B.E. Degree

in

MECHNICAL ENGINEERING

CURRICULUM & SYLLABUS (CBCS)

(For students admitted from the Academic Year 2022-2023)

DEPARTMENT OF MECHANICAL ENGINEERING

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

CHUNKANKADAI, NAGERCOIL – 629 003.

KANYAKUMARI DISTRICT, TAMIL NADU, INDIA

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

Chunkankadai, Nagercoil – 629 003.

AUTONOMOUS COLLEGE AFFILIATED TO ANNA UNIVERSITY

ACADEMIC REGULATIONS 2022

B.E. MECHANICAL ENGINEERING CURRICULUM

CHOICE BASED CREDIT SYSTEM

Inconsonance to the vision of our college,

An engineering graduate we form would be a person with optimal human development, i.e. physical, mental, emotional, social and spiritual spheres of personality.

He/she would be also a person mature in relationships, especially knowing how to treat everyone with respect, including persons of complementary gender with equality and gender sensitivity guided by clear and pro-social values.

He would be patriotic and would hold the Indian Constitution and all the precepts it outlays close to his heart and would have a secular spirit committed to safeguard and cherish the multi-cultural, multi-religious and multi-linguistic ethos of Indian Society.

Academically, he/she would be a graduate with a strong engineering foundation with proficient technical knowledge and skills. He would have enough exposure and experience into the ethos of relevant industry and be industry ready to construct a successful career for himself and for the benefit of the society.

He would have been well trained in research methodology and would have established himself as a researcher having taken up many research projects, with sound ethical standards and social relevance. He would be a person with a passion for technical innovations committed to lifelong learning and research.

He would be well prepared and confident to develop ingenuous solutions to the problems people face as an individual and as a team and work for the emancipation of our society with leadership and courage.

The curriculum is thoughtfully designed to encompass the core fundamentals of mechanical engineering while integrating advanced technologies, effective communication strategies, and essential management principles. This holistic approach equips students with the knowledge and competencies required to address both local and global engineering challenges, all while upholding ethical standards and social responsibility.

There is a strong alignment between the curriculum and the Program Outcomes (POs) as well as the Program Specific Outcomes (PSOs). Each course within the curriculum contributes meaningfully to the development of a mechanical engineering graduate, fostering a deep understanding of engineering principles and practical skills essential for professional success. The structured learning outcomes of the curriculum ensure the development of proficient mechanical engineers who exhibit technical excellence, problem-solving capabilities, and ethical awareness, as envisioned by the POs and PSOs. The transformation of students throughout their academic journey reflects a high level of coherence with the college's mission and vision.

Ultimately, the curriculum nurtures well-rounded, dynamic, and responsible technocrats prepared to contribute innovatively and ethically to the global engineering landscape, thereby reinforcing the institution's commitment to creating a society driven by knowledge, integrity, and technological advancement.

I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I	Have ability to understand, analyse and solve real case problems in core mechanical engineering as well as in other allied fields.
II	Have ability to adapt well into career in mechanical related Industries and to perceive higher studies.
III	Contribute for R&D efforts in technological development to meet international standards and future needs.
IV	Provide leadership skill by upholding ethical values with social responsibility.
V	Assimilate with the spirit of entrepreneurship and innovation.

II. PROGRAM OUTCOMES (POs)

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

III. PROGRAM SPECIFIC OUTCOMES (PSOs)

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

PSO1	Ability to utilize state-of-art IT tools to analyse, design and evaluate mechanical components.
PSO2	Ability to design and evaluate the performance of thermal systems and execute processes to manufacture various components and systems with quality assurance.
PSO3	Ability to apply modern management techniques with a concern for environment upholding ethical values.

PEO's – PO's & PSO's MAPPING:

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

PROGRAM ARTICULATION MATRIX

Year	Sem	Course Code	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	EN22101	-	-	-	-	-	-	-	-	2	2	-	2	1	-	-
		MA22101	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
		PH22101	2	1	-	-	-	-	-	-	-	-	-	1	2	2	-
		CH22101	3	2	2	1	-	-	2	-	-	-	-	1	-	1	1
		CS22101	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
		HS22101	3	2	2	1	-	-	2	-	2	-	1	1	-	-	-
		HS22102	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-
		CS22102	3	3	3	3	2	-	-	-	-	-	-	1	3	-	-
		BS22101	3	1	-	-	-	2	2	-	2	1	-	1	-	-	-
I	II	EN22201	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
		MA22201	3	2	-	-	-	-	-	-	-	-	-	1	-	2	-
		PH22204	2	1	-	-	-	-	-	-	2	1	-	1	-	2	-
		ES22201	3	2	2	2	-	-	-	-	-	-	-	1	1	-	-
		CH22201	3	2	2	2	-	-	-	-	-	-	-	1	-	-	2
		ME22201	3	1	-	-	-	-	-	-	-	2	-	-	1	2	-
		ME22202	3	3	2	2	-	-	-	-	-	1	-	2	-	2	-
		ME22203	1	-	-	-	2	-	-	-	1	1	-	1	2	-	-
		ES22203	3	-	-	-	-	-	-	-	3	1	-	1	-	1	-
II	III	MA22304	3	2	1	-	-	-	-	-	-	-	-	-	1		
		ME22301	3	2	2	-	-	-	-	-	-	1	-	1	-	2	-
		ME22302	3	2	2	-	-		-	-	-	2	1	1	-	2	-
		ME22303	3	2	2	-	-	-	-	-	-	-	-	1	1	2	-
		EE22308	3	2	2		-	-	-	-	2	1	-	1		2	-
		ME22304	3	1	-	-	-	-	1	-	1	1	-	1	1	1	
II	IV	ME22401	3	2	2	1	-	-	-	-	2	1	-	1	1	2	-
		ME22402	3	2	2	-	-	-	-	-	2	1	-	2	2	1	-
		ME22403	3	2	3	2	-	-	1	-	-	1	-	2		2	1
		ME22404	3	2	2	1	2	-	-	1	1	1	-	1	3	-	1
		ME22405	2	2	2	3	2	-	-	2	2	2	-	1	3	2	1
III	V	ME22502	2	2	2	1	-	-	-	-	-	2	-	-	1	2	-
		ME22503	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3

