of controls in automobiles, Machine Tools.		
UNIT IV	**ENVIRONMENTAL FACTORS**	**9**
Colour - Colour and light, Colour and objects, Colour and the eye - after Image, Colour blindness, Colour constancy, Colour terms - Colour circles, Munsel colour notation, reactions		

to colour and colour combination, colour on engineering equipments and Color coding, Psychological effects, colour and machine form, colour and style.		
UNIT V	**AESTHETIC CONCEPTS**	**9**
Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity - Proportion Style - The components of style, House style, Style in capital good - Introduction to Ergonomic and plant layout software's, total layout design.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the appreciate ergonomics need in the industrial design.
CO2: Apply ergonomics in creation of manufacturing system.
CO3: Analyze the design of controls and display.
CO4: Apply environmental factors in ergonomics design.
CO5: Apply the importance of aesthetics to manufacturing system and product.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Marcelo M. Soares , Francisco Rebelo, "Ergonomics in Design Methods and Techniques" 2007.
T2.	Bridger, R.C, "Introduction to Ergonomics", 2nd Edition, McGraw Hill Publications.

REFERENCE BOOK(S)	
R1.	Martin Helander, "A Guide to human factors and Ergonomics", Taylor and Francis, 2016.
R2.	Mayall W.H, "Industrial design for Engineers", London Hiffee books Ltd., 2005.

Course Code: 24MEP006	**Course Title: Tool & Die Design**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the basic types of cutting tools used in machining processes.
• To understand the jigs and fixtures and their critical role in the manufacturing process.
• To learn the essential components of die design and functions of die blocks, punches, strippers, and other parts integral to the die system.
• To understanding affects the mechanical properties and strength of forged parts.
• To understand the role of tooling in automating manufacturing processes.

UNIT I	**CUTTING TOOL DESIGN**	**9**
Fundamentals of Cutting tools design - cutting tools and their principal elements - Tool geometry - system of nomenclatures and their interrelations - setting for the grinding of various basic cutting tool (turning, drilling, milling).		
UNIT II	**ANALYSES AND DESIGN OF JIGS AND FIXTURE**	**9**
Principles of jig and fixture design - Dual cylinder location, diamond pin analysis - V-block analysis - design principles of centralisers - various mechanisms and design of equalizers, analysis for optimum number of clamping forces required and calculation of their magnitudes - concept of modular fixtures - design of fixtures for NC/CNC machines - computer applications in fixture design and analysis.		
UNIT III	**DESIGN OF PRESS TOOLS**	**9**
Components of die design, design of die blocks - punches and strippers - methods of holding punches - sketches of stock stops - Design procedure for progressive dies - compound dies and combination dies for press tool operation - forging die design for drop and machine forging parts - Computer applications in press tool design.		
UNIT IV	**DESIGN OF FORGING DIES**	**9**
Grain flow considerations, parting line selection, draft, design problems involving ribs, bosses and fillets - Flash and flash control - determination of number of impressions required and their sequence - design steps and analysis of forging dies, detail calculations, shrinkage, cavity		

shapes, heat transfer considerations, cooling and ejection systems - automation in forging operations - computer aided design and analysis.		
UNIT V	**TOOLING FOR AUTOMATS**	**9**
Cam design for automats, gauge design - gauge allowances and tolerance -materials for gauges - Economics of Tooling: Selection of economical method - amortization of tooling costs.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Recognize the types of cutting tools used in manufacturing processes.
CO2: Analyze how the design and composition of cutting tools impact their durability, heat resistance, and cutting efficiency.
CO3: Evaluate the individual components of forging dies, including die blocks etc.
CO4: Analyze dies for different types of forging, understanding the unique challenges.
CO5: Understanding of the principles and types of tooling used in automatic machines.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	"Fundamentals of Tool Design", Edward L. Peterson 2021.
T2.	"Tool and Die Design Handbook", Matthew J. P. Duffy 2020.

REFERENCE BOOK(S)	
R1.	"Tool Design", Donald P. LaRocca and Robert S. McDonald 2014.
R2.	"Principles of Tool Design", V. N. Krishnan 2025.

Course Code: 24MEP007	**Course Title: Composite Materials**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the composite materials, their classification, applications, and the influence.
• To explore the preparation, properties, and applications of various natural fibers.
• To explore the manufacturing techniques of Metal Matrix Composites.
• To understand the properties, and applications of Polymer Matrix Composites.
• To explore the strength and failure criteria of laminates, including laminar failure, and strength design.

UNIT I	**INTRODUCTION TO COMPOSITE MATERIALS**	**9**
Introduction: Definition - Classification and characteristics of Composite materials. Applications of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.		
UNIT II	**NATURAL FIBERS**	**9**
Reinforcements - Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Iso-strain and iso-stress conditions.		
UNIT III	**METAL MATRIX COMPOSITES**	**9**
Manufacturing of Metal Matrix Composites - Casting - Solid State diffusion technique, Cladding - Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration - Liquid phase sintering. Manufacturing of Carbon - Carbon composites - Knitting, Braiding, Weaving Properties and applications.		
UNIT IV	**POLYMER MATRIX COMPOSITES**	**9**
Manufacturing of Polymer Matrix Composites - Preparation of Molding compounds and prepregs - hand layup method - Autoclave method - Filament winding method - Compression molding - Reaction injection molding. Properties and applications.		
UNIT V	**DESIGN METHODS FOR COMPOSITE MATERIALS**	**9**
Strength: Laminar Failure Criteria - strength ratio - maximum stress criteria, maximum strain criteria - interacting failure criteria - hygrothermal failure - Laminate first play failure -		

insight strength - Laminate strength - ply discount truncated maximum strain criterion - strength design using caplet plots - stress concentrations.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the advantages and applications of composite materials.
CO2: Evaluate the properties of various natural composite materials.
CO3: Understand the manufacture of metal matrix composites.
CO4: Apply the manufacture of polymer matrix composites.
CO5: Analyze the failure theories of composite materials.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	R.W.Cahn, “Material Science and Technology" Volume 13, West Germany, 2020.
T2.	WD Callister and R. Balasubramaniam, “Materials Science and Engineering”, John Wiley & Sons, NY, 2017.

REFERENCE BOOK(S)	
R1.	K.K.Chawla, “Composite Materials”, 3rd Edition, springer, 2012.
R2.	Deborah D.L. Chung, “Composite Materials Science and Applications”, 2nd Edition, springer, 2010.

Course Code: 24MEP008	**Course Title: Smart Materials and Structures**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To familiarize fundamentals of smart materials and structures, including their properties.
• To understand the principles of piezoelectricity and the differences between single crystals.
• To explore the characteristics of materials, electro-active polymers, and ionic polymer matrix composites (IPMC).
• To examine the concepts of shape memory effect and materials.
• To study the principles of electro-rheological and magneto-rheological fluids.

UNIT I	**BASICS OF SMART MATERIALS**	**9**
Introduction to Smart Materials and Structures - Principles of Piezoelectricity - Single Crystals and Polycrystalline - Piezoelectric Polymers - Magnetostrictive materials - Electro-active Materials - Electronic Materials - Electro-active Polymers - Ionic Polymer Matrix Composite (IPMC) - Shape Memory Effect - Shape Memory Alloys - Shape Memory Polymers - Electro-rheological Fluids - Magneto Rheological Fluids.		
UNIT II	**SENSING AND ACTUATION**	**9**
Piezoelectric Sensors and actuators, Accelerometers - Active Fiber Sensing, Magnetostrictive Sensing - Shape Memory Actuators, Application of Smart Sensors and actuators for Structural Health Monitoring (SHM) - Closed loop and Open loop Smart Structures - Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.		
UNIT III	**SMART COMPOSITES**	**9**
Review of Composite Materials, Micro and Macro-mechanics - Modeling Laminated Composites based on Classical Laminated Plate Theory - Effect of Shear Deformation - Dynamics of Smart Composite Beam - Governing Equation of Motion and Finite Element - Modeling of Smart Composite Beams.		
UNIT IV	**SIGNAL PROCESSING AND CONTROL SYSTEMS**	**9**
Data Acquisition and Processing - Signal Processing and Control for Smart Structures - Sensors as Geometrical Processors - Signal Processing - Control System.		

UNIT V	ADVANCES IN SMART STRUCTURES AND MATERIALS	9
Self-Sensing Piezoelectric Transducers - Energy Harvesting Materials - Autophagous Materials - Self- Healing Polymers - Intelligent System Design, Emergent System Design.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the basic principles of smart materials.
CO2: Apply various actuators and sensors in smart structures.
CO3: Analyze smart composites.
CO4: Create signal processing and control systems.
CO5: Apply the utilization of smart materials in engineering applications.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	M. V. Gandhi and B. S. Thompson**,** "Smart Materials and Structures", Springer 2006.
T2.	Michelle Adding ton and Daniel Schodek Routledg, "Smart Materials and Technologies for the Architecture and Design Professions" Elsevier publications 2008.

REFERENCE BOOK(S)	
R1.	Vijay K. Varadan, K. J. Vinoy, and S. Gopalakrishnan "Introduction to Smart Materials and Structures" Wiley 2006.
R2.	A. V. Srinivasan and D. Michael McFarland, "Smart Materials and Structures" Cambridge University Press 2005.

Course Code: 24MEP009	**Course Title: Welding Technology**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the basics of welding and to know about the various types of welding processes.
• To explore the knowledge in resistance welding process and its applications.
• To understand the working principles of solid state welding process and its applications.
• To explore the knowledge about the various types welding process and its applications.
• To understand the design concepts and testing in weld elements.

UNIT I	**GAS AND ARC WELDING PROCESSES**	**9**
Fundamental principles - Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electro slag welding processes - advantages, limitations and applications.		
UNIT II	**RESISTANCE WELDING PROCESSES**	**9**
Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - Advantages, limitations and applications.		
UNIT III	**SOLID STATE WELDING PROCESSES**	**9**
Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - Advantages, limitations and applications.		
UNIT IV	**OTHER WELDING PROCESSES**	**9**
Thermit welds, atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.		
UNIT V	**DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS**	**9**
Various weld joint designs - Welding defects - causes and remedies - Weldability of Aluminum, Copper, and Stainless steels. Destructive and non-destructive testing of elements.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyze the construction and working principles of gas and arc welding process.
CO2: Analyze the construction and working principles of resistance welding process.
CO3: Understand the working principles of various solid states welding process.
CO4: Apply the construction and working principles of various special welding process.
CO5: Evaluate the concepts on weld joint design, weldability & testing of weld elements.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Little R.L, "Welding and welding Technology", 34th reprint, Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008.
T2.	Parmer R.S, "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2008.

REFERENCE BOOK(S)

R1.	Christopher Davis "Laser Welding- Practical Guide", Jaico Publishing House.
R2.	Davis A.C, "The Science and Practice of Welding", Cambridge University Press, Cambridge, 2013.

Course Code: 24MEP010	**Course Title: Industrial Layout Design and Safety**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
• To learn the facilities layout design algorithms and selecting appropriate software.
• To study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling.
• To learn the safety planning and management principles in industries.
• To learn the various safety management approaches in industries.

UNIT I	**INTRODUCTION TO INDUSTRIAL LAYOUT DESIGN AND SAFETY**	**9**
Industrial Facility Layout - Definition, Types of Layout Problems, Engineering Design Problem Approach - Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability - Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs. .		
UNIT II	**FACILITIES LAYOUT DESIGN & ALGORITHMS**	**9**
Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design - Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation)		
UNIT III	**FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS**	**9**
Models for the Layout Problem, Generic Modeling Tools, Models for the Single - Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area - Material Handling, Principles, Types, Models for Material-Handling System Design - Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.		

UNIT IV	SAFETY PLANNING & MANAGEMENT	9
Introduction: Elements of Safety Programming, Safety Management - Upgrading Safety Developmental Programs - Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety - Safety Performance - An Overview of an Accident, Occupational Health and Industrial Hygiene - Understanding the Risks - Prevention of Accidents Involving Hazardous Substances - Indian Factories Act 1948 for Health and Safety.		
UNIT V	**APPROACHES IN SAFETY MANAGEMENT**	**9**
Safeguarding against Common Potential Hazards - Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control - Specific Hazard Control Measures - Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage - Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.		
		Total:45 hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the industrial facility layout design principles, and material flow analysis.
CO2: Apply the facilities layout design algorithms and selecting appropriate software.
CO3: Analyze the facilities layout problem modeling tools and algorithms.
CO4: Evaluate the safety planning and management principles in industries.
CO5: Illustrate the various safety management approaches in industries. .

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Sunderesh S. Heragu, "Facilities Design", 3rd Edition, CRC Press Taylor & Francis Group, 2008.

T2.	L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", Tata McGraw-Hill Publishing Co. Ltd., 2005.

REFERENCE BOOK(S)	
R1.	James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, "Facilities Planning", 4th Edition, John Wiley & Sons, 2010.
R2.	Charles D.Reese, "Occupational Health and Safety Management", A Practical Approach, CRC Press, 2003.
R3.	Eric Teicholz, "Facility Design and Management Handbook", Tata McGraw-Hill Publishing Co. Ltd., 2001.

.

Course Code: 24MEP011	**Course Title: Automobile Engineering**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the construction and working principle of various parts of an automobile.
• To have the practice for assembling and dismantling of engine auxiliary system.
• To provide knowledge in various transmission systems.
• To learn the concepts of design to brakes and steering systems.
• To understand the various alternate fuels used in automobile.

UNIT I	**VEHICLE STRUCTURE AND ENGINES**	**9**
Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines - components- functions and materials, variable valve timing (VVT).		
UNIT II	**ENGINE AUXILIARY SYSTEMS**	**9**
Electronically controlled gasoline injection system for SI engine - Electronically controlled diesel injection system (Rotary injector, common rail direct injection system, unit injector system) - Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system) - Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system - Emission norms (Euro and BS).		
UNIT III	**TRANSMISSION SYSTEMS**	**9**
Clutch-types and construction, gear boxes - manual and automatic, gear shift mechanisms - Over drive, transfer box - fluid flywheel - torque converter, propeller shaft, slip joints, universal joints ,Differential and rear axle - Hotchkiss Drive and Torque Tube Drive.		
UNIT IV	**STEERING, BRAKES AND SUSPENSION SYSTEMS**	**9**
Steering geometry and types of steering gear box- Power Steering - Types of Front Axle - Types of Suspension Systems - Pneumatic and Hydraulic Braking Systems - Antilock Braking System (ABS) - electronic brake force distribution (EBD) and Traction Control.		
UNIT V	**ALTERNATIVE ENERGY SOURCES**	**9**
Use of Natural Gas - Liquefied Petroleum Gas - Bio-diesel - Bio-ethanol - Gasohol and Hydrogen in Automobiles - Engine modifications required - Performance - Combustion and		

Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note.
Total:45 hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply different layouts of automobile in order to resolve the various forces & moments associated with aerodynamics.
CO2: Understand engines and structures for automobiles based on fundamentals engines.
CO3: Analyze the suitable engine auxiliary systems for automobiles and gearboxes.
CO4: Select appropriate transmission systems for automobiles.
CO5: Apply the various alternate fuels for the automobile.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Kirpal Singh, "Automobile Engineering", Volume 1 & 2, Standard Publishers, New Delhi, Seventh Edition, 1997.
T2.	Jain K.K. and Asthana R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2022.

REFERENCE BOOK(S)	
R1.	Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 2015.
R3.	Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 2017.

Course Code: 24MEP012	**Course Title: Gas Dynamics And Jet Propulsion**	
Course Category: PEC	**Credits: 3**	
L: T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the basic difference between incompressible and compressible flow.
• To understand the basic difference between fanno and Rayleigh flow.
• To understand the phenomenon of shock waves and its effect on flow.
• To gain some basic knowledge about jet propulsion.
• To gain some basic knowledge about Rocket Propulsion.

UNIT I	**BASIC CONCEPTS AND ISENTROPIC FLOWS**	**9**
Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers.		
UNIT II	**FLOW THROUGH DUCTS**	**9**
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.		
UNIT III	**NORMAL AND OBLIQUE SHOCKS**	**9**
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.		
UNIT IV	**JET PROPULSION**	**9**
Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.		
UNIT V	**SPACE PROPULSION**	**9**
Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the concept of compressible flows in variable area ducts.
CO2: Apply the concept of compressible flows in constant area ducts.
CO3: Examine the effect of compression and expansion waves in compressible flow.
CO4: Use the concept of gas dynamics in Jet Propulsion.
CO5: Apply the concept of gas dynamics in Space Propulsion.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Anderson, J.D., "Modern Compressible flow", 3 rd Edition, McGraw Hill, 2012.
T2.	Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2002.

REFERENCE BOOK(S)	
R1.	Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010
R2.	Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980
R3.	Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2010

Course Code: 24MEP013	**Course Title: Additive Manufacturing**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the evolution, principles, and classification of AM processes.
• To learn various AM techniques like Vat Photo polymerization, FDM, SLS, and DED.
• To analyze the advantages, limitations, and industrial applications of AM.
• To explore post-processing techniques for quality improvement of AM parts.
• To develop skills to select appropriate AM processes for specific applications.

UNIT I	**INTRODUCTION TO ADDITIVE MANUFACTURING**	**9**
Introduction to AM, AM evolution - Distinction between AM & CNC machining - Steps in AM, Classification of AM processes - Advantages of AM and Types of materials for AM - Vat Photo polymerization AM Processes - Stereo lithography (SL), Materials - Process Modelling - SL resin curing process - SL scan patterns, Micro-stereo lithography - Mask Projection Processes - Two-Photon vat photo polymerization - Process Benefits and Drawbacks.		
UNIT II	**EXTRUSION - BASED AM PROCESSES**	**9**
Fused Deposition Modelling (FDM) - Principles - Materials, Process Modelling - Plotting and path control - Bio Extrusion, Contour Crafting - Process Benefits and Drawbacks - Applications of Extrusion - Based Processes. Sheet Lamination AM Processes - Bonding Mechanisms, Materials - Laminated Object Manufacturing (LOM) - Ultrasonic Consolidation (UC), Gluing - Thermal bonding - LOM and UC applications.		
UNIT III	**POWDER BED FUSION AM PROCESSES**	**9**
Selective laser Sintering (SLS), Materials - Powder fusion mechanism and powder handling - Process 11 Modelling - SLS Metal and ceramic part creation - Electron Beam melting (EBM) - Process Benefits and Drawbacks - Applications of Powder Bed Fusion Processes.		
UNIT IV	**DIRECTED ENERGY DEPOSITION AM PROCESSES**	**9**
Process Description - Material Delivery - Laser Engineered Net Shaping (LENS) - Direct Metal Deposition (DMD) - Electron Beam Based Metal Deposition, Processing- Structure properties, relationships, Benefits and drawbacks - Applications of Directed Energy Deposition Processes - Materials science for AM.		

UNIT V	POST PROCESSING OF AM PARTS	9
Support Material Removal - Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement- Preparation for use as a Pattern-Property Enhancements using Non-thermal and Thermal Techniques - Process Selection: Introduction Selection Methods for a Part - Challenges of Selection.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the evolution and classification of additive manufacturing.
CO2: Apply the concepts of Bio Extrusion for specific applications.
CO3: Analyze the material behaviour in SLS and EBM.
CO4: Evaluate the benefits and limitations of detected energy deposition additive mfg process
CO5: Analyze challenges in AM process selection.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1						2			2	2	
CO2	1	2	2	1						2			2	2	
CO3	1	2	2	1						2			2	2	
CO4	1	2	2	1						2			2	2	
CO5	1	1	2	1						2			2	2	

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Ian Gibson, David W Rosen and Brent Stucker, "Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2022.
T2.	Patri K. Venuvinod and Weiyin Ma, "Rapid Prototyping Laser-based and Other Technologies", Springer, 2024.

REFERENCE BOOK(S)

R1.	Chua Chee Kai and Leong Kah Fai, "3D Printing and Additive Manufacturing Principles & Applications", 4th Edition, World Scientific, 2019.
R2.	D.T. Pham and S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", Springer, 2011.

Course Code: 24MEP014	**Course Title: Design Thinking**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the fundamental principles of Design Thinking and its relevance in solving complex problems.
• To understand the key phases of the Design Thinking process.
• To understand the importance of visualizing and empathizing before ideating.
• To apply Prototyping in Product Development
• To equip with hands-on experience in prototype developing, testing, and scaling.

UNIT I	**FUNDAMENTALS OF DESIGN THINKING**	**9**
Design Thinking Process - Types of the thinking process - Common methods to change the human thinking process - Design thinking: Definition, Origin of design thinking, Importance of design thinking - Design vs Design thinking, -Problem solving, the need of design thinking - An approach to design thinking**,** Design thinking Process model, Design thinking tools.		
UNIT II	**EMPATHIZE AND DEFINE**	**9**
Design thinking phases, how to empathize - Role of empathy in design thinking - the purpose of empathy maps - Things to be done prior to empathy mapping - Activities during and after the session - Understanding empathy tools - Customer Journey Map, Personas.		
UNIT III	**IDEATION**	**9**
Challenges in idea generation, Visualize, Empathize, and Ideate method - Importance of visualizing and empathizing before ideating - Applying the method, Create Thinking, Generating Design Ideas, Lateral Thinking, Analogies, Brainstorming, Mind mapping, National Group Technique, Synectic's, Development of work, Analytical Thinking, Group Activities - Ideation Tools: How Might We? (HMW), Storyboard, Brainstorming.		
UNIT IV	**PROTOTYPING**	**9**
Introduction - Prototyping as a mindset, prototype examples, prototyping for products-Need for protype - Fidelity for prototypes, Process of prototyping- Minimum Viable prototype.		
UNIT V	**TESTING PROTOTYPES**	**9**
Prototyping for digital products - What's unique for digital products, Preparation - Prototyping for physical products - What's unique for physical products, Preparation -		

Testing prototypes with users - Create a Pitch-Plan for scaling up-Road map for Implementation, Fine-tuning and Submission of the project report.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand and implement the five key stages of the Design Thinking process to approach complex and ill-structured problems effectively.
CO2: Apply empathy-driven techniques to better understand users, identify pain points, and create user-centered design solutions.
CO3: Analyze practical techniques and tools to generate, develop, and refine creative ideas for innovative problem-solving.
CO4: Analyze Prototype Fidelity.
CO5: Create prototype, test, and scale innovative products from concept to reality.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Tim Brown, “Change by Design, How Design Thinking Transforms Organizations and Inspires Innovation”, HarperCollins Publishers Ltd, 2009.
T2.	Idris Mootee, “Design Thinking for Strategic Innovation”, John Wiley & Sons Inc, 2013

REFERENCE BOOK(S)	
R1.	Michael Lewrick, Patrick Link, Larry Leifer “The Design Thinking Playbook, Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems”,. John Wiley & Sons, 2018.
R2.	Nigel Cross,”Design Thinking Understanding How Designers Think”, 2nd Edition, Berg Publishers, 2023.

Course Code: 24MEP015	**Course Title: Value Engineering**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To study the value engineering process and able to identify its functions within the process.
• To determine the appropriate value engineering methodology for a given project.
• To learn various decision-making processes and cost evaluation models.
• To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing.
• To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT I	**VALUE ENGINEERING BASICS**	**9**
Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function - Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.		
UNIT II	**VALUE ENGINEERING JOB PLAN AND PROCESS**	**9**
Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioural and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering.		
UNIT III	**VALUE ENGINEERING TECHNIQUES**	**9**
Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions-Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)		
UNIT IV	**WORKSHEETS AND GUIDELINES**	**9**
Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.		
UNIT V	**VERSATILITY OF VALUE ENGINEERING**	**9**

Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.
CO2: Apply the product and articulate it in various phases of value engineering
CO3: Formulate and select appropriate methods, standards and apply them on value engineering project and propose appropriate training
CO4: Apply querying theory and FAST to prefect a value engineering project implementation.
CO5: Apply the various case studies related to value engineering project implementation.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Iyer. S.S., "Value Engineering", New Age International (P) Limited, 9th Edition, 2009.
T2.	Anil Kumar. and Mukhopadhyaya., "Value Engineering: Concepts Techniques and applications", SAGE Publications, 1st Edition, 2003.

REFERENCE BOOK(S)	
R1.	Lawrence D.Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015.
R2	Alphonse Dell'Isola., "Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations", R.S. Means Company, 1997.

Course Code: 24MEP016	Course Title: Digital Manufacturing	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To study the various aspects of Digital Manufacturing (DM).
• To inculcate the importance of DM in Product life-cycle Management and Supply chain Management.
• To formulate of smart manufacturing systems in the digital work environment.
• To interpret Internet of Things (IoT) to support the digital manufacturing.
• To elaborate the significance of digital twin.

UNIT I	DIGITAL MANUFACTURING	9
Introduction - Need - Overview of Digital Manufacturing and the Past - Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management - Practical Benefits of Digital Manufacturing - The Future of Digital Manufacturing.		
UNIT II	**DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT**	**9**
Collaborative Product Development, Mapping Requirements to specifications - Part Numbering, Engineering Vaulting, and Product reuse - Engineering Change Management, Bill of Material and Process Consistency - Digital Mock up and Prototype development - Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM.		
UNIT III	**SMART FACTORY**	**9**
Smart Factory - Levels of Smart Factories - Benefits - Technologies used in Smart Factory - Smart Factory in IoT- Key Principles of a Smart Factory - Creating a Smart Factory - Smart Factories and Cyber security.		
UNIT IV	**INDUSTRY 4.0**	**9**
Introduction - Industry 4.0 -Internet of Things - Industrial Internet of Things - Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cloud computing - Data analytics - Cyber physical systems -Machine to Machine communication - Case Studies.		

UNIT V	DIGITAL TWIN	9
Basic Concepts - Features and Implementation - Digital Twin: Digital Thread and Digital Shadow- Building Blocks - Types - Characteristics of a Good Digital Twin Platform - Benefits, Impact & Challenges - Future of Digital Twins.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply knowledge to use various elements in the digital manufacturing.
CO2: Understand the concepts involved in digital product development life cycle process .
CO3: Evaluate the proper procedure of validating practical work through digital validation.
CO4: Understand the concepts of IoT and its role in digital manufacturing.
CO5: Analyze and optimize various practical manufacturing processes through digital twin.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, "Fundamentals of Digital Manufacturing Science", Springer-Verlag London Limited, 2012.
T2.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCE BOOK(S)

R1.	Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer, Switzerland, 2018.
R2.	Lihui Wang and Andrew YehChing Nee, "Collaborative Design and Planning for Digital Manufacturing", Springer-Verlag London Limited, 2019.
R3.	Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science, United States, 2019.

Course Code: 24MEP017	**Course Title: Power Plant Engineering**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To study the coal based thermal power plants.
• To study the diesel, gas turbine and combined cycle power plants.
• To learn the basic of nuclear engineering and power plants.
• To learn the power from renewable energy.
• To study energy, economic and environmental issues of power plants.

UNIT I	**COAL BASED THERMAL POWER PLANTS**	**9**
Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants - Fuel and ash handling, Draught system, Feed water treatment - Binary Cycles and Co-generation systems.		
UNIT II	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**	**9**
Components of Diesel and Gas Turbine power plants - Combined Cycle Power Plants. Integrated Gasified based Combined Cycle systems.		
UNIT III	**NUCLEAR POWER PLANTS**	**9**
Basics of Nuclear Engineering - Layout and subsystems of Nuclear Power Plants - Working of Nuclear Reactors - Boiling Water Reactor (BWR) - Pressurized Water Reactor (PWR), CANADA Deuterium- Uranium reactor (CANDU), Breeder - Gas Cooled and Liquid Metal Cooled Reactors - Safety measures for Nuclear Power plants.		
UNIT IV	**POWER FROM RENEWABLE ENERGY**	**9**
Hydro Electric Power Plants - Classification, Typical Layout and associated components including Turbines - Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.		
UNIT V	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**	**9**
Power tariff types - Load distribution parameters, load curve - Comparison of site selection criteria - relative merits & demerits - Capital & Operating Cost of different power plants -		

Pollution control technologies including Waste Disposal for Coal and Nuclear Power Plants.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Illustrate the operation and maintenance of coal based thermal power plants.
CO2: Understand the Diesel, Gas Turbine and Combined Cycle Power Plants.
CO3: Illustrate the operation and maintenance of Nuclear Power Plants.
CO4: Understand the various renewable energy sources.
CO5: Analyze energy and economic related issues in power sectors.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	Nag. P.K., "Power Plant Engineering", Fourth Edition, Tata McGraw - Hill Publishing Company Ltd., 2017.
T2.	R.K. Rajput, "A Textbook of Power Plant Engineering", Fifth Edition, Laxmi Publications, 2019.

REFERENCE BOOK(S)

R1.	El-Wakil. M.M., "Power Plant Technology", Tata McGraw - Hill Publishing Company Ltd., 2020.
R2.	Godfrey Boyle, "Renewable energy", Open University, Oxford University Press, 2004.

Course Code: 24MEP018	**Course Title: Industry 4.0**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours:45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the evolution and principles of Industry 4.0 and its impact on modern industries.
• To explore the role of IoT, IIoT, and smart technologies in transforming industries.
• To analyze the enabling technologies like cyber-physical systems, robotics, and cybersecurity for Industry 4.0.
• To comprehend the significance of data, information, and collaboration in the Industry 4.0 era.
• To evaluate real-world applications, opportunities, and challenges of Industry 4.0 through case studies.

UNIT I	**INDUSTRY 4.0**	**9**
Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.		
UNIT II	**ROAD TO INDUSTRY 4.0**	**9**
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities Predictive Analytics.		
UNIT III	**ENABLING TECHNOLOGIES**	**9**
System, Technologies for enabling Industry 4.0-Cyber Physical Systems - Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing - Cyber Security.		
UNIT IV	**DATA AND COLLABORATION**	**9**
Role of data, information, knowledge and collaboration in future organizations - Resource-based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics -Cloud Computing and Industry 4.0.		

UNIT V	CASE STUDIES & FUTURE	9
Industry 4.0 - IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world - Society 5.0.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the evolution of Industry 4.0.
CO2: Apply the principles of smart logistics and smart cities for industry transformation.
CO3: Analyze the significance of cyber security in Industry 4.0.
CO4: Evaluate data as a strategic resource for organizations.
CO5: Analyze the future challenges and skill requirements for Industry 4.0.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Alasdair Gilchrist,"Industry 4.0: The Industrial Internet of Things", 1st Edition, Apress, 2016.
T2.	Arsheep Bahga,"Internet of Things: A Hands-On Approach",1st Edition, Orient Blackswan Private Limited - New Delhi, 2014.

REFERENCE BOOK(S)	
R1.	Klaus Schwab, "The Fourth Industrial Revolution", 1st Edition, Crown Business, 2017.
R2.	Bharat Bhushan, "Industry 4.0: Technologies, Trends, and Applications", 1st Edition, BPB Publications, 2021.

Course Code: 24MEP019	**Course Title: Alternative Fuels in IC Engines**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To analyse the availability, suitability, properties of alternative fuels.
• To study the utilization techniques of liquid fuels in spark ignition (SI) engines.
• To understand the emission impacts of liquid fuels for compression ignition (CI) engines.
• To examine the use of gaseous fuels like hydrogen, liquefied petroleum gas (LPG), and biogas in SI engines.
• To explore the application of gaseous fuels in CI engines, focusing on dual fuelling strategies.

UNIT I	**INTRODUCTION TO ALTERNATIVE FUELS**	**9**
Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels - Ethanol, Methanol, Diethyl ether, Dimethyl ether, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas and Bio-diesel.		
UNIT II	**LIQUID FUELS FOR S.I. ENGINES**	**9**
Requirements, Utilization techniques - Blends, Neat form, Reformed Fuels, Storage and Safety, Performance and Emission Characteristics.		
UNIT III	**LIQUID FUELS FOR C.I. ENGINES**	**9**
Requirements, Utilization techniques - Blends, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics.		
UNIT IV	**GASEOUS FUELS FOR S.I. ENGINES**	**9**
Hydrogen, Compressed Natural gas, Liquefied Petroleum gas, and Bio gas in SI engines - Safety Precautions - Engine performance and emissions.		
UNIT V	**GASEOUS FUELS FOR C.I. ENGINES**	**9**
Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines - Dual fuelling, Performance and emission characteristics.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the availability and suitability of alternative fuels.
CO2: Analyze the performance and emission characteristics of different liquid fuels in SI engines.
CO3: Examine the performance and emission effects of neat and reformed fuels in CI engines.
CO4: Analyze the operational challenges of gaseous fuels in SI engines.
CO5: Develop strategies for integrating gaseous fuels into CI engines for improved performance.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Y Hua, "Alcohols as motor fuels progress in technology", SAE Publication USE, 2020.
T2.	Keith Owen and Trevor Eoley, "Automotive Fuels Handbook", SAE Publications, 2020.

REFERENCE BOOK(S)	
R1.	Maheswar Dayal, "Energy today a tomorrow", Horishr India, 2019.
R2.	Osamu Hirao and Richard K. Pefley, "Present and Future Automotive Fuels", John Wiley and Sons, 2020.
R3.	Richard L.Bechfold "Alternative Fuels Guide Book", SAE International Warrendale, 2022.

Course Code: 24MEP020	**Course Title: Topology Optimization and Generative Design**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To Understand and appraise the importance of optimization in mechanical design.
• To evaluate the effectiveness of mathematical programming techniques for optimization.
• To analyze the application of topology optimization in mechanical systems.
• To evaluate the effectiveness of generative design principles and evolutionary algorithms.
• To analyze the impact of uncertainty on optimization outcomes in mechanical design.

UNIT I	**OPTIMIZATION IN MECHANICAL ENGINEERING**	**9**
optimization techniques, Importance of optimization in mechanical design, Applications of topology optimization and generative design in mechanical engineering.		
UNIT II	**MATHEMATICAL FOUNDATIONS OF OPTIMIZATION**	**9**
Optimization problem formulations, Mathematical programming techniques (linear, nonlinear, and integer programming), Sensitivity analysis and gradient-based methods.		
UNIT III	**TOPOLOGY OPTIMIZATION**	**9**
Fundamentals of topology optimization, Optimization algorithms for topology optimization, Case studies and applications in mechanical systems.		
UNIT IV	**GENERATIVE DESIGN TECHNIQUES**	**9**
generative design principles, Evolutionary algorithms and their application in generative design, Integration of generative design with additive manufacturing processes		
UNIT V	**TOPOLOGY OPTIMIZATION AND GENERATIVE DESIGN**	**9**
Optimization under uncertainty, Multi-objective optimization in mechanical design, Future trends and challenges in topology optimization and generative design		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Demonstrate the role of optimization in improving mechanical design efficiency.

CO2: Evaluate the effectiveness of different mathematical programming approaches.
CO3: Apply optimization algorithms to solve mechanical system problems.
CO4: Integrate generative design techniques with additive manufacturing processes.
CO5: Evaluate the future challenges and potential advancements in topology optimization and generative design.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Martin Philip Bendsoe and Ole Sigmund, “Topology Optimization: Theory, Methods, and Applications”.
T2.	Ravindra K. Ahuja, James B. Orlin, and Thomas L. “Magnanti Engineering Optimization: Methods and Applications”.
T3	Martin Philip Bendsoe “Topology Optimization for Structural Design".

REFERENCE BOOK(S)

R1.	Ashok D. Belegundu and Tirupathi R. Chandrupatla, “Optimization Concepts and Applications in Engineering".
R2.	D. M. Frangopol and H. Adeli, “Introduction to Structural Optimization".
R3.	Rolf Steinbuch and Anthony J. H. F. van den Boogaard, “Topology Optimization in Structural Mechanics".

Course Code: 24MEP021	Course Title: Hydrogen Engine Technology	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the basic production techniques of hydrogen, including conventional and advanced methods.
• To explore various hydrogen storage options, management practices, and applications across industries.
• To study the principles, working mechanisms, and performance evaluation of fuel cells.
• To differentiate between various types of fuel cells, including their merits and demerits
• To analyze the applications of fuel cells in power generation, transportation, and space.

UNIT I	HYDROGEN - BASICS AND PRODUCTION TECHNIQUES	9
Hydrogen - physical and chemical properties, salient characteristics. Production of hydrogen - steam reforming - water electrolysis - gasification and woody biomass conversion - biological hydrogen production - photo dissociation - direct thermal or catalytic splitting of water.		
UNIT II	**HYDROGEN STORAGE AND APPLICATIONS**	**9**
Hydrogen storage options - compressed gas - liquid hydrogen - Hydride - chemical Storage - comparisons. Safety and management of hydrogen. Applications of Hydrogen.		
UNIT III	**FUEL CELLS**	**9**
History - principle - working - thermodynamics and kinetics of fuel cell process - performance evaluation of fuel cell - comparison on battery Vs fuel cell.		
UNIT IV	**FUEL CELL - TYPES**	**9**
Types of fuel cells - AFC, PAFC, SOFC, MCFC, DMFC, PEMFC - relative merits and demerits.		
UNIT V	**APPLICATION OF FUEL CELL AND ECONOMICS**	**9**
Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic & environmental analysis on usage of Hydrogen, Fuel cell. Future trends in fuel cells.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply the various production methods for hydrogen, such as steam reforming, electrolysis, and biomass conversion.
CO2: Evaluate the safety protocols and management strategies for hydrogen storage.
CO3: Apply the thermodynamics and kinetics of fuel cell processes.
CO4: Evaluate the suitability of different fuel cell types for specific applications.
CO5: Analyze the integration of fuel cell systems into sustainable energy frameworks.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Viswanathan B and Aulice Scibioh.M"Fuel Cells - Principles and Applications, Universities Press, 2016.
T2.	Rebecca L. and Busby,"Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma, 2015.

REFERENCE BOOK(S)	
R1.	Bent Sorense"Hydrogen and Fuel Cells: Emerging Technologies and Applications", Elsevier, UK 2005.
R2.	Kordesch K. and G.Simader, "Fuel Cell and their Applications", Wiley-Vch Germany, 1996.

Course Code: 24MEP022	**Course Title: Refrigeration and Air - Conditioning**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the principles of operations in different Refrigeration & air conditioning systems and components.
• To provide knowledge on design aspects of vapour compression refrigeration systems.
• To gain knowledge on various types of refrigeration systems.
• To learn about the psychometric properties and its process.
• To gain knowledge about various AC systems and load calculation.

UNIT I	**INTRODUCTION TO REFRIGERATION**	**9**
Introduction to Refrigeration - Unit of Refrigeration and C.O.P.- Ideal cycles- Refrigerants Desirable properties - Classification - Nomenclature - ODP & GWP.		
UNIT II	**VAPOUR COMPRESSION REFRIGERATION SYSTEM**	**9**
Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle - sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system - low temperature refrigeration - Cascade systems - problems. Type of Compressors, Condensers, Expansion devices, Evaporators.		
UNIT III	**OTHER REFRIGERATION SYSTEMS**	**9**
Working principles of Vapour absorption systems and adsorption cooling systems - Steam jet refrigeration- Ejector refrigeration systems- Thermo electric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.		
UNIT IV	**PSYCHROMETRIC PROPERTIES AND PROCESSES**	**9**
Properties of moist Air - Gibbs Dalton law - Specific humidity - Dew point temperature, Degree of saturation - Relative humidity - Enthalpy - Humid specific heat - Wet bulb temperature Thermodynamic wet bulb temperature - Psychrometric chart - Psychrometric of air-conditioning processes - mixing of air streams.		
UNIT V	**AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION**	**9**
Air conditioning loads: Outside and inside design conditions - Heat transfer through structure - Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat		

load - Apparatus selection - fresh air load, human comfort & IAQ principles, -effective temperature & chart - calculation of summer & winter air conditioning load - Classifications, Layout of plants - Air distribution system - Filters - Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors - Actuators & Safety controls.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the basic concepts of Refrigeration.
CO2: Analyze the Vapor compression, Refrigeration systems and to solve problems.
CO3: Analyze the various types of Refrigeration systems.
CO4: Apply the Psychometric properties and its use in psychometric processes.
CO5: Apply the concepts of Air conditioning and to solve problems.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Arora C.P., "Refrigeration and Air Conditioning", 5th edition, McGraw Hill, New Delhi, 2020.
T2.	Jones W.P., "Air conditioning engineering", 3rd edition, Elsevier Butterworth-Heinemann, 2018.