		ME22501	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
		SD22503	2	2	2	-	1	1	1	1	2	3	1	2	2	-	-
		ME22504	3	3	3	2	1	-	-	-	2	2	1	2	3	2	1
		AC22501	1	1	1	1	1	2	1	2	1	1	1	1	-	2	-
		HS22501	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
III	VI	HS22601	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-
		ME22602	3	3	3	2	1	-	-	-	-	-	-	1	1	1	-
		ME22601	3	1	1	-	2	-	1	-	-	1	-	1	2	-	-
		ME22604	3	1	-	-	3	-	-	-	2	2	-	2	3	2	-
		SD22603	3	2	2	-	2	-	-	-	-	-	-	2	1	-	-
IV	VII	ME22701	2	2	-	-	4	2	2	-	-	-	3	-	-	-	3
		ME22702	3	2	3	3	3	-	-	-	-	-	2	-	3	-	-
		ME22703	3	3	3	2	2	-	3	-	3	3	3	2	3	3	3
		SD22703	3	2	2	-	2	-	-	-	-	-	-	2	3	-	-
IV	VIII	ME22801	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	MA22101	Matrices and Calculus	BSC	3	1	0	4	4
2	PH22101	Engineering Physics	BSC	3	0	0	3	3
3	CH22101	Engineering Chemistry	BSC	3	0	0	3	3
4	CS22101	Problem Solving and Python Programming	ESC	3	0	0	3	3
5	GE3152	தமிழர் மரபு (Heritage of Tamil)	HSMC	1	0	0	1	1
THEORY COURSES WITH PRACTICAL COMPONENT								
5	EN22101	Communicative English	HSMC	2	0	2	4	3
PRACTICAL COURSES								
6	BS22101	Physics – Chemistry Laboratory	BSC	0	0	4	4	2
7	CS22102	Python Programming Laboratory	ESC	0	0	4	4	2
MANDATORY COURSES								
8	IP22101	Induction programme	-	-	-	-	-	0
9	HS22101	Higher Order thinking	MC	1	0	0	1	1
10	HS22102	Universal Human Values: Understanding Harmony and Ethical Human Conduct	HSMC	2	0	0	2	2
TOTAL				**18**	**1**	**10**	**29**	**24**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	MA22201	Statistics and Numerical Methods	BSC	3	1	0	4	4
2	ES22202	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
3	ME22201	Engineering Graphics	ESC	2	0	2	4	3
4	ME22202	Engineering Mechanics	PCC	2	1	0	3	3
5	GE3252	Tamils and Technology	HSMC	1	0	0	1	1
THEORY COURSES WITH PRACTICAL COMPONENT								
6	EN22201	Technical English	HSMC	2	0	2	4	3
7	PH22204	Material Science	BSC	2	0	2	4	3
8	CH22201	Environment and Sustainability	BSC	2	0	2	4	3
PRACTICAL COURSES								
9	ME22203	Computer Aided design and Drafting Laboratory	PCC	0	0	4	4	2
10	ES22203	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL				**17**	**2**	**16**	**35**	**27**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	MA22304	Transforms and partial differential equations	BSC	3	1	0	4	4
2	ME22301	Engineering Thermodynamics	PCC	3	1	0	4	4
3	ME22303	Manufacturing Process	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
4	ME22302	Fluid Mechanics and Machinery	PCC	3	0	2	5	4
5	EE22308	Electrical drives and control	PCC	3	0	2	5	4
PRACTICAL COURSES								
6	ME22304	Manufacturing Process Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
7	SD22303	Coding Skills and Soft Skills Training – Phase I	EEC	0	0	4	4	2
MANDATORY COURSES								
8	AC22301	Constitution of India	MC	2	0	0	2	0
9	HS22301	Value Education - I	MC	1	0	0	1	0
TOTAL				**18**	**2**	**12**	**32**	**23**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	ME22403	Engineering Materials and Metallurgy	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
2	ME22401	Thermal Engineering	PCC	2	1	2	5	4
3	ME22402	Strength of Materials	PCC	2	1	2	5	4
4	ME22404	Mechanics of Machines	PCC	2	1	2	5	4
5	ME22405	Metrology and Measurements	PCC	3	0	2	5	4
EMPLOYABILITY ENHANCEMENT COURSES								
6	SD22403	Coding Skills and Soft Skills Training – Phase II	EEC	0	0	4	4	2
MANDATORY COURSES								
7	AC22401	Industrial Safety Engineering	MC	2	0	0	2	0
TOTAL				**14**	**3**	**12**	**29**	**21**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	ME22502	Design of Machine Elements	PCC	2	1	0	3	3
2	ME22503	Hydraulics and Pneumatics	PCC	3	0	0	3	3
3		Professional Elective I	PEC	3	0	0	3	3
4		Professional Elective II	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
5	ME22501	Heat Transfer	PCC	2	1	2	5	4
EMPLOYABILITY ENHANCEMENT COURSES								
6	SD22503	Coding Skills and Soft Skills Training – Phase III	EEC	0	0	4	4	2
7	ME22504	Technical Seminar	EEC	0	0	2	2	1
8	ME22505	Inplant / Industrial Training (2 weeks - During 4th semester Summer Vacation)	EEC	-	-	-	-	1
MANDATORY COURSES								
9	AC22501	Entrepreneurship Development	MC	2	0	0	2	0
10	HS22501	Value Education - II	MC	1	0	0	1	0
TOTAL				**16**	**2**	**8**	**26**	**20**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	HS22601	Professional Ethics	HSMC	3	0	0	3	3
2	ME22602	Finite Element Analysis	PCC	3	0	0	3	3
3		Open Elective – I	OEC	3	0	0	3	3
4		Professional Elective III	PEC	3	0	0	3	3
5		Professional Elective IV	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
6	ME22601	Mechatronics	PCC	3	0	2	5	4
PRACTICAL COURSES								
7	ME22604	CAD/CAM laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	SD22603	Coding Skills, Logical Reasoning and Quantitative Aptitude Training – Phase I	EEC	0	0	4	4	2
TOTAL				**18**	**1**	**10**	**28**	**23**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	ME22701	Total Quality Management	HSMC	3	0	0	3	3
2		Professional Elective V	PEC	3	0	0	3	3
3		Professional Elective VI	PEC	3	0	0	3	3
4		Open Elective – II	OEC	3	0	0	3	3
5		Open Elective – III	OEC	3	0	0	3	3
PRACTICAL COURSES								
6	ME22702	Simulation and Analysis laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
7	ME22703	Product development Lab/ Mini project	EEC	0	0	6	6	2
8	SD22703	Coding Skills, Logical Reasoning and Quantitative Aptitude Training – Phase II	EEC	0	0	4	4	2
TOTAL				**15**	**-**	**14**	**29**	**21**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
EMPLOYABILITY ENHANCEMENT COURSES								
1	ME22801	Project Work/ Internship	EEC	0	0	16	16	8
TOTAL						**16**	**16**	**8**

SUMMARY

B.E. Mechanical Engineering									
Sl. No.	**Subject Area**	**Credits per Semester**							**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
1	**HSMC**	6	4				3	3		16
2	**BSC**	12	10	4						26
3	**ESC**	6	8							14
4	**PCC**		5	17	19	10	9	2		62
5	**PEC**					6	6	6		18
6	**OEC**						3	6		9
7	**EEC**			2	2	4	2	4	8	22
8	**Non-Credit /(Mandatory)**	1 course		2 course	1 course	2 course	-	-		-
Total		24	27	23	21	20	23	21	8	167