REFERENCE BOOK(S)	
R1.	Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2019.
R2.	Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 2014.

Course Code: 24MEP023	**Course Title: Computer Integrated Manufacturing**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To learn the basic concepts of computer integrated manufacturing.
• To understand production planning and control and computerized process planning.
• To train students to differentiate the different coding systems used in group technology.
• To familiarize the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system.
• To introduce to basics of classification of robots used in industrial applications.

UNIT I	**OVERVIEW OF CIM**	**9**
CIM concepts -Computerised elements of CIM system -Types of production - Manufacturing models and Metrics -Mathematical models of Production Performance - Simple problems -Manufacturing Control -Simple Problems -Basic Elements of an Automated system -Levels of Automation -Lean Production and Just-In-Time Production.		
UNIT II	**PRODUCTION PLANNING AND CONTROL**	**9**
Process planning - Computer Aided Process Planning (CAPP) - Logical steps in Computer Aided Process Planning - Aggregate Production Planning and the Master Production Schedule -Material Requirement planning - Capacity Planning - Control Systems-Shop Floor Control -Inventory Control - Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.		
UNIT III	**CELLULAR MANUFACTURING**	**9**
Group Technology(GT), Part Families -Parts Classification and coding -Simple Problems in Opitz Part Coding system -Production flow Analysis -Cellular Manufacturing -Composite part concept -Machine cell design and layout -Quantitative analysis in Cellular Manufacturing -Rank Order Clustering Method - Arranging Machines in a GT cell -Hollier Method -Simple Problems.		
UNIT IV	**FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)**	**9**

Types of Flexibility - FMS -FMS Components -FMS Application & Benefits -FMS Planning and Control -Quantitative analysis in FMS -Simple Problems. Automated Guided Vehicle System AGVS - Application -Vehicle Guidance technology -Vehicle Management & Safety.		
UNIT V	**INDUSTRIAL ROBOTICS**	**9**
Robot Anatomy and Related Attributes -Classification of Robots- Robot Control systems - End Effectors -Sensors in Robotics -Robot Accuracy and Repeatability - Industrial Robot Applications -Robot Part Programming -Robot Accuracy and Repeatability -Simple Problems.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the basic concepts of CAD, CAM and computer integrated manufacturing systems.
CO2: Apply the production planning and control and computerized process planning.
CO3: Apply the different coding systems used in group technology.
CO4: Analyze the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system.
CO5: Analyze the robots used in industrial applications.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
T2.	Radhakrishnan P, Subramanyan S and Raju V, "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCE BOOK(S)	
R1.	Gideon Halevi and Roland Weill, "Principles of Process Planning -A Logical Approach" Chapman & Hall, London, 1995.
R2.	Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

Course Code: 24MEP024	Course Title: Foundation of Robotics	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To study the kinematics, drive systems and programming of robots.
• To study the basics of robot laws and robot kinematics.
• To familiarize the concepts and techniques of robot drives and end effectors.
• To familiarize the various Programming and Machine Vision application in robots.
• To evaluate the robot programming and its application.

UNIT I	FUNDAMENTALS OF ROBOT	9
Robot - Definition - Robot Anatomy - Co-ordinate systems, Work Envelope, types and classification - specifications - Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Robot Parts and their functions - Need for Robots - Different Applications.		
UNIT II	**ROBOT KINEMATICS**	**9**
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) - derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.		
UNIT III	**ROBOT DRIVE SYSTEMS AND END EFFECTORS**	**9**
Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives - D.C. Servo Motors, Stepper Motor, A.C. Servo Motors - Salient Features, Applications and Comparison of All These Drives. End Effectors - Grippers - Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper.		
UNIT IV	**SENSORS IN ROBOTICS**	**9**
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data - signal conversion, image storage, lighting techniques, image processing and analysis - data reduction, segmentation, feature extraction, object recognition, other		

algorithms, applications - Inspection, identification, visual serving and navigation.		
UNIT V	**PROGRAMMING AND APPLICATIONS OF ROBOT**	**9**
Teach pendant programming, lead through programming, robot programming languages - VAL programming - Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the features of robots and technology involved in the control.
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Analyse the basic concepts like grippers and sensors used in robots.
CO4: Understand the concept of various types of sensors.
CO5: Analyze the various robot programming using various programmes.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Ganesh.S.Hedge, "A textbook of Industrial Robotics", Lakshmi Publications, 2016.
T2.	Mikell.P.Groover, "Industrial Robotics - Technology, Programming and applications" 2nd edition, McGraw Hill, 2022.

REFERENCE BOOK(S)	
R1.	Fu K.S. Gonalz R.C. and Ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2019.
R2.	Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2015.

Course Code: 24MEO001	**Course Title: Drone Technologies**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the basics of drone technology concepts.
• To learn and understand the fundamental of design, fabrication and programming of drone.
• To impart the knowledge of a flying and operation of drone.
• To know about the various applications of drone.
• To understand the safety risks and guidelines of fly safely.

UNIT I	**INTRODUCTION TO DRONE TECHNOLOGY**	**9**
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.		
UNIT II	**DRONE DESIGN, FABRICATION AND PROGRAMMING**	**9**
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer-Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.		
UNIT III	**DRONE FLYING AND OPERATION**	**9**
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.		
UNIT IV	**DRONE COMMERCIAL APPLICATIONS**	**9**
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcel sand other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.		

UNIT V	FUTURE DRONES AND SAFETY	9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone License-Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Understand the various types of drone technology, drone fabrication and programming.
CO 2: Apply the suitable operating procedures for functioning a drone.
CO 3: Understand appropriate sensors and actuators for Drones.
CO 4: Apply the drone mechanism for specific applications.
CO 5: Create the programs for various drones.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and construction a Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, Inc, 2021.
T2.	Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones", Maker Media, Inc, 2016.

REFERENCE BOOK(S)	
R1.	John Baichtal, "Building Your Own Drones: A Beginners Guide to Drones, UAVs, and ROVs", Que Publishing, 2020.
R2.	Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2022.

Course Code: 24MEO002	Course Title: Introduction to Six Sigma	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the core concepts of Six Sigma, including its history, philosophy, and principles.
• To explore various tools and techniques used in Six Sigma for defining, measuring, analysing, improving, and controlling processes.
• To learn Six Sigma methodologies like DFSS and FMEA for designing and optimizing processes.
• To comprehend the strategies for effective implementation of Six Sigma and the challenges faced during its deployment.
• To examine evaluation strategies and continuous improvement techniques, focusing on lean manufacturing and waste reduction.

UNIT I	SIX SIGMA BACKGROUND AND FUNDAMENTALS	9
Historical Overview -Definition of quality -What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance -Six sigma and cultural changes -six sigma capability -six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing -assessment questions.		
UNIT II	**THE SCOPE OF TOOLS AND TECHNIQUES**	**9**
Tools for definition -IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter -Tools for measurement -Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis -Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving -Tools for improvement -Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis -Tools for control -Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.		
UNIT III	**SIX SIGMA METHODOLOGIES**	**9**
Design For Six Sigma (DFSS), Design for Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN) - Six Sigma and Leadership,		

committed leadership -Change Acceleration Process (CAP) - Developing communication plan -Stakeholder.		
UNIT IV	**SIX SIGMA IMPLEMENTATION AND CHALLENGES**	**9**
Tools for implementation -Supplier Input Process Output Customer (SIPOC) -Quality Function Deployment or House of Quality (QFD) -alternative approach –implementation -leadership training, close communication system, project selection -project management and team -champion training -customer quality index -challenges -program failure, CPQ vs six sigma, structure the deployment of six sigma -cultural challenge -customer/internal metrics.		
UNIT V	**EVALUATION AND CONTINUOUS IMPROVEMENT METHODS**	**9**
Evaluation strategy -the economics of six sigma quality, return on six Sigma (ROSS), ROI, poor project estimates -continuous improvement -lean manufacturing -value, customer focus, Perfection, focus on waste, overproduction -waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people -Kaizen -5S.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the concepts of Six Sigma and various tools.
CO2: Analyze the solutions and corrective actions to improve process performance and reduce defects using tools like DOE and mistake-proofing.
CO3: Evaluate and develop the control plans and monitor key performance indicators (KPIs) to ensure sustained improvement in processes.
CO4: Create the process documentation, Standard Operating Procedures (SOPs), and regular reviews to maintain improvements over time.
CO5: Understand about the Gain leadership and team management skills for leading Six Sigma projects, including project planning, execution, and resource management.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Thomas Pyzdek and Paul A. Keller, "The Six Sigma Handbook", McGraw-Hill, 2018.
T2.	Mikel Harry and Richard Schroeder, "Six Sigma the Breakthrough Management Strategy Revolutionizing the World's Top Corporations", double day, 2006.

REFERENCE BOOK(S)	
R1.	Michael George, David Rowlands, and Bill Kastle, "What is Lean Six Sigma", McGraw -Hill 2003.
R2.	Thomas Pyzdek, "The Six Sigma Handbook", McGraw-Hill, 2000.
R3.	Fred Soleimannejed, "Six Sigma, Basic Steps and Implementation", Author House, 2004.
R4.	Forrest W. Breyfogle, III and James M. Cupello, Becki Meadows, "Managing Six Sigma a Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success", John Wiley & Sons, 2000.

Course Code: 24MEO003	Course Title: Sustainable Engineering	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To be acquainted with sustainability in engineering and its evaluation.
• To provide knowledge in environment and social sustainability.
• To provide the student with the knowledge of strategy to achieve sustainability.
• To familiarize with trends in sustainable operations.
• To create awareness in current sustainable practices in manufacturing industry.

UNIT I	ECONOMIC SUSTAINABILITY	9
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability -Assessments of economic sustainability.		
UNIT II	**SOCIAL AND ENVIRONMENTAL SUSTAINABILITY**	**9**
Social sustainability -Introduction-Work management -Human rights - Societal Commitment-Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources - Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability.		
UNIT III	**SUSTAINABILITY PRACTICES**	**9**
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model.		
UNIT IV	**MANUFACTURING STRATEGY FOR SUSTAINABILITY**	**9**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.		

UNIT V	TRENDS IN SUSTAINABLE OPERATIONS	9
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - Influence of product design on operations - Process analysis -Capacity management - Quality management -Inventory management - Just-In-Time systems -Resource efficient design - Consumerism and sustainable well-being.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Apply the importance of economic sustainability.
CO 2: Understand the importance of sustainable practices.
CO 3: Analyze the drivers and barriers for the given conditions.
CO 4: Apply strategy in sustainable manufacturing.
CO 5: Create the plan for sustainable operation of industry with environmental, cost consciousness.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)

T1.	Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2019.
T2.	Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2021.

REFERENCE BOOK(S)

R1.	Jovane F., Ęmper, W.E. and Williams, D.J., "The Manufuture Road towards Competitive and Sustainable High-Adding-Value Manufacturing", Springer, United States, 2019.
R2.	Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., United States, 2021

Course Code: 24MEO004	**Course Title: Foundation Skills in Integrated Product Development**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the fundamentals of product development, including global trends and product decision-making.
• To explore requirement engineering, system design, and modelling for effective product development.
• To learn various design, testing, and prototyping techniques for product development.
• To understand the concepts of sustenance engineering, product validation, and end-of-life (EoL) support.
• To comprehend the business dynamics of the engineering services industry.

UNIT I	**FUNDAMENTALS OF PRODUCT DEVELOPMENT**	**9**
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economic Trends -Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management.		
UNIT II	**REQUIREMENTS AND SYSTEM DESIGN**	**9**
Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis -Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization -System Specification - Sub-System Design - Interface Design.		
UNIT III	**DESIGN AND TESTING**	**9**
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques –Challenges in Integration of Engineering Disciplines -Concept Screening & Evaluation - Detailed Design -Component Design and Verification -Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing -Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing -		

System Integration, Testing, Certification and Documentation		
UNIT IV	**SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT**	**9**
Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation- Sustenance -Maintenance and Repair -Enhancements - Product EoL -Obsolescence Management -Configuration Management - EOL Disposal.		
UNIT V	**BUSINESS DYNAMICS -ENGINEERING SERVICES INDUSTRY**	**9**
The Industry - Engineering Services Industry - Product Development in Industry versus Academia -The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems - Product Development Trade-offs -Intellectual Property Rights and Confidentiality -Security and Configuration Management.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1. Apply product life cycle concepts to plan and manage product development effectively.
CO2. Analyse system design and optimization techniques for subsystem and interface design.
CO3. Understand the concepts using concept generation techniques.
CO4. Formulate the strategies for product maintenance, repair, and enhancements.
CO5. Evaluate the integration of mechanical, embedded, and software systems in product manufacturing and assembly.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Ulrich, Karl T.; Eppinger, Steven D.; Yang, Maria C.; Product Design and Development; 7th Edition; McGraw-Hill Education; 2020.
T2.	Pugh, Stuart; Total Design: Integrated Methods for Successful Product Engineering; 1st Edition; Addison-Wesley Publishing; 1990.

REFERENCE BOOK(S)	
R1.	Cross, Nigel*;* Engineering Design Methods: Strategies for Product Design; 4th Edition; John Wiley & Sons; 2008.
R2.	Otto, " Product Design: Techniques in Reverse Engineering and New Product Development" 1st Edition; Pearson Education; 2000.

Course Code: 24MEO005	**Course Title: Maintenance Engineering**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
• To introduce different maintenance categories, its merits and types of lubrication.
• To expose the idea of condition monitoring, methods and instruments used for allied measurements.
• To learn about failure analysis and repair methods for few mechanical elements.
• To promote computerization in maintenance and inventory management.

UNIT I	**PRINCIPLES OF MAINTENANCE PLANNING**	**9**
Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.		
UNIT II	**MAINTENANCE CATEGORIES AND LUBRICATION**	**9**
Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.		
UNIT III	**CONDITION MONITORING**	**9**
Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.		
UNIT IV	**FAILURE ANALYSIS AND REPAIR METHODS**	**9**
Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.		
UNIT V	**COMPUTER AIDED MAINTENANCE MANAGEMENT**	**9**
Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the principles, objectives and importance of maintenance adopted in industry.
CO2: Select the suitable maintenance category and lubrication type.
CO3: Apply the appropriate methods and instruments for condition monitoring.
CO4: Analyze the failures of mechanical systems and select suitable repair methods.
CO5: Utilize computers in maintenance and inventory management.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Srivastava S.K, "Maintenance Engineering", S Chand and Company, 2010.
T2.	Mishra R.C, Pathak K, "Maintenance Engineering and Management", Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.

REFERENCE BOOK(S)	
R1.	Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, "Maintenance Engineering" , Seventh edition, McGraw-Hill Professional, 2008.
R2.	Davies A, "Handbook of Condition Monitoring: Techniques and Methodology", Springer, 2012.
R3.	Otegui Jose Luis, "Failure Analysis, Fundamentals and Applications in Mechanical Components", Nineteenth edition, Springer, 2014.

MANDATORY COURSES:

Course Code: 24MAC001	**Course Title: Indian Constitution**	
Course Category: MC	**Credits: 0**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand evolution of Indian Constitution.
• To analyze the fundamental rights.
• To understand the composition of Parliament.
• To study constitution amendment procedure.
• To know about the powers of high court and supreme court.

UNIT I	**INTRODUCTION**	**2**
Evolution of Indian Constitution, Significance of Constitution, Composition, Preamble and its Philosophy.		
UNIT II	**RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES**	**3**
Fundamental Rights- Writs and Duties, Directive Principles of State Policy.		
UNIT III	**COMPOSITION OF PARLIAMENT AND FEDERALISM**	**4**
Union Government, President and Vice President, Houses of the Parliament and their functions, Composition of State Legislature, Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers, The Indian Federal System, Administrative Relationship between Union and States.		
UNIT IV	**BILLS AND CONSTITUTION AMENDMENT PROCEDURE**	**3**
Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India.		
UNIT V	**JUDICIARY**	**3**
Supreme Court and High Court, Functions and powers, Judicial Review.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the evolution of Indian Constitution.
CO2: Understand the fundamental rights and duties of state policies.
CO3: Understand the functions of Parliament and federalism.

CO4: Learn about constitution amendment procedure.
CO5: Understand the functions of High court and Supreme court.

TEXT BOOK(S)	
T1.	Subash C. Kashyap, "Our Constitution", 5th Edition, NBT, India, New Delhi, 2015.
T2.	Basu D D, "Introduction to the Constitution of India", 20th Edition, Prentice Hall of India, New Delhi, 2011.

REFERENCE BOOK(S)	
R1.	Briji Kishore Sharma, "Introduction to the Constitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
R2.	Hoshiar Singh, "Indian Administration", 1st Edition, Pearson Education, New Delhi, 2011.
R3.	Jain M C, "The Constitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
R4.	Shukla V N, "Constitution of India", 13th Edition, Eastern Book Company Limited, New Delhi, 2017.

Course Code : 24MAC002	**Course Name: Industrial Safety**	
Course Category : MC	**Credits : 0**	
L:T:P(Hours/Week) : 1:0:0	**Total Contact Hours : 15**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the Introduction and basic terminologies of safety.
• To learn about the Important Statutory Regulations and standards.
• To conduct and participate the various safety activities in the Industry.
• To have knowledge about Workplace Exposures and Hazards.
• To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I	**SAFETY TERMINOLOGIES**	**3**
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS.		
UNIT II	**STANDARDS AND REGULATIONS**	**3**
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S).		
UNIT III	**SAFETY ACTIVITIES**	**3**
Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.		
UNIT IV	**WORKPLACE HEALTH AND SAFETY**	**3**
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA.		
UNIT V	**HAZARD IDENTIFICATION TECHNIQUES**	**3**
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the safety terminologies and safety policy.
CO2: Understand the occupational health and safety standards.
CO3: Understand the on-site and off-site emergency safety action plans.
CO4: Learn about the health and safety in workplace.
CO5: Expose the hazard identification techniques with qualitative and quantitative risk assessment.

TEXT BOOK(S)	
T1.	R.K. Jain and Prof. Sunil S. Rao "Industrial Safety, Health and Environment Management Systems", Khanna Publisher, 2012.
T2.	L. M. Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", McGraw-Hill Education, 2015

REFERENCE BOOK(S)	
R1.	Frank Lees, "Loss Prevention in Process Industries", 4th Edition, Butterworth-Heinemann publications, UK, 2012.
R2.	John Ridley and John Channing, "Safety at Work: Routledge", 7th Edition, McGraw-Hill Education, 2015.
R3.	Dan Petersen, "Techniques of Safety Management: A System Approach", Khanna Publisher, 2012.

Course Code: 24MAC003	**Course Title: Entrepreneurship**	
Course Category: MC	**Credits: 0**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks : 100**

COURSE OBJECTIVES
• To develop and strengthen the entrepreneurial quality and motivation of learners.
• To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
• To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
• To empower the learners to run a Technology driven business efficiently and effectively
• To understand the emerging trends in Entreppreneurship.

UNIT I	**INTRODUCTION TO ENTREPRENEURSHIP**	**3**
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entreprenrship to Economic Development.		
UNIT II	**BUSINESS OWNERSHIP & ENVRIONMENT**	**3**
Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilization-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.		
UNIT III	**FUNDAMENTALS OF TECHNOPRENEURSHIP**	**3**
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts-Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends		
UNIT IV	**APPLICATIONS OF TECHNOPRENEURSHIP**	**3**
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship –- Success Stories of Technopreneurs - Case Studies.		

UNIT V	EMERGING TRENDS IN ENTREPRENERUSHIP	3
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the basics of Entrepreneurship.
CO2: Understand the business ownership patterns and environment.
CO3: Understand the Job opportunities in Industries relating to Technopreneurship.
CO4: Learn about applications of Tehnopreneurship and to become a successful Technopreneurs.
CO5: Acquaint with the recent and emerging trends in entrepreneurship.

TEXT BOOK(S)	
T1.	S.S.Khanka, “Entrepreneurial Development”, S.Chand & Co. Ltd., Ram Nagar New Delhi, 2021.
T2.	Donal F Kuratko, “Entrepreneurship Theory, Process, Practice”, 11th Edition, Cengage Learning, 2019.
T3.	Daniel Mankani, “Technopreneurship: The successful Entrepreneur in the new Economy”, Prentice Hall, 2012.