PROFESSIONAL ELECTIVE COURSES

LIST OF IDENTIFIED VERTICALS	
1	THERMAL SCIENCES
2	ENGINEERING DESIGN & MANUFACTURING
3	GREEN ENERGY TECHNOLOGIES
4	DIGITAL MANUFACTURING
5	ELECTRIC VEHICLE TECHNOLOGY
6	COMPUTATIONAL ENGINEERING

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6
Thermal Sciences	Engineering Design & Manufacturing	Green Energy Technologies	Digital Manufacturing	Electric Vehicle Technology	Computational Engineering
Advanced Internal Combustion Engineering	Process Planning and Cost Estimation	Bioenergy Conversion Technologies	Digital Manufacturing and IOT	Advanced Vehicle Engineering	Computational Solid Mechanics
Refrigeration and Air-Conditioning	Design of Transmission System	Carbon Footprint Estimation and Reduction Techniques	Robot Design, Dynamics and Control	Hybrid and Electric Vehicle Technology	Computational Fluid Dynamics and Heat transfer
Turbo Machines	Design of Jigs, Fixtures and Press Tools	Energy Conservation in Industrial Utilities	Sensors, Actuators and controllers for Automation	Vehicle Maintenance and Safety	Computational Bio-Mechanics
Gas Dynamics and Jet Propulsion	Non-Traditional Machining Processes	Energy Storage Devices	3D Printing Process and Applications	Electric Vehicle design, Mechanics and Control	Computer Aided Inspection
Power plant Engineering	Computer Integrated Manufacturing	Renewable Energy Technologies	Lean Manufacturing	Electric Vehicle Power Management	CAD and CAE
Measurements and Controls	Production Planning and Control	Energy Efficient Buildings	Non-Destructive Testing	Autonomous Electric Vehicles	Machine Learning for Intelligent Systems

VERTICAL 1: THERMAL SCIENCES

Sl. No.	Course code	Course title	Categ-ory	Periods Per week			Total contact periods	Credits
				L	T	P		
1.	ME22511	Advanced Internal Combustion Engineering	PEC-1	3	0	0	3	3
2.	ME22512	Refrigeration and Air-conditioning	PEC-2	3	0	0	3	3
3.	ME22611	Turbo Machines	PEC-3	3	0	0	3	3
4.	ME22612	Gas Dynamics and Jet Propulsion	PEC-4	3	0	0	3	3
5.	ME22711	Power plant Engineering	PEC-5	3	0	0	3	3
6.	ME22712	Measurements and Controls	PEC-6	3	0	0	3	3

VERTICAL 2: ENGINEERING DESIGN & MANUFACTURING

Sl. No.	Course code	Course title	Categ ory	Periods Per week			Total contact periods	Credits
				L	T	P		
1.	ME22521	Process Planning and Cost Estimation	PEC-1	3	0	0	3	3
2.	ME22522	Design of Transmission System	PEC-2	3	0	0	3	3
3.	ME22621	Design of Jigs, Fixtures and Press Tools	PEC-3	3	0	0	3	3
4.	ME22622	Non-traditional Machining Processes	PEC-4	3	0	0	3	3
5.	ME22721	Computer Integrated Manufacturing	PEC-5	3	0	0	3	3
6.	ME22722	Production Planning and Control	PEC-6	3	0	0	3	3

VERTICAL 3: GREEN ENERGY TECHNOLOGIES

Sl. No.	Coursecode	Course title	Cate gory	Periods Per week			Total contact periods	Credits
				L	T	P		
1	ME22531	Bioenergy Conversion Technologies	PEC-1	3	0	0	3	3
2	ME22532	Carbon footprint estimation and reduction techniques	PEC-2	3	0	0	3	3

3	ME22631	Energy conservation in Industrial utilities	PEC-3	3	0	0	3	3
4	ME22632	Energy storage devices	PEC-4	3	0	0	3	3
5	ME22731	Renewable Energy Technologies	PEC-5	3	0	0	3	3
6	ME22732	Energy efficient Buildings	PEC-6	3	0	0	3	3