REFERENCE BOOK(S)	
R1.	Edward Elgar, “Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe”, Wiley Publication, 2010.
R2.	S.S.Khanka, “Entrepreneurial Development”, S.Chand & Co. Ltd. Ram Nagar New Delhi, 2021.

Course Code: 24MAC004	**Course Title: Film Appreciation**	
Course Category: MC	**Credits: 0**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks:100**

COURSE OBJECTIVES
• To understand the historical development of film as an art and entertainment form.
• To learn the language of cinema and its evolution over a century.
• To develop the ability to read a film critically and appreciate its various nuances.
• To cultivate an appreciation for film as a text, exploring its narrative, themes, and stylistic elements.
• To foster a joyful and engaging approach to studying films.

UNIT I	**THEME - A: THE COMPONENT OF FILMS**	**3**
A-1: The material and equipment A-2: The story, screenplay and script A-3: The actors, crew members, and the director A-4: The process of film making… structure of a film		
UNIT II	**THEME - B: EVOLUTION OF FILM LANGUAGE**	**3**
B-1: Film language, form, movement etc. B-2: Early cinema… **silent film** (Particularly French) B-3: The emergence of feature films: **Birth of a Nation** B-4: Talkies		
UNIT III	**THEME - C: FILM THEORIES AND CRITICISM/APPRECIATION**	**3**
C-1: Realist theory; Autarkists C-2: Psychoanalytic, Ideological, Feminists C-3: How to read films? C-4: Film Criticism / Appreciation		
UNIT IV	**THEME – D: DEVELOPMENT OF FILMS**	**3**
D-1: Representative Soviet films D-2: Representative Japanese films D-3: Representative Italian films		

D-4: Representative Hollywood film and the studio system		
UNIT V	**THEME - E: INDIAN FILMS**	**3**
E-1: The early era E-2: The important films made by the directors E-3: The regional films E-4: The documentaries in India		

COURSE OUTCOMES
At the end of this course, students will be able to:
CO1: Understand the historical development of film as an art and entertainment form.
CO2: Learn the language of cinema and its evolution over a century.
CO3: Develop the ability to read a film critically and appreciate its various nuances.
CO4: Cultivate an appreciation for film as a text, exploring its narrative, themes, and stylistic Elements.
CO5: Foster a joyful and engaging approach to studying films.

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

Course Code: 24MAC005	Course Title: Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week) 1:0:0	Total Contact Hours: 15	Max Marks : 100

COURSE OBJECTIVES
• To enjoy life happily with fun filled new style activities that help to maintain health.
• To adapt a few lifestyle changes that will prevent many health disorders.
• To be cool and handbill every emotion very smoothly in every walk of life.
• To learn to eat cost effective but healthy foods that are rich in essential nutrients.
• To develop immunity naturally that will improve resistance against many health disorders.

UNIT I	HEALTH AND ITS IMPORTANCE	3
Health- Definition - Importance of maintaining health - More importance on prevention than treatment, Types of health, Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Causes of the diseases / disorders - Importance of prevention of illness - Simple lifestyle modifications to maintain health - Maintaining BMI-Importance and actions to be taken.		
UNIT II	**DIET**	**3**
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, Balanced diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water, Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions, Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM.		
UNIT III	**ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH**	**3**
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH -		

AYUSH as a soft therapy, Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life, Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / **(**Five Element Theory) 96 fundamental Principles - Uyir Thathukkal **(**Tri-Dosha Theory) - Udal Thathukkal.

UNIT IV	**MENTAL WELLNESS**	**3**
Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances, Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.		
UNIT V	**YOGA**	**3**
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn the importance of different components of health.
CO2: Understand the importance of diet and workouts in maintaining health.
CO3: Learn new techniques of Ayurveda and Siddha systems.
CO4: Understand about emotional health and stress management.
CO5: Understand the concept of Yogasanas.

TEXT BOOK(S)	
T1.	Ashley Martin, "Nutrition and Dietetics", White Word Publications, New York, NY 10001, USA, 2012
T2.	Cory Martin, "Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body", Althea Press, Berkeley, California, 2015.

REFERENCE BOOK(S)	
R1.	Moshe Zeidner, Gerald Matthews, and Richard D. Roberts, "What We Know About Emotional Intelligence - How It Affects Learning, Work, Relationships, and Our Mental Health", Cambridge, Massachusetts, London, England, 2012
R2.	Kristin Neff and Christopher Germer, "A Bradford Book", The MIT Press, Cambridge, Massachusetts, London, England, 2015

Course Code: 24MAC006	**Course Title: Elements of Literature**	
Course Category: MC	**Credits: 0**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks : 100**

COURSE OBJECTIVES
• To develop an awareness of the finer sensibilities of human existence through art.
• To appreciate the role of literature in expressing human experience.
• To explore different forms of literature as modes of human expression.
• To understand the elements of drama.

UNIT I	**RELEVANCE OF LITERATURE**	**3**
a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect.		
UNIT II	**ELEMENTS OF FICTION**	**3**
a) Fiction, fact and literary truth. b) Fictional modes and patterns. c) Plot character and perspective.		
UNIT III	**ELEMENTS OF POETRY**	**3**
a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend.		
UNIT IV	**ELEMENTS OF DRAMA**	**3**
a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop an awareness of the finer sensibilities of human existence through art
CO2: Appreciate the role of literature in expressing human experience
CO3: Explore different forms of literature as modes of human expression
CO4: Understand the features and varieties of drama

TEXT BOOK(S)	
T1.	W.H. Hudson, "An Introduction to the Study of English Literature", Atlantic, 2007.
T2.	Mario Klarer, Routledge, "An Introduction to Literary Studies", Pearson, 2013.

REFERENCE BOOK(S)	
R1.	Graham Mode, "The Experience of Poetry", Open college of Arts with Open Unv Press, 2012.
R2.	J.L.Styan, "The Elements of Drama", Literary Licensing, 2011.

MANAGEMENT ELECTIVES:

Course Code: 24HSM301	**Course Title: Principles of Management**	
Course Category: HSMC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks : 100**

COURSE OBJECTIVES
• To outline the fundamental activities of managers.
• To apply the planning techniques and decision making.
• To understand the concept of Human Resource Management.
• To understand motivation, leadership and communication principles.
• Analyze the position of self and company goals towards business.

UNIT I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**6**
Definition of Management – Science or Art – Manager vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.		
UNIT II	**PLANNING**	**6**
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		
UNIT III	**ORGANISING**	**6**
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.		
UNIT IV	**DIRECTING**	**6**
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.		

UNIT V	CONTROLLING	6
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the role of managers in an organization.
CO2: Understand the planning process in the organization.
CO3: Examine the managerial functions having an impact on the organizational effectiveness.
CO4: Show the ability in directing, leadership and communicate effectively.
CO5: Analyse the isolate issues and formulate best control methods.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Harold Koontz and Heinz Weihrich "Essentials of Management", 11th Edition, Tata McGraw Hill, 2020.
T2.	Stephen P. Robbins and Mary Coulter, "Management", 13th Edition, Prentice Hall Pvt. Ltd., 2017.

REFERENCE BOOK(S)

R1.	Robert Kreitner and Mamata Mohapatra, "Management", Biztantra, 2008.
R2.	Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
R3.	P C Tripathi, P N Reddy and Ashish Bajpai, "Principles of Management", 7th Edition, Tata McGraw Hill, 2021.

Course Code: 24HSM302	**Course Title: Total Quality Management**	
Course Category: HSMC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks : 100**

COURSE OBJECTIVES
• To communicate the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
• To explain the TQM Principles for application.
• To define the basics of Six Sigma and apply traditional tools, new tools, Benchmarking and FMEA.
• To describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
• To illustrate and apply QMS and EMS in any organization.

UNIT I	**INTRODUCTION**	**6**
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Definition of TQM- Basic concepts of TQM - Gurus of TQM - TQM Framework- Barriers to TQM - Benefits of TQM.		
UNIT II	**TQM PRINCIPLES**	**6**
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction - Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal- Continuous process improvement - Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating and Relationship development.		
UNIT III	**TQM TOOLS & TECHNIQUES I**	**6**
The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		

UNIT IV	TQM TOOLS & TECHNIQUES II	6
Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures - Cost of Quality - BPR.		
UNIT V	**QUALITY MANAGEMENT SYSTEM**	**6**
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards – Sector - Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements - Implementation – Documentation - Internal Audits - Registration - Environmental Management System: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001-Benefits of EMS.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Apply TQM concepts in a selected enterprise.
CO2: Apply TQM principles in a selected enterprise.
CO3: Understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Apply QMS and EMS in any organization.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary Besterfield-Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Revised Third Edition, Pearson Education, Indian Reprint, 2018.
T2.	Joel. E. Ross, “Total Quality Management – Text and Cases and Readings”, Third Edition, St. Lucie Press, New York, 2017.

REFERENCE BOOK(S)	
R1.	D. R. Kiran, "Total Quality Management: Key concepts and case studies", Butterworth – Heinemann, 2016.
R2.	John S. Oakland, "Total Quality Management text with cases", Third Edition, Butterworth – Heinemann, Oxford, 2012.
R3.	L. Suganthi and Anand A. Samuel, "Total Quality Management", PHI Learning Private Limited, 2011.

Course Code: 24HSM303	**Course Title: Engineering Economics and Financial Accounting**	
Course Category: HSMC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the concepts of demand and supply analysis.
• To provide the insight on theory of production and cost analysis.
• To understand the different procedures of pricing.
• To acquire in depth knowledge of financial accounting.
• To determine the factor influencing working capital and its importance.

UNIT I	**Demand & Supply Analysis**	**6**
Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function - Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.		
UNIT II	**Production and Cost Analysis**	**6**
Production function - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.		
UNIT III	**Pricing**	**6**
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.		
UNIT IV	**Financial Accounting (Elementary Treatment)**	**6**
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.		
UNIT V	**Capital Budgeting (Elementary Treatment)**	**6**
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Describe the overall functions of Demand, Supply, Price and Income of the firms.
CO2: Evaluate the production function and identifies the least cost combination to control the costs of production.
CO3: Understand the structures of various market types and their pricing policies.
CO4: Understand the basic concepts of financial accounting and evaluation of company performance using ratio analysis.
CO5: Understand the types of business forms and also be able to evaluate the investments using capital budgeting techniques.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	R. Panneer Selvam, “Engineering Economics”, Second Edition, PHI Learning Private Limited, New Delhi, 2013.
T2.	Lila J.Truett and Dale B. Truett, “Managerial Economics: Analysis, Problems and Cases”, Eighth Edition, Wiley-India, 2008.

REFERENCE BOOK(S)	
R1.	Chan S. Park, “Contemporary Engineering Economics”, Global Edition, Pearson Education, 2016.
R2.	Donald G. Newnan, Ted G. Eschenbach, Jerome P. Lavelle and Neal A. Lewis, “Engineering Economics and Analysis” Oxford University Press, 2017.
R3.	William G. Sullivan, Elin M.Wicks and C. Patrick Koelling, “Engineering Economy”, 14th Edition, Pearson Education, 2011.

Course Code: 24HSM304	**Course Title: Human Resource Management**	
Course Category: HSMC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the functions, systems and policies of human resource management.
• To recruit and interview job candidates and appraise the performance of the employees.
• To train using various methods of training and implement management development techniques.
• To learn the factors determining the pay rates and salary administration.
• To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I	**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT**	**6**
Importance of Human Resources - Objective of Human Resource Management - Human Resource Policies - Role of Human Resource Manager.		
UNIT II	**HUMAN RESOURCE PLANNING**	**6**
Importance of Human Resource Planning - Internal and External sources of Human Resources -Recruitment - Selection - Socialization.		
UNIT III	**TRAINING AND EXECUTIVE DEVELOPMENT**	**6**
Types of training and Executive Development methods - Purpose - Benefits.		
UNIT IV	**EMPLOYEE COMPENSATION**	**6**
Compensation plan - Reward - Motivation - Career Development - Mentor - Protege relationships.		
UNIT V	**PERFORMANCE EVALUATION AND CONTROL**	**6**
Performance evaluation - Feedback - the control process - Importance - Methods - Grievances - Causes - Redressal methods.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop understanding of the basic concepts, functions and processes of human

resource management.
CO2: Apply knowledge of human resource planning and implement techniques of job design.
CO3:Design HRM processes such as Recruitment/Selection/Training/Performance appraisals/Reward Systems etc.
CO4: Implement Employee benefits and Welfare measures.
CO5: Handle employee issues and evaluate the new trends in HRM.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	David A. DeCenzo and Stephen P. Robbins, "Fundamentals of Human Resource Management", 8th Edition, Wiley, 2007.
T2.	H John Bernardin, "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCE BOOK(S)

R1.	Luis R, Gomez-Mejia, David B. Balkin and Robert L. Cardy, "Managing Human Resources", 8th Edition, Pearson Education, India, 2016.
R2.	Gary Dessler, "Human Resource Management", 13th Edition, Pearson Education, 2013.
R3.	Biswajeet Pattanayak, "Human Resource Management", 6th Edition, PHI Learning Private Limited, Delhi, 2020.

Course Code: 24HSM305	Course Title: Knowledge Management	
Course Category: HSMC	Credits: 2	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks : 100

COURSE OBJECTIVES
• To understand the basic concept of knowledge management and knowledge management systems.
• To know the Organizational Structure, Culture, Communities and KM practices, Information Technology as an enabler.
• To identify some of the key tools and techniques used in knowledge management applications.
• To analyse the recent trends in Knowledge Management.
• To formulate a framework for thinking about knowledge intensive organizations.

UNIT I	INTRODUCTION	6
Introduction to knowledge management - foundations of knowledge management - including cultural issues - technology applications organizational concepts and processes - management aspects - and decision support systems. The evolution of knowledge management: From information management to knowledge management - Key challenges facing the evolution of knowledge management - Ethics for knowledge management.		
UNIT II	**CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING**	**6**
Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among distributed technical specialists - Tacit Knowledge and Quality Assurance.		
UNIT III	**KNOWLEDGE MANAGEMENT-THE TOOLS**	**6**
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.		
UNIT IV	**KNOWLEDGE MANAGEMENT APPLICATION**	**6**
Components of a knowledge strategy - Case Studies from Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries.		

UNIT V	FUTURE TRENDS AND CASE STUDIES	6
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life - cycles of an organization.		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyse the issues in knowledge management.
CO2: Discuss the various levels in knowledge sharing and learning.
CO3: Express effectively about knowledge management systems, tools and portals.
CO4: Apply the knowledge management in library and information centers.
CO5: Create a knowledge management plan to leverage opportunities to create, capture, represent and share knowledge within an organization.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	T. Kanti Srikantaiah and Michael E.D.Koenig, "Knowledge Management for the Information Professional", Information Today, Inc., 2000.
T2.	Mohammad Nazim and Bhaskar Mukherjee, "Knowledge Management in Libraries Concepts, Tools and Approaches", Chandos Publications, 2016.

REFERENCE BOOK(S)	
R1.	Kimiz Dalkir, "Knowledge Management in Theory and Practice", 4th Edition, the MIT Press, 2023.
R2.	Donald Hislop, Rachelle Bosua and Remko Helms, "Knowledge Management in Organizations a critical Introduction", 4th Edition, Oxford University Press, 2018.

Course Code: 24HSM306	**Course Title: Industrial Management**	
Course Category: HSMC	**Credits: 2**	
L:T:P (Hours/Week) 2:0:0	**Total Contact Hours: 30**	**Max Marks : 100**

COURSE OBJECTIVES
• To study the basic concepts of management, approaches to management, contributors to management studies; various forms of business organization and professional organizations.
• To study the planning, organizing and staffing functions of management in professional organization.
• To study the leading, controlling and decision making functions of management in professional organization.
• To learn the organizational theory in professional organization.
• To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I	**INTRODUCTION TO MANAGEMENT**	**6**
Management : Introduction; Definition and Functions - Approaches to the study of Management - Mintzberg's Ten Managerial Roles - Principles of Taylor; Fayol; Weber; Parker - Forms of Organization : Sole Proprietorship; Partnership; Company (Private and Public); Cooperative - Public Sector vs Private Sector Organization - Business Environment : Economic; Social; Political; Legal - Trade Union : Definition; Functions; Merits & Demerits.		
UNIT II	**FUNCTIONS OF MANAGEMENT - I**	**6**
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning - Organizing : Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility - Staffing : Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.		
UNIT III	**FUNCTIONS OF MANAGEMENT - II**	**6**
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) - Communication: Purpose; Model; Barriers - Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control - Decision Making: Elements; Characteristics; Nature; Process; Classifications.		

UNIT IV	ORGANIZATION THEORY	6
Organizational Conflict : Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management - Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory - Change Management : Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.		
UNIT V	**PRODUCTIVITY AND MODERN TOPICS**	**6**
Productivity : Concept; Measurements; Affecting Factors; Methods to Improve - Modern Topics (concept, feature/characteristics, procedure, merits and demerits) : Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).		
		Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
CO2: Discuss the planning; organizing and staffing functions of management in professional organization.
CO3: Apply the leading; controlling and decision making functions of management in professional organization.
CO4: Discuss the organizational theory in professional organization.
CO5: Apply principles of productivity and modern concepts in management in professional organization.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	M. Govindarajan and S. Natarajan, "Principles of Management", PHI Learning Private Limited, New Delhi, 2012.
T2.	Harold Koontz and Heinz Weihrich and Mark V. Cannice, "Essentials of Management: An International, Innovation and Leadership Perspective", 11th Edition, Mc Graw Hill, New Delhi, 2020.

REFERENCE BOOK(S)	
R1.	Joseph L Massie, "Essentials of Management", 4th Edition, Prentice-Hall, 1987.
R2.	Saxena, P. K., "Principles of Management: a Modern Approach", Global India Publications Private Limited, New Delhi, 2009.
R3.	Samuel C. Certo and S.Trevis Certo, "Modern Management: Concepts and Skills (What's New in Management)", 15th Edition, Pearson Education, 2018.

OPEN ELECTIVES OFFERED BY MECHANICAL DEPARTMENT

Course Code: 24MEO001	**Course Title: Drone Technologies**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the basics of drone technology concepts.
• To learn and understand the fundamental of design, fabrication and programming of drone.
• To impart the knowledge of a flying and operation of drone.
• To know about the various applications of drone.
• To understand the safety risks and guidelines of fly safely.

UNIT I	**INTRODUCTION TO DRONE TECHNOLOGY**	**9**
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.		
UNIT II	**DRONE DESIGN, FABRICATION AND PROGRAMMING**	**9**
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer-Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.		
UNIT III	**DRONE FLYING AND OPERATION**	**9**
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.		
UNIT IV	**DRONE COMMERCIAL APPLICATIONS**	**9**
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcel sand other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.		

UNIT V	FUTURE DRONES AND SAFETY	9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone License-Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Understand the various types of drone technology, drone fabrication and programming.
CO 2: Apply the suitable operating procedures for functioning a drone.
CO 3: Understand appropriate sensors and actuators for Drones.
CO 4: Apply the drone mechanism for specific applications.
CO 5: Create the programs for various drones.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and construction a Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, Inc, 2021.
T2.	Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones", Maker Media, Inc, 2016.

REFERENCE BOOK(S)	
R1.	John Baichtal, "Building Your Own Drones: A Beginners Guide to Drones, UAVs, and ROVs", Que Publishing, 2020.

Course Code: 24MEO002	Course Title: Introduction to Six Sigma	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To understand the core concepts of Six Sigma, including its history, philosophy, and principles.
• To explore various tools and techniques used in Six Sigma for defining, measuring, analysing, improving, and controlling processes.
• To learn Six Sigma methodologies like DFSS and FMEA for designing and optimizing processes.
• To comprehend the strategies for effective implementation of Six Sigma and the challenges faced during its deployment.
• To examine evaluation strategies and continuous improvement techniques, focusing on lean manufacturing and waste reduction.

UNIT I	SIX SIGMA BACKGROUND AND FUNDAMENTALS	9
Historical Overview -Definition of quality -What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance -Six sigma and cultural changes -six sigma capability -six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing -assessment questions.		
UNIT II	**THE SCOPE OF TOOLS AND TECHNIQUES**	**9**
Tools for definition -IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter -Tools for measurement -Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis -Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving -Tools for improvement -Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis -Tools for control -Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.		

UNIT III	SIX SIGMA METHODOLOGIES	9
Design For Six Sigma (DFSS), Design for Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN) - Six Sigma and Leadership, committed leadership -Change Acceleration Process (CAP) - Developing communication plan -Stakeholder.		
UNIT IV	**SIX SIGMA IMPLEMENTATION AND CHALLENGES**	**9**
Tools for implementation -Supplier Input Process Output Customer (SIPOC) -Quality Function Deployment or House of Quality (QFD) -alternative approach –implementation -leadership training, close communication system, project selection -project management and team -champion training -customer quality index -challenges -program failure, CPQ vs six sigma, structure the deployment of six sigma -cultural challenge -customer/internal metrics.		
UNIT V	**EVALUATION AND CONTINUOUS IMPROVEMENT METHODS**	**9**
Evaluation strategy -the economics of six sigma quality, return on six Sigma (ROSS), ROI, poor project estimates -continuous improvement -lean manufacturing -value, customer focus, Perfection, focus on waste, overproduction -waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people -Kaizen -5S.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the concepts of Six Sigma and various tools.
CO2: Analyze the solutions and corrective actions to improve process performance and reduce defects using tools like DOE and mistake-proofing.
CO3: Evaluate and develop the control plans and monitor key performance indicators (KPIs) to ensure sustained improvement in processes.
CO4: Create the process documentation, Standard Operating Procedures (SOPs), and regular reviews to maintain improvements over time.
CO5: Understand about the Gain leadership and team management skills for leading Six Sigma projects, including project planning, execution, and resource management.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
CO1	3	3	1	1					2			1			
CO2	3	3	1	1					2			1			
CO3	3	3	1	1					2			1			
CO4	3	3	1	1					2			1			
CO5	3	3	1	1					2			1			

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Thomas Pyzdek and Paul A. Keller, "The Six Sigma Handbook", McGraw-Hill, 2018.
T2.	Mikel Harry and Richard Schroeder, "Six Sigma the Breakthrough Management Strategy Revolutionizing the World's Top Corporations", double day, 2006.

REFERENCE BOOK(S)	
R1.	Michael George, David Rowlands, and Bill Kastle, "What is Lean Six Sigma", McGraw -Hill 2003.
R2.	Thomas Pyzdek, "The Six Sigma Handbook", McGraw-Hill, 2000.
R3.	Fred Soleimannejed, "Six Sigma, Basic Steps and Implementation", Author House, 2004.
R4.	Forrest W. Breyfogle, III and James M. Cupello, Becki Meadows, "Managing Six Sigma a Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success", John Wiley & Sons, 2000.

Course Code: 24MEO003	Course Title: Sustainable Engineering	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To be acquainted with sustainability in engineering and its evaluation.
• To provide knowledge in environment and social sustainability.
• To provide the student with the knowledge of strategy to achieve sustainability.
• To familiarize with trends in sustainable operations.
• To create awareness in current sustainable practices in manufacturing industry.

UNIT I	ECONOMIC SUSTAINABILITY	9
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability -Assessments of economic sustainability.		
UNIT II	**SOCIAL AND ENVIRONMENTAL SUSTAINABILITY**	**9**
Social sustainability -Introduction-Work management -Human rights - Societal Commitment-Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources - Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability.		
UNIT III	**SUSTAINABILITY PRACTICES**	**9**
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model.		
UNIT IV	**MANUFACTURING STRATEGY FOR SUSTAINABILITY**	**9**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.		

UNIT V	TRENDS IN SUSTAINABLE OPERATIONS	9
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - Influence of product design on operations - Process analysis -Capacity management - Quality management -Inventory management - Just-In-Time systems -Resource efficient design - Consumerism and sustainable well-being.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO 1: Apply the importance of economic sustainability.
CO 2: Understand the importance of sustainable practices.
CO 3: Analyze the drivers and barriers for the given conditions.
CO 4: Apply strategy in sustainable manufacturing.
CO 5: Create the plan for sustainable operation of industry with environmental, cost consciousness.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2019.
T2.	Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2021.

REFERENCE BOOK(S)	
R1.	Jovane F., Ęmper, W.E. and Williams, D.J., "The Manufuture Road towards Competitive and Sustainable High-Adding-Value Manufacturing", Springer, United States, 2019.
R2.	Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., United States, 2021

Course Code: 24MEO004	**Course Title: Foundation Skills in Integrated Product Development**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the fundamentals of product development, including global trends and product decision-making.
• To explore requirement engineering, system design, and modelling for effective product development.
• To learn various design, testing, and prototyping techniques for product development.
• To understand the concepts of sustenance engineering, product validation, and end-of-life (EoL) support.
• To comprehend the business dynamics of the engineering services industry.

UNIT I	**FUNDAMENTALS OF PRODUCT DEVELOPMENT**	**9**
Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economic Trends -Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management.		
UNIT II	**REQUIREMENTS AND SYSTEM DESIGN**	**9**
Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis -Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization -System Specification - Sub-System Design - Interface Design.		
UNIT III	**DESIGN AND TESTING**	**9**
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques –Challenges in Integration of Engineering Disciplines -Concept Screening & Evaluation - Detailed Design -Component Design and Verification -Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and		

Hardware Testing -Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation		
UNIT IV	**SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT**	**9**
Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation- Sustenance -Maintenance and Repair -Enhancements - Product EoL -Obsolescence Management -Configuration Management - EOL Disposal.		
UNIT V	**BUSINESS DYNAMICS -ENGINEERING SERVICES INDUSTRY**	**9**
The Industry - Engineering Services Industry - Product Development in Industry versus Academia -The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems - Product Development Trade-offs -Intellectual Property Rights and Confidentiality -Security and Configuration Management.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1. Apply product life cycle concepts to plan and manage product development effectively.
CO2. Analyse system design and optimization techniques for subsystem and interface design.
CO3. Understand the concepts using concept generation techniques.
CO4. Formulate the strategies for product maintenance, repair, and enhancements.
CO5. Evaluate the integration of mechanical, embedded, and software systems in product manufacturing and assembly.

COURSE ARTICULATION MATRIX

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

(1 -Low, 2 -Medium, 3 -High)

TEXT BOOK(S)	
T1.	Ulrich, Karl T.; Eppinger, Steven D.; Yang, Maria C.; *Product Design and Development*; 7th Edition; McGraw-Hill Education; 2020.
T2.	Pugh, Stuart; *Total Design: Integrated Methods for Successful Product Engineering*; 1st Edition; Addison-Wesley Publishing; 1990.

REFERENCE BOOK(S)	
R1.	Cross, Nigel*; Engineering Design Methods: Strategies for Product Design*; 4th Edition; John Wiley & Sons; 2008.
R2.	Otto, " *Product Design: Techniques in Reverse Engineering and New Product Development"* 1st Edition; Pearson Education; 2000.

Course Code: 24MEO005	**Course Title: Maintenance Engineering**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
• To introduce different maintenance categories, its merits and types of lubrication.
• To expose the idea of condition monitoring, methods and instruments used for allied measurements.
• To learn about failure analysis and repair methods for few mechanical elements.
• To promote computerization in maintenance and inventory management.

UNIT I	**PRINCIPLES OF MAINTENANCE PLANNING**	**9**
Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.		
UNIT II	**MAINTENANCE CATEGORIES AND LUBRICATION**	**9**
Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.		
UNIT III	**CONDITION MONITORING**	**9**
Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.		
UNIT IV	**FAILURE ANALYSIS AND REPAIR METHODS**	**9**
Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.		
UNIT V	**COMPUTER AIDED MAINTENANCE MANAGEMENT**	**9**
Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.		
Total: 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the principles, objectives and importance of maintenance adopted in industry.
CO2: Select the suitable maintenance category and lubrication type.
CO3: Apply the appropriate methods and instruments for condition monitoring.
CO4: Analyze the failures of mechanical systems and select suitable repair methods.
CO5: Utilize computers in maintenance and inventory management.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Srivastava S.K, "Maintenance Engineering", S Chand and Company, 2010.
T2.	Mishra R.C, Pathak K, "Maintenance Engineering and Management", Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.

REFERENCE BOOK(S)	
R1.	Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, "Maintenance Engineering" , Seventh edition, McGraw-Hill Professional, 2008.
R2.	Davies A, "Handbook of Condition Monitoring: Techniques and Methodology", Springer, 2012.
R3.	Otegui Jose Luis, "Failure Analysis, Fundamentals and Applications in Mechanical Components", Nineteenth edition, Springer, 2014.

OPEN ELECTIVES OFFERED BY PARENT (ECE) DEPARTMENT

Course Code: 24ECO001	**Course Title: Introduction To Control Engineering**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To introduce the control system components and transfer function model with their graphical representation
• To understand the analysis of system in time domain along with steady state error.
• To introduce frequency response analysis of systems.
• To accord basic knowledge in design of compensators.
• To introduce the state space models.

UNIT I	**MATHEMATICAL MODELLING**	**9**
Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies		
UNIT II	**FEEDBACK CONTROL SYSTEMS**	**9**
Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios		
UNIT III	**TIME DOMAIN ANALYSIS**	**9**
Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.		
UNIT IV	**STABILITY ANALYSIS**	**9**
Necessary and sufficient conditions, Routh - Hurwitz criteria of stability, Root locus and Bode techniques ,Concept and construction, frequency response.		
UNIT V	**STATE SPACE TECHNIQUE**	**9**
State vectors–state space models-Digital Controllers–design aspects.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Represent and develop systems in different forms using the knowledge gained.

CO2: Analyses the system in time and frequency domain and the stability of physical systems.
CO3: Ability to Derive Transfer function Model of Electrical and Mechanical Systems.
CO4: Ability to Obtain the transfer Function by the Reduction of Block diagram & Signal flow graph.
CO5: Acquire and analyze knowledge in State variable model for MIMO systems.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
T2.	Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014

REFERENCE BOOK(S)

R1.	Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
R2.	John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
R3.	Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.

Course Code: 24ECO002	**Course Title: SEMICONDUCTOR MANUFACTURING**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand basic semiconductor manufacturing technology
• To know Integrated Circuit Fabrication
• To introduce the basic semiconductor manufacturing processes
• To familiarize with steps involved in CMOS IC chip fabrication
• To explain major processing technology used IC manufacturing.

UNIT I	**INTRODUCTION TO SEMICONDUCTOR MANUFACTURING**	**9**
Historical perspective, processing overview, semiconductor materials, semiconductor devices, process technology, fabrication steps.		
UNIT II	**MANUFACTURING PROCESS: CRYSTAL GROWTH, SILICON OXIDATION, PHOTOLITHOGRAPHY**	**9**
Silicon crystal growth, material characterization, thermal oxidation process, impurity redistribution, masking properties of silicon dioxide, oxidation thickness characteristics.		
UNIT III	**MANUFACTURING PROCESS: ETCHING, DIFFUSION, ION IMPLANTATION, FILM DEPOSITION**	**9**
Wet chemical etching, Dry etching, basic diffusion process, extrinsic diffusion, lateral diffusion, Photolithography, Ion Implantation, implanted damage and annealing, epitaxial growth techniques, structures and defects, dielectric deposition, metallization.		
UNIT IV	**PROCESS INTEGRATION**	**9**
Passive components, bipolar technology, MOSFET Technology, MESFET Technology, MEMS Technology.		
UNIT V	**IC MANUFACTURING**	**9**
Electrical testing, packing, statistical process control, computer integrated manufacturing, challenges for integration, system-on-a-chip.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Relate technology changes from semiconductor manufacturing industry.

CO2: Explain steps for making silicon wafers from sand.
CO3: Apply various technology involved in manufacturing.
CO4: Analyze the integration of steps in CMOS IC chip fabrication.
CO5: Build CMOS-based used in the electronics industry.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1									1	2	
CO2	1	1	2	1										2	
CO3	1	2	1	1										2	
CO4	2	1	2	2									1	1	
CO5		2	2	1									1		

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	G. S. May and S. M. Sze, "Fundamentals of Semiconductor Fabrication", Wiley India, 2004.
T2.	Hong Xiao, "Introduction to Semiconductor Manufacturing Technology", 2nd Edition, SPIE Press, 2012.

REFERENCE BOOK(S)

R1.	W. R. Runyan and K. E. Bean, "Semiconductor Integrated Circuit Processing Technology", Addison Wesley Publishing Company, 2010.
R2.	S. A. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press, 2012.
R3.	M. J. Madou, "Fundamentals of Micro fabrication", CRC Press, 2nd Edition, 2011.
R4.	S. M. Sze, "Semiconductor Devices: Physics and Technology", 2nd Edition., Wiley India, 2011.

Course Code: 24ECO003	**Course Title: Mechatronics**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To illustrate the selecting the sensors to develop mechatronics systems.
• To explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
• To design appropriate interfacing circuits to connect I/O devices with microprocessor.
• To apply PLC as a controller in mechatronics system.
• To design and develop the apt mechatronics system for an application.

UNIT I	**INTRODUCTION AND SENSORS**	**9**
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.		
UNIT II	**8085 MICROPROCESSOR**	**9**
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.		
UNIT III	**PROGRAMMABLE PERIPHERAL INTERFACE**	**9**
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.		
UNIT IV	**PROGRAMMABLE LOGIC CONTROLLER**	**9**
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.		
UNIT V	**ACTUATORS AND MECHATRONICS SYSTEM DESIGN**	**9**
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO4: Apply PLC as a controller in mechatronics system.
CO5: Design and develop the apt mechatronics system for an application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1								2			
CO2	1	2	1	1								2			
CO3	1	2	1	1								2			
CO4	1	2	1	1								2			
CO5	2	2	1	1								2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Bolton W., "Mechatronics", 6th Edition, Pearson Education, 2015.
T2.	Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", 6th Edition, Penram International Publishing Private Limited, 2013.

REFERENCE BOOK(S)	
R1.	Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 2012.
R2.	Davis G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
R3.	Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.

Course Code: 24ECO004	Course Title: Sensors and Actuators	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To illustrate the fundamental concepts of Instrument types and its Sensors
• To analyze the variable resistance and the Inductance Sensors
• To study about the Variable Sensors and the Special Sensors.
• To understand about the Automotive Actuators
• To study about the Automatic Temperature Control Actuators .

UNIT I	INTRODUCTION TO MEASUREMENTS AND SENSORS	9
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards-Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error-Propagation of error- Odds and uncertainty- principle of transduction- Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers-Dynamic characteristics of first and second order transducers for standard test inputs.		
UNIT II	**VARIABLE RESISTANCE AND INDUTANCE SENSORS**	**9**
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezo resistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT		
UNIT III	**VARIABLE AND OTHER SPECIAL SENSORS**	**9**
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers- Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
UNIT IV	**AUTOMOTIVE ACTUATORS**	**9**
Electromechanical actuators Fluid mechanical actuators Electrical machines Direct current machines Three phase machines Single phase alternating current Machines Duty type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.		
UNIT V	**AUTOMATIC TEMPERATURE CONTROL ACTUATORS**	**9**
Different types of actuators used in automatic temperature control Fixed and variable		

displacement temperature control Semi Automatic Controller design for Fixed and variable displacement type air conditioning system.

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: List common types of sensor and actuators used in vehicles.
CO2: Design measuring equipment's for the measurement of pressure force, temperature and flow.
CO3: Generate new ideas in designing the sensors and actuators for automotive application
CO4: Understand the operation of the sensors, actuators and electronic control.
CO5: Design temperature control actuators for vehicles.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Doebelin, Ernest O. Doebelin Dhanesh N. Manik, " Measurement Systems", 7th Edition, McGraw Hill Publishers, 2019.
T2.	Robert Brandy, "Automotive Electronics and Computer System", Prentice Hall, 2001.
T3.	Bosch, "Automotive Electrics, Automotive Electronics Systems and Components, Networking and Hybrid Drive", 5th Edition, McGraw Hill Publishers, 2007.

REFERENCE BOOK(S)	
R1.	James D Halderman, " Automotive Electrical and Electronics", Prentice Hall, USA, 2013.
R2.	Tom Denton, "Automotive Electrical and Electronics Systems," 3rd Edition, SAE International, 2004.
R3.	William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective," 7th Edition, Elsevier Butterworth- Heinemann Publishers, 2012.

Course Code: 24ECO005	**Course Title: Wireless Networks**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the concept about Wireless networks, protocol stack and standards
• To understand and analyze the network layer solutions for Wireless networks
• To study about fundamentals of 3G Services, its protocols and applications
• To have in depth knowledge on internetworking of WLAN and WWAN
• To learn about evolution of 4G Networks, its architecture and applications

UNIT I	**WIRELESS LAN**	**9**
Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART.		
UNIT II	**MOBILE NETWORK LAYER**	**9**
Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP.		
UNIT III	**3G OVERVIEW**	**9**
Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.		
UNIT IV	**INTERNETWORKING BETWEEN WLANS AND WWANS**	**9**
Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System		
UNIT V	**4G & BEYOND**	**9**
Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Identify and choose wireless transmission standard, physical layer protocol and MAC layer protocol on the basis of various network applications.
CO2: Understand and explain mobile IP and data routing using it. Classify ad hoc network protocols
CO3: Understand the TCP protocol for wireless networks and able to do congestion free transmission over wireless networks.
CO4: Understand the major concepts involved in wireless wide-area networks and its architecture.
CO5: Have knowledge of 4G technologies and analyze various smart antenna techniques, modulation and coding techniques used in 4G technology.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2	3	3													
CO3	3	3													
CO4	2	3													
CO5	2														

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Jochen Schiller, ”Mobile Communications”, 2nd Edition, Pearson Education 2012.
T2.	Vijay Garg, “Wireless Communications and Networking”, 1st Edition, Elsevier 2007.

REFERENCE BOOK(S)	
R1.	Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband”, 2nd Edition, Academic Press, 2008.
R2.	Anurag Kumar, D.Manjunath, Joy kuri, “Wireless Networking”, 1st Edition, Elsevier 2011.
R3.	Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”, 1st Edition, Pearson Education 2013

OPEN ELECTIVE OFFERED BY CIVIL DEPARTMENT

Course Code: 24CEO001	**Course Title: Environment and Agriculture**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the environmental basis of agriculture and the impact of globalization on agro-ecosystems.
• To analyze the environmental impacts of irrigation, mechanized agriculture, and urbanization on land and water resources.
• To study the effects of climate change, global warming, and water cycle disruptions on agricultural systems
• To examine the relationship between ecological diversity, agricultural biotechnology, and sustainable farming practices.
• To explore emerging agricultural environmental concerns, including global policies, alternative farming methods, and sustainable agricultural solutions.

UNIT I	**ENVIRONMENTAL CONCERNS**	**9**
Environmental basis for agriculture and food - land use and landscape changes - water quality issues - changing social structure and economic focus - globalization and its impacts - agro ecosystems.		
UNIT II	**ENVIRONMENTAL IMPACTS**	**9**
Irrigation development and watersheds - mechanized agriculture and soil cover impacts - erosion and problems of deposition in irrigation systems - agricultural drainage and downstream impacts - agriculture versus urban impacts.		
UNIT III	**CLIMATE CHANGE**	**9**
Global warming and changing environment - ecosystem changes - changing blue – green - grey water cycles - water scarcity and water shortages - desertification.		
UNIT IV	**ECOLOGICAL DIVERSITY AND AGRICULTURE**	**9+3**
Ecological diversity, wild life and agriculture - GM crops and their impacts on the environment - insets and agriculture - pollination crisis - ecological farming principles - forest fragmentation and agriculture - agricultural biotechnology concerns.		

UNIT V	EMERGING ISSUES	9+3
Global environmental governance - alternate culture systems - mega farms and vertical farms - virtual water trade and its impacts on local environment - agricultural environment policies and its impacts - sustainable agriculture distributed GIS.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the environmental basis of agriculture, land use changes, and the impact of globalization on agro-ecosystems.
CO2: Analyze the environmental impacts of irrigation, mechanized agriculture, soil erosion, and urbanization on land and water resources.
CO3: Evaluate the effects of climate change, global warming, and water cycle disruptions on agricultural sustainability.
CO4: Assess the role of ecological diversity, GM crops, and agricultural biotechnology in sustainable farming practices.
CO5: Explore emerging environmental challenges in agriculture and assess policies, alternative farming methods, and sustainable agricultural solutions.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	2						2	1	1
CO2	2	2	1	2	2	2	2					1	2	2	2
CO3	2	2	2	2	1	2	2					1			
CO4	2	2	2	2	2	2	2	1				2	2		
CO5	2	2	2	2	2	2	2	1				2	2		

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
T2.	Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

REFERENCE BOOK(S)	
R1.	T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
R2.	Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

Course Code: 24CEO002	Course Title: Green Building Design	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the environmental implications of buildings, including energy use, carbon emissions, water consumption, and waste disposal
• To analyze the impact of building technologies and materials, considering embodied energy, resource utilization, and sustainable alternatives.
• To evaluate thermal comfort in buildings by examining heat transfer characteristics and the effects of geographical location.
• To explore the role of solar energy in buildings, focusing on solar passive cooling and heating techniques through case studies
• To apply green building principles by implementing efficient water management, waste disposal, and urban sustainability practices.

UNIT I	ENVIRONMENTAL IMPLICATIONS OF BUILDINGS	9
Energy use - carbon emissions - water use, waste disposal; building materials: sources, methods of production and environmental implications - embodied energy in building materials: transportation energy for building materials; maintenance energy for buildings.		
UNIT II	**IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**	**9**
Framed construction - masonry construction - resources for building materials, alternative concepts - recycling of industrial and buildings wastes - biomass resources for buildings.		
UNIT III	**COMFORTS IN BUILDING**	**9**
Thermal comfort in buildings issues; heat transfer - characteristic of building materials and building techniques - incidence of solar heat on buildings - implications of geographical locations.		
UNIT IV	**UTILITY OF SOLAR ENERGY IN BUILDINGS**	**9**
Utility of solar energy in buildings - concepts of solar passive cooling and heating of buildings - low energy cooling - case studies of solar passive cooled and heated buildings.		
UNIT V	**GREEN COMPOSITES FOR BUILDINGS**	**9**
Concepts of green composites - water utilisation in buildings - low energy approaches to		

water management - management of solid wastes - management of sullage water and sewage. urban environment and green buildings - green cover and built environment.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the environmental implications of buildings, including energy use, carbon emissions, and waste disposal.
CO2: Examine the impact of building technologies and construction materials on sustainability and embodied energy.
CO3: Assess thermal comfort in buildings and determine the influence of heat transfer characteristics of materials.
CO4: Demonstrate the utility of solar energy in buildings and implement solar passive cooling and heating techniques.
CO5: Develop green building solutions incorporating water management, solid waste disposal, and urban environmental sustainability strategies.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			2	2	1				1	2	1	2
CO2	2	2	2	2	1	2	2	1		1	1	1	2		
CO3	1	1	2	1		2	2			1		1	2		
CO4	2	2	2	2	1	2	2	1		1	1	2	2		
CO5	2	1	1	1		2	2	1					2	1	2

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
T2.	Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
T3.	Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOK(S)	
R1.	Osman Attmann, “Green Architecture Advanced Technologies and Materials”, McGraw. Hill, 2010.
R2.	Jerry Yudelson, McGraw Hil “Green building Through Integrated Design”. 2009.

Course Code: 24CEO003	**Course Title: Geographical Information System**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the basic concepts and significance of GIS.
• To understand different database structures, including relational and object-oriented models
• To understand different methods of spatial data input, including scanning and digitization.
• To understand the importance of metadata in GIS.
• To explore various data management functions and their significance.

UNIT I	**FUNDAMENTALS OF GIS**	**9**
Introduction to GIS - basic spatial concepts - coordinate systems - GIS and information systems - definitions - history of GIS - components of a GIS - hardware, software, data, people, methods - proprietary and open source software - types of data - spatial, attribute data- types of attributes - scales/ levels of measurements.		
UNIT II	**SPATIAL DATA MODELS**	**9**
Database structures - relational, object oriented - entities - ER diagram - data models - conceptual, logical and physical models - spatial data models - raster data structures - raster data compression - vector data structures - raster vs vector models- tin and grid data models.		
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - raster data input - raster data file formats - geo referencing - vector data input - digitizer - datum projection and reprojection -coordinate transformation - topology - adjacency, connectivity and containment - topological consistency - non topological file formats - attribute data linking - linking external databases - GPS data integration.		
UNIT IV	**DATA QUALITY AND STANDARDS**	**9+3**
Data quality - basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage - metadata - GIS standards –interoperability - OGC - spatial data infrastructure		
UNIT V	**DATA MANAGEMENT AND OUTPUT**	**9+3**
Import/Export - data management functions- raster to vector and vector to raster conversion -		

data output - map compilation - chart/graphs - multimedia - enterprise vs desktop GIS - distributed GIS.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the fundamental principles and components of a Geographic Information System (GIS).
CO2: Analyze differentiate between raster and vector data models and analyze their suitability for specific applications.
CO3: Apply data input techniques to create and manage spatial data, including establishing topological relationships.
CO4: Evaluate spatial data quality based on established standards and recommend appropriate data sharing practices.
CO5: Create design and produce effective GIS outputs, including maps and reports, to communicate spatial information.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1									1	1	1	1
CO2	2		2	1	1							1	1		
CO3	2		2	1	1							1	1		
CO4	2	1	2	2	1							1			
CO5	2	1	2	2	2							1	1	1	1

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
T2.	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition, 2007.

REFERENCE BOOK(S)	
R1.	Lo. C. P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.

Course Code: 24CEO004	**Course Title: Climate Change and its Impacts**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To explore key climate parameters such as temperature, rainfall, humidity, and wind
• To identify greenhouse gases and their impact on climate change.
• To assess the effects of climate change on human health, malnutrition, and migration.
• To identify various adaptation options for mitigating climate change effects.
• To understand the importance of conducting an energy audit to improve energy efficiency.

UNIT I	**ENVIRONMENTAL IMPLICATIONS OF BUILDINGS**	**9**
Energy use - carbon emissions - water use - waste disposal; Building materials: sources, methods of production and environmental Implications - Embodied Energy in Building Materials: Transportation Energy for Building Materials - Maintenance Energy for Buildings.		
UNIT II	**IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**	**9**
Framed Construction - Masonry Construction - Resources for Building Materials - Alternative concepts - Recycling of Industrial and Buildings Wastes - Biomass Resources for buildings.		
UNIT III	**COMFORTS IN BUILDING**	**9**
Thermal Comfort in Buildings - Issues; Heat Transfer Characteristic of Building Materials and Building Techniques - Incidence of Solar Heat on Buildings - Implications of Geographical Locations.		
UNIT IV	**UTILITY OF SOLAR ENERGY IN BUILDINGS**	**9**
Utility of Solar energy in buildings - concepts of Solar Passive Cooling and Heating of Buildings - Low Energy Cooling - Case studies of Solar Passive Cooled and Heated Buildings.		
UNIT V	**GREEN COMPOSITES FOR BUILDINGS**	**9**
Concepts of Green Composites - Water Utilisation in Buildings - Low Energy Approaches to Water Management - Management of Solid Wastes - Management of Sullage Water and Sewage - Urban Environment and Green Buildings - Green Cover and Built Environment.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the environmental implications of buildings, including energy use, carbon emissions, and waste disposal.
CO2: Analyze the impact of building technologies and construction materials on sustainability and embodied energy
CO3: Evaluate thermal comfort in buildings and the influence of heat transfer characteristics of materials.
CO4: Assess the utility of solar energy in buildings and explore solar passive cooling and heating techniques.
CO5: Apply green building concepts, including water management, solid waste disposal, and urban environmental sustainability.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			2	2	1					2	1	2
CO2	2	2	2	1	1	2	2			1	1	1	2		
CO3	1	1	2			2	2	1		1		1	1		
CO4	2	2	2	1	1	2	2	1			1	2			
CO5	2	1	1			2	2	1				1	2	1	2

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
T2.	Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
T3.	Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOK(S)	
R1.	Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
R2.	Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
R3.	Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke.

Course Code: 24CEO005	**Course Title: Disaster Management**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To provide students an exposure to disasters, their significance and types.
• To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
• To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
• To enhance awareness of institutional processes in the country.
• To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I	**INTRODUCTION TO DISASTERS**	**9**
Definition: disaster, hazard, vulnerability, resilience, risks - disasters: types of disasters - earthquake, landslide, flood, drought, fire etc - classification, causes, impacts including social, economic, political, environmental, health, psychosocial, etc.- differential impacts- in terms of caste, class, gender, age, location, disability - global trends in disasters: urban disasters, pandemics, complex emergencies, climate change- dos and don'ts during various types of disasters.		
UNIT II	**APPROACHES TO DISASTER RISK REDUCTION (DRR)**	**9**
Disaster cycle - phases, culture of safety, prevention, mitigation and preparedness community based DRR, structural- non-structural measures, roles and responsibilities of- community, panchayat raj institutions/urban local bodies(PRIS/ULBS), states, centre, and other stakeholders- institutional processes and framework at state and central level- state disaster management authority(SDMA) - early warning system - advisories from appropriate agencies.		
UNIT III	**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9**
Factors affecting vulnerabilities, differential impacts, impact of development projects such as dams, embankments, changes in land-use etc. - climate change adaptation- IPCC scenario and scenarios in the context of India - relevance of indigenous knowledge, appropriate technology and local resources.		

UNIT IV	DISASTER RISK MANAGEMENT IN INDIA	9
Hazard and vulnerability profile of India, components of disaster relief: water, food, sanitation, shelter, health, waste management, institutional arrangements (mitigation, response and preparedness, disaster management act and policy - other related policies, plans, programmes and legislation - role of GIS and information technology components in preparedness, risk assessment, response and recovery phases of disaster - disaster damage assessment		
UNIT V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9**
Landslide hazard zonation: case studies, earthquake vulnerability assessment of buildings and infrastructure: case studies, drought assessment: case studies, coastal flooding: storm surge assessment, floods: fluvial and pluvial flooding: case studies; forest fire: case studies, man-made disasters: case studies, space based inputs for disaster mitigation and management and field works related to disaster management.		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain key concepts related to disasters, including hazard, vulnerability, resilience, and risk.
CO2: Understand disaster risk reduction (DRR) strategies, including structural and non-structural measures.
CO3: Analyze factors affecting vulnerabilities and their differential impacts on different communities.
CO4: Assess India's hazard and vulnerability profile.
CO5: Assess the vulnerabilities of buildings and infrastructure to earthquakes and other hazards.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2	2					2	2	1	1
CO2	2	2	1			2	2	1				2	2		
CO3	1	2	2		1	2	2						2		
CO4	1	1	2	1	1	2	2					1	2		
CO5	1			1		2	2						1	1	2

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-938038642
T2.	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-12590073
T3.	Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
T4.	Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOK(S)	
R1.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.
R2.	Government of India, National Disaster Management Policy, 2009.

OPEN ELECTIVE OFFERED BY EEE DEPARTMENT

Course Code: 24EEO001	**Course Title: Sustainable and Environmental Friendly HV Insulation system**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To know about the products related with sustainable application.
• To learn about Green Gaseous insulators and its hazardous effects.
• To learn about Green liquid insulators and its hazardous effects.
• To learn about Green solid insulators and its hazardous effects.
• To understand the standards and testing of green insulation systems.

UNIT I	**SUSTAINABLE AND ENVIRONMENTAL ENERGY AND PRODUCTS**	**9**
Carbon print, global warming potential, environment requirement for any product and system.		
UNIT II	**ALTERNATE GREEN GASEOUS INSULATORS**	**9**
SF6 gas and its hazardous environmental effects, alternate gases, gaseous mixtures and othersources and its properties.		
UNIT III	**ALTERNATE GREEN LIQUID INSULATORS**	**9**
Hazardous effects of existing liquid dielectric materials (such as organic oil), alternate sources ofenvironmental friendly liquid such as ester oil, vegetable oils dielectric and its properties.		
UNIT IV	**ALTERNATE GREEN SOLID INSULATORS**	**9**
Hazardous effects of existing solid dielectric materials, alternate sources of environmental friendlysolid dielectric and its properties.		
UNIT V	**EVOLVING STANDARDS FOR GREEN INSULATION SYSTEMS**	**9**
Requirements, evolving standards of management, testing, usage and disposal of alternateinsulation systems, Major applications and standards.		
		Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand sustainable and environmental energy and products.
CO2: Understand the alternate green gaseous insulators.
CO3: Understand the alternate green liquid insulators.
CO4: Understand the alternate green solid insulators.
CO5: Understand the standards and testing of Green insulation systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			1	1	1	1						1		
CO2	2					2	2						2		
CO3	2					2	2						2		
CO4	2					2	2						2		
CO5	2				2	2	2						2		

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	R. Arora and H.C.W Mosch, "High Voltage Insulation Engineering", 2nd Edition, New Age International Publishers, 2021.
T2.	Chandra Swaroop Meena, Ashwani Kumar and Varun Pratap Singh, "Sustainable Technologies for Energy Efficient Building", 2nd Edition, CRC Press, 2021.
T3.	U.Mohan Rao and Ramanujam Sarathi, "Alternative Liquid Dielectrics for High Voltage Transformer Insulation Systems: Performance Analysis and Applications", 2nd Edition, Wiley- IEEE press, 2021.

REFERENCE BOOK(S)	
R1.	M.H. Fulekar, Bhawana Pathak and R.K. Kale, "Environment and Sustainable Development", Springer, 2020.
R2.	P. Muthukumar and Dilip Kumar Sakar, "Innovations in Sustainable Energy and Technology", Springer, 2020.

Course Code: 24EEO002	Course Title: Smart Grids	
Course Category: OEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks : 100

COURSE OBJECTIVES
• To acquire knowledge about the evolution of Smart and Interconnected energy systems.
• To gain knowledge about the various challenges and benefits of smart grid and the national andinternational initiatives taken.
• To acquire knowledge on the concepts related with transmission in smart grid technologies.
• To get an insight into smart grid technologies applied to distribution systems.
• To gain knowledge about various computing technologies for Smart Operation of the Grid.

UNIT I	SMART GRID	9
Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.		
UNIT II	**SMART METERING**	**9**
Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).		
UNIT III	**SMART GRID TECHNOLOGIES (Transmission)**	**9**
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.		
UNIT IV	**SMART GRID TECHNOLOGIES (Distribution)**	**9**
DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.		
UNIT V	**HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS**	**9**
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN),		

Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.
Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Understand the importance and objectives of Power System Grid.
CO2: Understand the concept of a smart grid.
CO3: Identify and discuss smart metering devices and associated technologies on Transmission Sector.
CO4: Deliver an overview of Micro grid and Electric Vehicle Technology on Distribution Sector.
CO5: Interpret the various computing technologies to understand the role of Cloud computing and IoT for effective and efficient operation of Smart Grid.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			1		1	1		1			1	2		
CO2	2		2	1		1	1		2			1	2		
CO3	2	2	2	2		2	1		1			2	2	2	
CO4	2	1	2	2		2	1		2			2	2	2	
CO5	2	1	2	2		2	1		2			2	2		

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Stuart Borlase, "Smart Grids Advanced Technologies and Solutions", 2nd Edition, CRC, 2018.
T2.	Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid:Technology and Applications", John Wiley, 2012.
T3.	James Momoh, "Smart Grid Fundamentals of Design and Analysis", IEEE press, 2012.

REFERENCE BOOK(S)	
R1.	Ahmed F. Zobaa and Trevor J. Bihl, "Big data analytics in future power systems", 1st Edition, CRC press, 2018.
R2.	Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012.
R3.	Janaka B. Ekanayake , "Smart Grid: Technology and Applications", 1st Edition, Wiley Publications, 2021.

Course Code: 24EEO003	**Course Title: Hybrid Energy Technology**	
Course Category: OEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• To acquire knowledge about different types of hybrid energy systems.
• To know about the various electrical Generators used for the Wind Energy Conversion Systems.
• To design the power converters used in SPV Systems.
• To gain knowledge about the various power converters used in hybrid energy systems.
• To get knowledge about the performance of the various hybrid Renewable energy systems.

UNIT I	**HYBRID ENERGY SYSTEMS**	**9**
Hybrid Energy Systems - Need for Hybrid Energy Systems - Solar - Wind - Fuel Cell - Diesel, Wind - Biomass - Diesel, Micro - Hydel - PV, Ocean and geyser energy - Classification of Hybrid Energy systems - Importance of Hybrid Energy systems - Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.		
UNIT II	**ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS**	**9**
Review of reference theory fundamentals - Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).		
UNIT III	**POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS**	**9**
Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck- boost converters - selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems.		

UNIT IV	**ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS**	**9**
Introduction to Power Converters - Stand-alone Converters - AC - DC - AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter - Merits and Limitations.		
UNIT V	**CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Hybrid Systems - Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel - PV, Wind - PV - Fuel - cell, Micro - hydel - PV, Biomass-Diesel - Fuel - cell systems.		
Total : 45 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.
CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulatewind energy conversion system.
CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.
CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.
CO5: Interpret the hybrid renewable energy systems.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2	1		1	1		1			1	2	1	
CO2	2	1	2	1		1	1		1			1	2	2	
CO3	2	2	2	1		1	1		1				2	2	
CO4	2	2	1	2		1	1		1				2	2	
CO5	2	2	2	2		1	1		1			1	1	1	

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Bahman Zohuri, "Hybrid Energy Systems", Springer, 1st Edition, 2018.
T2.	S.M. Muyeen, "Wind Energy Conversion Systems", 1st Edition, Springer, 2012.
T3.	Md. Rabiul Islam, Md. Rakibuzzaman Shah and Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", 1st Edition, CRC Press, 2021.

REFERENCE BOOK(S)	
R1.	Ernst Joshua, "Wind Energy Technology", 3rd Edition, PHI, India, 2018.
R2.	Rashid.M. H, "Power electronics Hand book", 4th Edition, Academic press, 2018.
R3.	Rai. G.D, "Non-conventional energy sources", 6th Edition, Khanna publishers, 2017.

Course Code: 24EEO004	**Course Title: Introduction to PLC Programming**	
Course Category: PEC	**Credits: 3**	
L:T:P(Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand basic PLC terminologies, PLC architecture and operation.
• To configure and integrate sensors, switches, and solid-state relays in PLC-based control systems.
• To develop PLC logic for simple applications using ladder logic.
• To understand the hardware and software behind PLC and SCADA.
• To gain exposure to the applications of PLC programming.

UNIT I	**INTRODUCTION TO PLC**	**9**
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC - PLC Construction: What is a PLC, PLC Memories, PLC I/O, PLC Special I/O, PLC Types.		
UNIT II	**PLC INSTRUCTIONS**	**9**
PLC Basic Instructions: PLC Ladder Language - Function block Programming- Ladder/Function Block functions - PLC Basic Instructions, Basic Examples (Start/Stop Rung, Entry/Reset Rung) - Configuration of Sensors, Switches, Solid State Relays - Interlock examples - Timers, Counters, Examples.		
UNIT III	**PLC PROGRAMMING**	**9**
Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions.		
UNIT IV	**COMMUNICATION OF PLC AND SCADA**	**9**
Communication Protocol - Modbus, HART, Profibus. SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures.		
UNIT V	**CASE STUDIES**	**9**
Stepper Motor Control - Elevator Control - CNC Machine Control - conveyor control - Interlocking Problems.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Identify the basic requirements of PLC input/output devices and architecture.
CO2: Apply the Instruction Set used for ladder Logic and Function Block Programming.
CO3: Design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.
CO4: Analyze SCADA hardware, software, remote terminal units, master stations, and communication architectures.
CO5: Understand the applications of PLC programming.

COURSE ARTICULATION MATRIX

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

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)	
T1.	Frank Petruzzula, "Programmable Logic Controllers", 6th Edition, Tata Mc-Graw Hill, 2023.
T2.	John W. Webb and Ronald A. Reis, "Programmable Logic Controllers Principles and Applications", 3rd Edition, PHI publication, 2011.
T3.	Madhuchhanda Mitra and Samarjit Sen Gupta, "Programmable Logic Controllers and Industrial Automation: An Introduction", 2nd Edition, Penram International Publishing () Pvt. Ltd, 2017.

REFERENCE BOOK(S)	
R1.	Madhuchand Mitra and Samerjit Sengupta, "Programmable Logic Controllers Industrial Automation an Introduction", 2nd Edition, Penram International Publishing Pvt. Ltd, 2005.
R2.	J. R. Hackworth and F. D. Hackworth, "Programmable Logic Controllers Principlesand Applications", Pearson publication, 2004.

Course Code: 24EEO005	Course Title: Flexible AC Transmission Systems	
Course Category: OEC	Credits: 3	
L:T:P(Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To know about the Power control in Electrical Transmission lines.
• To impart knowledge about static VAR Compensator and its applications.
• To gain knowledge on Thyristor Controlled Series Capacitor and its applications.
• To understand the performance of power systems with FACTS controllers.
• To acquire knowledge about advanced FACTS controllers.

UNIT I	REAL AND REACTIVE POWER COMPENSATION	9
Real and reactive power control in electrical power transmission lines - loads & system compensation - Uncompensated transmission line - shunt and series compensation.		
UNIT II	**STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS**	**9**
Voltage control by SVC - Advantages of slope in dynamic characteristics - Influence of SVC on system voltage - Design of SVC voltage regulator - TCR - FC - TCR - Modeling of SVC for power flow and fast transient stability- Applications: Enhancement of transient stability - Steady state power transfer - Enhancement of power system damping.		
UNIT III	**THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS**	**9**
Operation of the TCSC - Different modes of operation - Modelling of TCSC, Variability reactance model - Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit - Enhancement of system damping.		
UNIT IV	**VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS**	**9**
Static Synchronous Compensator (STATCOM) - Principle of operation - VI Characteristics. Applications: Steady state power transfer - enhancement of transient stability - prevention of voltage instability. SSSC - operation of SSSC and the control of power flow - modelling of SSSC in load flow and transient stability studies - Dynamic voltage restorer (DVR).		
UNIT V	**ADVANCED FACTS CONTROLLERS**	**9**
Interline DVR(IDVR) - Unified Power flow controller (UPFC) - Interline power flow		

controller (IPFC) - Unified Power quality conditioner (UPQC).
Total : 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain Power control in Electrical Transmission lines.
CO2: Analyze and develop Static VAR Compensator (SVC) for Steady state power transfer.
CO3: Analyze and develop Thyristor Controlled Series Capacitor (TCSC) for system stability.
CO4: Analyze the performance of steady state and dynamics of facts controllers.
CO5: Explain about advanced FACTS controllers.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2					2				2		
CO2	2	1	2	1					2				2		1
CO3	2	2		2					2				2		
CO4	2	2	1	1					2				2		
CO5	2	1	2	2					2				2		1

(1 - Low, 2 - Medium, 3 - High)

TEXT BOOK(S)

T1.	R.Mohan Mathur and Rajiv K.Varma, "Thyristor-Based Facts Controllers for Electrical Transmission Systems", IEEE press and JohnWiley &Sons, Inc, 2002.
T2.	Narain G. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, 2011.

REFERENCE BOOK(S)

R1.	K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.
R2.	V.K.Sood, "HVDC and FACTS controllers-Applications of Static Converters in Power System", Kluwer Academic Publishers, April 2004.

OPEN ELECTIVE OFFERED BY CSE DEPARTMENT

Course Code: 24CSO001	**Course Title: Generative AI**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To Understand the capabilities, evolution, benefits, challenges, and applications of Generative AI.
• To Learn techniques for writing effective prompts and explore different prompt engineering approaches.
• To Study the fundamentals of generative models, including RNNs, LSTMs, GANs, VAEs, transformers, and diffusion models.
• To Explore Generative AI platforms, pre-trained models, and applications for text, image, and code generation.
• To Analyze the ethical, social, and economic implications, along with the limitations and future of Generative AI.

UNIT I	**INTRODUCTION TO GENERATIVE AI**	**9**
Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI – Tools for Text, Image Code, Audio and Video generation– Economic Potential of Generative AI - Use cases.		
UNIT II	**PROMPT ENGINEERING TECHNIQUES AND APPROACHES**	**9**
Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shot and few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts.		
UNIT III	**MODELS FOR GENERATIVE AI**	**9**
Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) - Variational Auto encoders (VAEs) – Transformer–based Models - Diffusion models Applications.		
UNIT IV	**PLATFORMS FOR GENERATIVE AI**	**9**

Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.		
UNIT V	**ETHICAL ISSUES AND LIMITATIONS OF GENERATIVE AI**	**9**
Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.		
		Total: 45 Hours

COURSE OUTCOMES

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

CO1: Understand the capabilities, evolution, benefits, challenges, and applications of Generative AI.

CO2: Apply effective prompt engineering techniques for improving AI-generated outputs.

CO3: Analyze various generative models, including RNNs, LSTMs, GANs, VAEs, transformers, and diffusion models.

CO4: Explore Generative AI platforms, pre-trained models, and multimodal AI generation techniques.

CO5: Evaluate ethical, social, and economic implications along with the future potential of Generative AI.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	David Foster, "Deep Learning: Teaching Machines to Paint, Write", 2nd edition. O'Reilly Media, Inc 2023.
T2.	Joseph Babcock, Raghav Bali, "Generative AI with Python and TensorFlow 2: Create Images, Text, Music with VAEs, GANs, LSTMs, Transformer Models", Publishing,2021

REFERENCE BOOK(S)	
R1.	Ian Good fellow, Joshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016.
R2.	Ben Auffarth "Generative AI with LangChain: Build Large Language Model (LLM) Apps with Python, ChatGPT, and Other LLMs",2023
R3.	Rajeev Kapur, "AI Made Simple: A Beginner's Guide to Generative Intelligence",2023

Course Code: 24CSO002	**Course Title: Game Programming**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To understand the concepts of Game design and development.
• To learn the processes, mechanics and issues in Game Design.
• To be exposed to the Core architectures of Game Programming.
• To know about Game programming platforms, frame works and engines.
• To learn to develop games.

UNIT I	**3D GRAPHICS FOR GAME PROGRAMMING**	**9**
3D Transformations, Quaternions, 3D Modeling and Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera and Projections, Culling and Clipping, Character Animation,Physics-based Simulation, Scene Graphs.		
UNIT II	**GAME ENGINE DESIGN**	**9**
Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling.		
UNIT III	**GAME PROGRAMMING**	**9**
Application layer, Game logic, Game views, managing memory, controlling the main loop, loading and caching game data, User Interface management, Game event management.		
UNIT IV	**GAMING PLATFORMS AND FRAMEWORKS**	**9**
2D and 3D Game development using Flash, DirectX, Java, Python, Game engines - Unity. DX Studio,		
UNIT V	**GAME DEVELOPMENT**	**9**
Developing 2D and 3D interactive games using DirectX or Python – Isometric and Tile Based Games, Puzzle games, Single Player games, Multi Player games.		
		Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Discuss the concepts of Game design and development.
CO2: Design the processes, and use mechanics for game development.
CO3: Explain the Core architectures of Game Programming.
CO4: Use Game programming platforms, frame works and engines.
CO5: Create interactive Games.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.
T2.	David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2 nd Editions, Morgan Kaufmann, 2006.

REFERENCE BOOK(S)	
R1.	Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", 2 nd Edition Prentice Hall / New Riders, 2009.
R2.	Eric Lengyel, "Mathematics for 3D Game Programming and Computer Graphics", 3 rd Edition, Course Technology PTR, 2011.
R3.	David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2 nd Editions, Morgan Kaufmann, 2006.

Course Code: 24CSO003	Course Title: Neural Networks and Deep Learning	
Course Category: PEC	Credits: 3	
L:T:P (Hours/Week) 3:0:0	Total Contact Hours: 45	Max Marks: 100

COURSE OBJECTIVES
• To understand the fundamental concepts of artificial neural networks and their applications.
• To explore different deep learning architectures and their significance in real-world problems.
• To study optimization techniques for training deep neural networks effectively.
• To analyze various deep learning frameworks and tools used for implementation.
• To apply deep learning techniques to solve problems in areas such as image processing, NLP, and speech recognition.

UNIT I	INTRODUCTION TO NEURAL NETWORKS	9
Biological vs. Artificial Neural Networks - Perceptron and Multilayer Perceptron (MLP) - Activation Functions (Sigmoid, ReLU, Tanh, Softmax) - Gradient Descent and Backpropagation Algorithm		
UNIT II	**DEEP LEARNING ARCHITECTURES**	**9**
Introduction to Deep Neural Networks (DNN) - Convolutional Neural Networks (CNN) - Architecture and Applications - Recurrent Neural Networks (RNN) - LSTMs and GRUs - Autoencoders and Generative Adversarial Networks (GANs)		
UNIT III	**OPTIMIZATION TECHNIQUES IN DEEP LEARNING**	**9**
Loss Functions and Cost Functions - Regularization Techniques (Dropout, L1/L2 Regularization) - Batch Normalization and Data Augmentation - Adam, RMSprop, and other Optimization Methods		
UNIT IV	**TOOLS AND FRAMEWORKS FOR DEEP LEARNING**	**9**
Overview of Deep Learning Frameworks (TensorFlow, PyTorch, Keras) - Model Training, Validation, and Hyperparameter Tuning - Transfer Learning and Pretrained Models (ResNet, VGG, BERT) - Deployment of Deep Learning Models		
UNIT V	**APPLICATIONS OF DEEP LEARNING**	**9**
Image Processing and Object Detection (YOLO, Faster R-CNN) - Natural Language		

Processing (NLP) and Speech Recognition - Reinforcement Learning and AI in Robotics - Case Studies in Healthcare, Finance, and Autonomous Systems
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the architecture and functioning of different types of neural networks.
CO2: Design and implement deep learning models using different architectures.
CO3: Optimize deep learning models using various training strategies.
CO4: Utilize deep learning frameworks such as TensorFlow and PyTorch for problem-solving.
CO5: Apply deep learning techniques to domains such as computer vision and natural language processing.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016.
T2.	Simon Haykin, *Neural Networks and Learning Machines*, Pearson, 2018.
T3.	François Chollet, *Deep Learning with Python*, Manning Publications, 2021.

REFERENCE BOOK(S)

R1.	Aurelien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly, 2022.
R2.	Charu C. Aggarwal, *Neural Networks and Deep Learning: A Textbook*, Springer, 2018.
R3.	Satish Kumar, *Neural Networks: A Classroom Approach*, McGraw-Hill, 2017.

Course Code: 24CSO004	**Course Title: Introduction to Augmented Reality (AR) / Virtual Reality (VR)**	
Course Category: PEC	**Credits: 3**	
L:T:P (Hours/Week) 3:0:0	**Total Contact Hours: 45**	**Max Marks: 100**

COURSE OBJECTIVES
• To know the basic concepts of virtual reality.
• To understand visual computation in computer graphics.
• To understand the interaction between the system and the computer.
• To know the application of VR in Digital Entertainment.
• To know the basic concepts of augmented reality.

UNIT I	**INTRODUCTION OF VIRTUAL REALITY**	**9**
Fundamental Concept and Components of Virtual Reality - Primary Features and Present Development on Virtual Reality - Multiple Models of Input and Output Interface in Virtual Reality: Input - Tracker - Sensor - Digital Glove - Movement Capture - Video-based Input - 3D Menus & 3DScanner – Output - Visual /Auditory / Haptic Devices.		
UNIT II	**VISUAL COMPUTATION IN VIRTUAL REALITY**	**9**
Fundamentals of Computer Graphics - Software and Hardware Technology on Stereoscopic Display - Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering.		
UNIT III	**INTERACTIVE TECHNIQUES IN VIRTUAL REALITY**	**9**
Body Track - Hand Gesture - 3D Manus - Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR.		
UNIT IV	**APPLICATION OF VR IN DIGITAL ENTERTAINMENT**	**9**
VR Technology in Film & TV Production - VR Technology in Physical Exercises and Games - Demonstration of Digital Entertainment by VR.		
UNIT V	**AUGMENTED AND MIXED REALITY**	**9**
Taxonomy - technology and features of augmented reality - difference between AR and VR - Challenges with AR - AR systems and functionality - Augmented reality methods - visualization techniques for augmented reality - wireless displays in educational augmented		

reality applications - mobile projection interfaces - marker-less tracking for augmented reality - enhancing interactivity in AR environments - evaluating AR systems.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Explain the architecture and functioning of different types of neural networks.
CO2: Design and implement deep learning models using different architectures.
CO3: Optimize deep learning models using various training strategies.
CO4: Utilize deep learning frameworks such as TensorFlow and PyTorch for problem-solving.
CO5: Apply deep learning techniques to domains such as computer vision and natural language processing.

COURSE ARTICULATION MATRIX

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Burdea, G. C., P. Coffet., "Virtual Reality Technology", Second Edition, Wiley-IEEE Press, 2003/2006.
T2.	Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013.

REFERENCE BOOK(S)	
R1.	Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann, 2009.
R2.	Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", ACM Books,2015

Course Code:24CSO005	**Course Title: High Speed Networks**	
Course Category: OEC	**Credits: 3**	
L:T:P(Hours/Week): 3:0:0	**Total Contact Hours: 45**	**Max Marks : 100**

COURSE OBJECTIVES
• Understand High-Speed Network Technologies
• Analyze Congestion and Traffic Management
• Explore TCP and ATM Congestion Control Mechanisms
• Study Integrated and Differentiated Services
• Learn About QoS-Supporting Protocols

UNIT I	**HIGH SPEED NETWORKS**	**9**
Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture,ATM logical Connection – ATM Cell – ATM Service Categories – AAL. High Speed LAN's: Fast Ethernet – Gigabit Ethernet– Fibre Channel – Wireless LAN's, WiFi and WiMax Networks applications, requirements – Architecture of 802.11.		
UNIT II	**CONGESTION AND TRAFFIC MANAGEMENT**	**9**
Queuing Analysis – Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.		
UNIT III	**TCP AND ATM CONGESTION CONTROL**	**9**
TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats – ABR Capacity allocations – GFR traffic management.		
UNIT IV	**INTEGRATED AND DIFFERENTIATED SERVICES**	**9**
Integrated Services Architecture – Approach, Components, Services- Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.		
UNIT V	**PROTOCOLS FOR QOS SUPPORT**	**9**
RSVP – Goals & Characteristics, Data Flow, RSVP operations – Protocol Mechanisms–		

Multiprotocol Label Switching – Operations, Label Stacking – Protocol details – RTP – Protocol Architecture – Data Transfer Protocol– RTCP.
Total: 45 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: compare and analyse the fundamental principles of various high speed communication networks and their protocol architectures
CO2: Analyse the methods adopted for performance modeling of traffic flow and estimation
CO3: Examine the congestion control issues and traffic management in TCP/IP and ATM networks
CO4: Compare, analyse and implement the various routing protocols in simulation software tools examine the various services.

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

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	William Stallings, "High speed networks and internet", Second Edition, PearsonEducation, 2002.

REFERENCE BOOK(S)	
R1.	Warland, Pravin Varaiya, "High performance communication networks", 2 nd Edition , Jean Harcourt Asia Pvt. Ltd., , 2001.
R2.	Irvan Pepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture",Cisco Press, Volume 1 and 2, 2003.
R3.	Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.

EMPLOYABILITY ENHANCEMENT COURSES

Course Code: 24CDC101	**Course Title: Career Development Skills I**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• Learn about the career planning and goal setting to meet the corporate world.
• Develop motivational skills and personality development.
• Develop the methodologies for team building.

UNIT I	**CAREER PLANNING AND GOAL SETTING**	3

Career planning: Self-Assessment – Skills Development – Networking – Professional Development – Flexibility and Adaptability – Work-Life Balance – Seeking Feedback – Stay Updated

Goal Settings: - Set SMART > Specificity – Measurability – Achievability – Relevance – Time-bound – Breakdown into Steps – Review and Adjust – Accountability – Celebrate Achievements

UNIT II	**MOTIVATION**	**3**

Motivation I – Purpose – Learning mind-set – Stay Organized – Embrace Responsibility – Stay appositive – Reflect and Adapt – Peer Recognition and Support – Inspirational Guest Speakers of Role Models

Personality Effectiveness - Self –Awareness – Emotional Intelligence – Adaptability – Conflict Resolution – Leadership Skills – Time Management – Continuous Learning – Positive Attitude

i) Building Personality – Self-Reflection and Awareness – Assertiveness and Confidence – Relationship Building – Personal Branding

ii) Discipline – Consistency and Persistence – Self-Control and Delayed Gratification – Accountability – Resilience – Interpersonal Skills and Collaboration – Presentation skills – Learning from Mistakes

UNIT III	**PERSONALITY DEVELOPMENT**	**3**

i) Grooming – Dress Code Etiquette – Personal Appearance – Body Language and Posture

ii) Hygiene – Practices & clothing care

iii) Cleanliness – Workspace maintenance – Environmental Awareness & Digital hygiene

Overall preparation – Role of confidence & Cultural Sensitivity

UNIT IV	PRESENTATION AND PUBLIC SPEAKING SKILLS	3

Presentation Speaking Skills – Know the audience – Clear objective – Content structure – Postures and Gestures – Voice projection – Eye contact – appropriate language – Speech Clarity – Visual aids interaction

Public Speaking skills – Research – audience pulse – Pace and Pause – Expertise – Authenticity – Adaptability to unexpected situations

SWOT Analysis – Enhanced Self-awareness **–** Benchmarking with Strength, Weakness, Challenges and Opportunities – Risk management – Versatility – Decision making

UNIT V	TEAM BUILDING	3

Team building – Openness **–** Cooperation **–** Building trust – Respect – Diversity and Inclusion – Cohesion – Prioritisation – Learning team culture – Celebrate success

Activity Sessions- i) Debate – Critical thinking – Confidence building – Persuasive techniques – Ethical reasoning – Empathy

ii) Picture connector – Imagination and Innovation – Analysis **–** Societal awareness **–** Expression **–** Cognitive development – Playful exploration

Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Learn about the career planning and goal setting to meet the corporate world.
CO2: Develop motivational skills and personality development.
CO3: Develop the methodologies for team building

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			
CO3	1	1	1					1	2	2					

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)

T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.

T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC102	**Course Title: Career Development Skills II**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• Develop interpersonal skills.
• Develop Listening and Speaking skills.
• Make interferences and predictions about spoken discourse that enhance RW skills.

UNIT I	**MOTIVATION AND INTERPERSONAL SKILLS**	3
Motivation II – Offer personalised guidance and support – Engage active learning methods – Create a supportive environment personally – Highlight success stories – Celebrate progress – Follow ups. **Interpersonal Skills** – Verbal, Non-verbal and Listening skills – Analysing problems – Contributing ideas – Positive relationships – Mutual respect – Negotiation.		
UNIT II	**LISTENING AND CONVERSATION SKILLS**	**3**
Listening skills – Focus and attention – Non-verbal cues – Paraphrasing – Understanding emotions – Reflecting feelings – Allowing pause – Avoiding interruption – Respond appropriately – Clarifying and Confirming – Maintaining open-mindedness **Conversation skills –** Opening lines – Ice-breakers – Sharing and expressing ideas – Clarity and relevance – Smooth translations – Articulate thoughts - Avoid judgement – Polite language – Express appreciation – Open to feedback		
UNIT III	**TYPES OF SKILLS**	**3**
Reading skills – Speed and Accuracy – Understanding main ideas – Skimming and Scanning – Word recognition – Expanding vocabulary – Analysing text – Making connections – Evaluate and Synthesise – Academic / Professional/ Personal reading **Writing skills –** Clear communication – Logical organization – Grammar and Mechanics – Avoiding redundancy – Choosing strong words – Tone and Style – Concluding structure – Editing and Revision – Originality – Academic/ Professional/ Personal writing **Attitudes –** Positive Attitudes - Preparedness – Adaptability – Professionalism – Resilience – Listening skills – Teamwork and Collaboration – Curiosity and Learning orientation – Gratitude and Humility		

Manners & Behaviour – Politeness and Courtesy – Confidence without arrogance – Respect for personal space and boundaries – Flexibility and Conflict Resolution skills		
UNIT IV	**TIME AND STRESS MANAGEMENT**	**3**
i)Self-awareness – Understanding Strengths and Weaknesses – Personal values – Emotional intelligence – Self-Reflection and Learning Style **ii)Self-confidence –** building a Positive Self – Image – Overcoming fear of failure – Assertiveness **Time management –** Setting Priorities – Planning and Scheduling – Time Estimation and Budgeting – Minimizing Procrastination – Effective decision making **Stress management** – Stressors Identification - Relaxation techniques – Mindfulness-Physical Activity – Positive thinking - Healthy lifestyle – Sound sleep – Hobbies and leisure activities – Humour and laughter – Say 'no' to unwanted **Emotional intelligence** – Self-regulation – empathy – Societal bearing – Understanding causes and consequences of emotions		
UNIT V	**HIGHER EDUCATION AND ENTREPRENEURSHIP**	**3**
i) Introduction to Higher Education – Specialization – Research opportunities – Career advancement – Employability – **ii) Competitive exams –** Merit recognition – Validation of academic abilities – Global recognition (GRE, GMAT, SAT) – Competitive edge – Global career opportunities – Excel, Grow and Achieve professionally **Introduction to Entrepreneurship –** Independence and autonomy – Opportunity to pursue passion – Innovation and creativity – Creating jobs – Sharing and Mutual growth via collaborations and partnerships.		
		Total : 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop strong interpersonal skills.
CO2: Develop strong listening and speaking skills.
CO3: Make predictions about spoken discourse that enhance RW skills

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1								3			
CO2								2	2	3		2			
CO3	1	1	1			1		1	2	2		1			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC201	**Course Title: Career Development Skills III**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• To enhance numerical, analytical, and logical reasoning skills.
• To develop professional workplace etiquette and effective email communication skills.

UNIT I	**QUANTITATIVE APTITUDE AND REASONING**	**12**
Quantitative Aptitude – Number System – HCF and LCM – Average – AP&GP – Logarithm. Data Interpretation and Logical Reasoning Skills – Tabulations – Logical Sequence – Puzzle Test. Verbal and Non-Verbal Reasoning – Logical Sequence of Words – Truth Verification – Analogy – Figure Matrix. Verbal Ability – Grammar Concepts – Antonyms and Synonyms – Reading Comprehension.		
UNIT II	**BUSINESS ETIQUETTE**	**3**
Workplace Etiquette – Punctuality and Time Management – Professional Attire and Grooming – Respectful Communication – Workspace Cleanliness and Organization – Ethical Behaviour and Integrity. E-Mail Etiquette – Importance of Professional Email Communication – Crafting an Effective Subject Line – Maintaining a Polite and Respectful Tone – Respond with Proper Salutations and Closings – Responding Promptly to Emails – Avoid Excessive Formatting or Emojis – Proper Use of Reply All and Forward Functions – Handling Sensitive or Confidential Information. Activities – Role Play, Presentation, Case Study, Mock Team Meeting, Discussion, Responding to Email.		
Total: 15 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Develop strong analytical, reasoning, and verbal skills across quantitative aptitude, data interpretation, logical reasoning, and verbal ability.
CO2: Apply professional workplace etiquette and exhibit proficiency in crafting clear, respectful, and effective email communication.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC202	**Course Title: Career Development Skills IV**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• To strengthen numerical, analytical, and logical reasoning abilities.
• To improve business communication abilities.

UNIT I	**QUANTITATIVE APTITUDE AND REASONING**	**12**
Quantitative Aptitude – Percentage – Profit and Loss – Ratio and Proportion – Pipes and Cistern – Time and Work. Data Interpretation and Logical Reasoning Skills – Bar Graphs – Coding and Decoding – Venn Diagram. Verbal and Non-Verbal Reasoning – Critical Reasoning – Types of Reasoning – Cube and Dice – Pattern Completion. Verbal Ability – Grammar Concepts – Enhancing Vocabulary – One Word Substitution.		
UNIT II	**BUSINESS COMMUNICATION SKILLS**	**3**
Business Communication – Effective Listening Skills – Summarizing and Paraphrasing – Presentation, Planning and Delivery. Sales and Negotiations – Understanding Customers' Needs, Building Rapport and Trust – Negotiation Techniques and Closing the Deal – Continuous Improvement and Professional Development. Customer Service – Importance and Key Elements of Effective Customer Service – Empowering Frontline Employees and Leveraging Technology – Measuring and Improving Customer Satisfaction. Activities – Paraphrasing, Self-Introduction, Presentation, Role Play, Group Discussion.		
Total: 15 Hours		

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Solve problems using numerical, analytical, and logical reasoning skills.
CO2: Utilize communication techniques for effective business interactions for improving professional efficiency.

COURSE ARTICULATION MATRIX

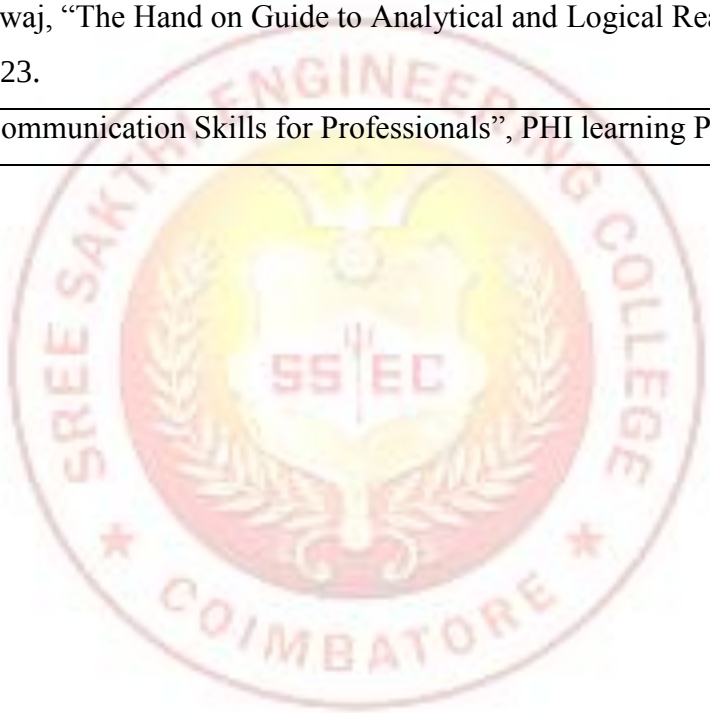
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

Version 1.0, dated 14.06.2025

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.



labercises.

Course Code: 24CDC301	**Course Title: Career Development Skills V**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• To extend logical reasoning, analytical, and numerical skills.
• To learn how to create effective resumes and job applications.

UNIT I	**QUANTITATIVE APTITUDE AND REASONING**	**12**
Quantitative Aptitude – Time and Distance – Boats and Streams – Mixture – Simple Interest – Compound Interest. Data Interpretation and Logical Reasoning Skills – Pie Chart – Blood Relation – Direction Sense. Verbal and Non-Verbal Reasoning – Verbal Analogy –Syllogism – Series – Counting of Figures. Verbal Ability – Word Roots, Affixes and Foreign Words – Idioms and Phrases – Spotting Common Errors.		
UNIT II	**EMPLOYABILITY SKILLS**	**3**
Resume Building – Basic Facts – Resume Types – Sections of Resume – Resume Format – Ordinary Resume "Do's and Don'ts" – Electronic Resume Formats – Using Resume Keywords – Online Resume Banks. Job Application Basic Formats – Personal Information – Work History – Education – Skills and Qualifications – Achievements and Awards – References – Examples. Activities – Developing Corporate Resume, Drafting Job Application, Rendering Presentation, Discussion.		
		Total: 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Use the logical reasoning, analytical thinking, and numerical skills to find answers for complex problems.
CO2:Apply appropriate formats, sections and keywords to effectively present their qualifications while preparing resume and job application.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

Version 1.0, dated 14.06.2025

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC302	**Course Title: Career Development Skills VI**	
Course Category: EEC	**Credits: 1**	
L:T:P (Hours/Week) 1:0:0	**Total Contact Hours: 15**	**Max Marks: 100**

COURSE OBJECTIVES
• To broaden logical reasoning, analytical and numerical skills.
• To equip students with essential leadership traits.

UNIT I	**QUANTITATIVE APTITUDE AND REASONING**	**12**
Quantitative Aptitude – Area – Calendar – Clocks – Permutation &Combination – Probability. Data Interpretation and Logical Reasoning Skills – Line Graph-Data Sufficiency – Seating Arrangement. Verbal and Non-Verbal Reasoning – Cause and Effect – Cloze Test – Mirror and Water Images – Mathematical Operator. Verbal Ability – Sentence Formation, Completion, Correction and Improvement – Change of Voice and Speech – Jumbled Sentences and Paragraph Formation.		
UNIT II	**LEADERSHIP ETIQUETTE**	**3**
Leadership – Characteristics and Styles – Developing Leadership Skills – Communication and Interpersonal Skills – Motivating and Inspiring Teams – Ethical Leadership – Decision Making – Problem Solving. Behavioural Skills (Using Star Method – Situation, Task, Action and Result) – Introduction – Defining the Context – Identifying the Objectives – Describing the Steps to be Taken – Highlighting the Outcome – Developing Behavioral Skills – STAR Method in Interviews and Benefits. Specific Technical Knowledge – Specialized Skills – Foundational Concepts and Principles – Practical Applications – Industry-Specific Regulations and Standards – Emerging Trends and Innovations – Continuous Learning and Professional Development – Troubleshooting and Problem – Solving Techniques – Collaboration and Knowledge Sharing. Activities – Role Play, Presentation, Case Study, Group Discussion.		
		Total: 15 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Utilize logical reasoning, analytical thinking, and numerical skills to solve complex problems.
CO2: Demonstrate key leadership traits to effectively lead teams.

COURSE ARTICULATION MATRIX															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1								3			
CO2								2	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Dr.R.S.Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand Publishing, 2023.
T2.	Arun Sharma and Meenakshi Upadhyay, "Verbal Ability and Reading comprehension", Tata McGraw Hill Education, 2014.
T3.	Sanjay Kumar and Pushp Lata, "Communication skills", Oxford Higher Education, 2011.

REFERENCE BOOK(S)	
R1.	Arun Sharma, "Logical Reasoning for CAT", Tata McGraw Hill Education, 2024.
R2.	Peeyush Bhardwaj, "The Hand on Guide to Analytical and Logical Reasoning", Arihant Publication, 2023.
R3.	Nira Konar, "Communication Skills for Professionals", PHI learning Pvt. Ltd, 2011.

Course Code: 24CDC401	Course Title: Career Development Skills VII	
Course Category: EEC	Credits: 1	
L:T:P (Hours/Week) 2:0:0	Total Contact Hours: 30	Max Marks: 100

COURSE OBJECTIVES
• To build skills to prepare for interviews, focusing on professionalism, clear communication, and making a positive impression.
• To enhance students ability for effective communication and professional success.

UNIT I	INTERVIEW SKILLS	15

Preparing for the Interview – Company and Role – Common Interview Questions – Skills and Experience – Maintain Positive Mind-Set. Before the Interview – Practice Critical Interview Questions – Genuine Questions to Ask the Interviewer – Reviewing Resume – Dress code – Early Arrival – Keep Enough Copies of Resume. During the Interview – Professional Look – Greeting the Interviewer – Answering Questions Confidently. The Interviewee's Behavior – Importance – Creating Good Impression – Body Language – Eye Contact – Tone – Voice – Confidence and Composure – Enthusiasm and Engagement – Responding to Questions. Taking Questions-Types of Questions Expected – Strategies for Answering Questions – Avoiding Pitfalls While Answering-Turning Questions into Opportunities – Maintaining Emotional Control – Leaving a Positive Impression. Tackling Questions – Answering to Behavioural Questions – Responding to Technical Questions – Handling Situational and Hypothetical Questions – Handling Weaknesses and Challenges. Questioning the Interviewer – Demonstrating Interest and Engagement – Showcasing Talents, Knowledge and Research Expertise – Exploring the Company Culture and Values – Inquiring about Growth Opportunities – Addressing Concerns or Challenges – Closing the Interview on a Strong Positive Note. Farewell and Follow-Up – Expressing gratitude – Offering Resources and Support – Importance of Staying in Touch – Contact Information – Inviting Feedback and Follow-Up – Closing Wishes.

UNIT II	GROUP DISCUSSION AND MOCK INTERVIEW	15

Group Discussion – Introduction & Importance – Effective Communication in Group Discussion – Roles and Responsibilities – Strategies for Active Participation - Overcoming Challenges in Group Discussion – Evaluating the Process – Conclusion and Key Takeaways. Body Language, Voice Modulation – Importance & Techniques for Effective Voice Modulation – Pitch Variation – Tone and Inflection – Volume Control – Pace and Pause –

Practical Applications of Voice Modulation. Content and Creativity – Importance of Engaging Content – Leveraging Creativity to Stand Out – Crafting Compelling Narratives – Optimizing for Different Platforms – Measuring and Analyzing Content Performance – Staying Ahead of Trends and Innovations. Basic Mock Interview Sessions – Introduction – Purpose and Benefits – Interview Preparation – Common Interview Questions – Behavioral Interview Techniques –Technical Interview Strategies – Mock Interview Feedback and Reflection – Steps and Resources. Activities – Group Discussion, Role Play, Presentation, Mock Interview.
Total: 30 Hours

COURSE OUTCOMES
At the end of this course, students will be able to
CO1: Show professionalism, apply clear communication strategies, and effectively present themselves during interviews to make a positive impression.
CO2: Apply effective communication strategies and professional behavior to enhance their success in various workplace scenarios.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								3	2	3		2			
CO2								3	2	3		2			

(1 – Low, 2 – Medium, 3 – High)

TEXT BOOK(S)	
T1.	Marry Stella, “Facing Job Interviews”, Lotus Press, New Delhi, 2007.
T2.	Uco Jillert Wiersma, “Interview Charisma”, Career Knows Publishing, Norwalk, Connecticut, 2016.
T3.	Theodore Kingsley, “Interviewing Skills 3 in 1”, Indy Pub, 2023.

REFERENCE BOOK(S)	
R1.	Stephen R Covey, “Seven Habits of Highly Effective People”, G.K Hall, 1997.
R2.	Sanjay Kumar and Pushp Lata, “Communication skills”, Oxford Higher Education, 2011.
R3.	Nira Konar, “Communication Skills for Professionals”, PHI learning Pvt. Ltd, 2011.

Course Code : 24CDC221	Course Title : Mini Project I	
Course Category : EEC	Credits : 1	
L:T:P(Hours/Week) : 0:0:2	Total Contact Hours : 30	Max Marks : 100

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code :24CDC222	**Course Title: Mini Project II**	
Course Category: EEC	**Credits:1**	
L:T:P(Hours/Week) : 0:0:2	**Total Contact Hours:30**	**Max Marks:100**

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code :24CDC321	**Course Title: Mini Project III**	
Course Category: EEC	**Credits:1**	
L:T:P(Hours/Week) : 0:0:2	**Total Contact Hours:30**	**Max Marks:100**

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code :24CDC322	**Course Title: Mini Project IV**	
Course Category: EEC	**Credits:1**	
L:T:P(Hours/Week) : 0:0:2	**Total Contact Hours:30**	**Max Marks:100**

COURSE OBJECTIVES
• To enhance students' analytical skills for better problem understanding and evaluation.
• To foster a passion for problem-solving through engaging and challenging tasks.
• To develop students' ability to apply engineering concepts in real-world scenarios effectively.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Formulate a real-world problem, identify the requirements, and design solutions.
CO 2: Identify technical ideas, strategies, and methodologies.
CO 3: Utilize new tools, algorithms, and techniques to contribute to the solution.
CO 4: Test and validate the prototype for cost-effectiveness.
CO 5: Prepare a report and deliver oral demonstrations.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	-	-	2	2	2	-	-			
CO2	1	2	1	1	2	-	-	2	2	2	-	-			
CO3	1	2	1	1	2	-	-	2	2	2	2	-			
CO4	1	2	1	1	2	-	-	2	2	2	2	-			
CO5	1	2	-	-	2	-	-	2	2	2	-	-			

Course Code : 24CDC422	**Course Title : Project Work Phase I**	
Course Category : EEC	**Credits : 2**	
L:T:P(Hours/Week) : 0:0:4	**Total Contact Hours :60**	**Max Marks :100**

COURSE OBJECTIVES
• To enable students to apply learned technologies in the design, analysis, and simulation of physical systems.
• To help students integrate various systems into a cohesive and functional product.
• To develop students' ability to work effectively in teams and manage time constraints.
• To improve students' skills in presenting and documenting technical work clearly in both oral and written formats.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Design, analyze, realize/simulate a physical system by using the technology they learned during the program.
CO 2: Integrate various systems into a single product.
CO 3: Work in a team with confined time duration.
CO 4: Disseminate their work both in oral and written format.

COURSE ARTICULATION MATRIX

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

COURSE ASSESSMENT METHODS:

Direct	**Indirect**
1. Interdisciplinary work 2. Innovation 3. Working model/ simulation result 4. Report with good referencing 5. End Semester Viva Voce	1.Course end survey
Students are required to work in groups of up to 4 members to complete their main project. Special exceptions may be granted for interdisciplinary projects and computer-based simulations, with prior approval from the department committee. Management-related projects will not be permitted. Interdisciplinary projects will be given higher weightage.	

Course Code : 24CDC423	Course Title : Project Work Phase II	
Course Category : EEC	Credits : 2	
L:T:P(Hours/Week) : 0:0:4	Total Contact Hours :60	Max Marks : 100

COURSE OBJECTIVES
• To enable students to apply learned technologies in the design, analysis, and simulation of physical systems.
• To help students integrate various systems into a cohesive and functional product.
• To develop students' ability to work effectively in teams and manage time constraints.
• To improve students' skills in presenting and documenting technical work clearly in both oral and written formats.

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Design, analyze, realize/simulate a physical system by using the technology they learned during the program.
CO 2: Integrate various systems into a single product.
CO 3: Work in a team with confined time duration.
CO 4: Disseminate their work both in oral and written format.

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	2	2	-	-	-	3			
CO2	3	3	3	3	3	2	2	2	-	-	-	3			
CO3	-	-	-	-	-	-	-	-	3	-	-	-			
CO4	-	-	-	-	-	-	-	-	-	3	3	-			
Max															

COURSE ASSESSMENT METHODS:

Direct	**Indirect**
1. Interdisciplinary work 2. Innovation 3. Working model/ simulation result 4. Report with good referencing 5. End Semester Viva Voce	1.Course end survey
Students are required to work in groups of up to 4 members to complete their main project. Special exceptions may be granted for interdisciplinary projects and computer-based simulations, with prior approval from the department committee. Management-related projects will not be permitted. Interdisciplinary projects will be given higher weightage.	

Course Code: 24MAC221	Course Title: Summer Internship I	
Course Category: MC	Credits: 0	
L:T:P (Hours/Week):0:0:0	Total Contact Hours: 2weeks	Max Marks: 100

COURSE OBJECTIVES
• To enable students to apply theoretical knowledge to real-world engineering challenges.
• To expose students to industry-standard tools, technologies, and practices.
• To enhance professional skills such as teamwork, communication, and time management in a workplace environment

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Apply engineering principles to design and solve real-world problems using acquired knowledge.
CO 2: Analyze industry processes and technologies to evaluate their effectiveness in solving engineering challenges.
CO 3: Evaluate the performance of engineering systems and propose enhancements based on hands-on experience.
CO 4: Design and implement innovative solutions in collaborative projects, demonstrating leadership and teamwork.

COURSE ARTICULATION MATRIX

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

Course Code: 24MAC321	**Course Title: Summer Internship II**	
Course Category: MC	**Credits: 0**	
L:T:P (Hours/Week):0:0:0	**Total Contact Hours: 2 Weeks**	**Max Marks: 100**

COURSE OBJECTIVES
• To enable students to apply theoretical knowledge to real-world engineering challenges.
• To expose students to industry-standard tools, technologies, and practices.
• To enhance professional skills such as teamwork, communication, and time management in a workplace environment

COURSE OUTCOMES
At the end of this course, students will be able to:
CO 1: Apply engineering principles to design and solve real-world problems using acquired knowledge.
CO 2: Analyze industry processes and technologies to evaluate their effectiveness in solving engineering challenges.
CO 3: Evaluate the performance of engineering systems and propose enhancements based on hands-on experience.
CO 4: Design and implement innovative solutions in collaborative projects, demonstrating leadership and teamwork.

COURSE ARTICULATION MATRIX

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