VERTICAL 4: DIGITAL MANUFACTURING

Sl. No.	Course code	Course title	Category	Periods Per week			Total contact periods	Credits
				L	T	P		
1	ME22541	Digital Manufacturing and IOT	PEC-1	3	0	0	3	3
2	ME22542	Robot Design, Dynamics and Control	PEC-2	3	0	0	3	3
3	ME22641	Sensors, Actuators and controllers for Automation	PEC-3	3	0	0	3	3
4	ME22642	3D Printing process and Applications	PEC-4	3	0	0	3	3
5	ME22741	Lean Manufacturing	PEC-5	3	0	0	3	3
6	ME22742	Non-Destructive Testing	PEC-6	3	0	0	3	3

`VERTICAL 5: ELECTRIC VEHICLE TECHNOLOGY

Sl. No.	Course code	Course title	Category	Periods Per week			Total contact periods	Credits
				L	T	P		
1.	ME22551	Advanced Vehicle Engineering	PEC-1	3	0	0	3	3
2.	ME22552	Hybrid and Electric Vehicle Technology	PEC-2	3	0	0	3	3
3.	ME22651	Vehicle maintenance and safety	PEC-3	3	0	0	3	3
4.	EE22621	Electric Vehicle design, Mechanics and Control	PEC-4	2	0	2	4	3
5.	ME22751	Electric vehicle power management	PEC-5	3	0	0	3	3
6.	ME22752	Autonomous Electric Vehicles	PEC-6	3	0	0	3	3

`VERTICAL 6: COMPUTATIONAL ENGINEERING

Sl. No.	Course code	Course title	Category	Periods Per week			Total contact periods	Credits
				L	T	P		
1	ME22561	Computational Solid Mechanics	PEC-1	3	0	0	3	3
2	ME22562	Computational Fluid Dynamics and Heat transfer	PEC-2	3	0	0	3	3
3	ME22661	Computational Bio-Mechanics	PEC-3	3	0	0	3	3
4	ME22662	Computer Aided Inspection	PEC-4	3	0	0	3	3
5	ME22761	CAD and CAE	PEC-5	2	0	2	4	3
6	ME22762	Machine Learning for Intelligent Systems	PEC-6	3	0	0	3	3

SEMESTER - I

MA22101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

UNIT I MATRICES **12**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Problem solving using Cayley-Hamilton method – Orthogonal transformation of a symmetric matrix to Diagonal form – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature, rank, index.

UNIT II DIFFERENTIAL CALCULUS **12**

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

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

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

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Double integrals in Cartesian and polar coordinates –Area enclosed by plane curves - Change of order of integration – Triple integrals – Volume of solids: cube, rectangular parallelopiped.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **12**

Linear differential equations of second and higher order with constant coefficients when the R.H.S is e^{ax}, x^n , sin ax, cos ax, $e^{ax}x^n$, e^{ax} sinbx, e^{ax} cosbx – Linear differential equations of second and third order with variable coefficients: Cauchy's and Legendre's linear equations – Method of variation of parameter .

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Define the basic concepts of matrices, limit and continuity of a function, differentiation, ODE and integration

CO2: Explain the properties of matrices and nature of the quadratic form

CO3: Interpret the techniques of differentiation, partial differentiation, ODE and integration

CO4: Apply diagonalization of matrices in quadratic form and apply Cayley Hamilton theorem to find the inverse of matrices

CO5: Solve problems on differentiation, partial differentiation, integration and ODE using different methods

TEXT BOOKS:

1. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Narayanan, S. and ManicavachagomPillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, Reprint 2017.
3. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition,2014.

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
4. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
6. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

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

CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-

PH22101 **ENGINEERING PHYSICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology
- To help the students to interrelate the topics such as properties of matter, thermal physics, ultrasonics, quantum theory and crystals, learned in the course
- To motivate students to compare and contrast the available equipment in the respective fields
- To induce the students to design new devices that serve humanity by applying the knowledge gained during the course

UNIT I PROPERTIES OF MATTER **9**

Elasticity – Types of Elastic moduli – Factors affecting elasticity - Stress-strain diagram and its uses - beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: determination of young's modulus – I shaped Girders - twisting couple - torsion pendulum: determination of rigidity modulus and moment of inertia – torsion springs - other states of matter

UNIT II THERMAL PHYSICS **9**

Modes of Heat transfer – Thermal conductivity – Newton's law of cooling – Linear heat flow – Thermal conductivity in compound media - Lee's Disc method – Radial heat flow – Rubber tube method – Solar water heater - Thermodynamics – Isothermal and adiabatic process – Otto cycle – Diesel cycle

UNIT III ULTRASONICS **9**

Sound waves – ultrasonics – properties - production: magnetostriction method - piezoelectric method – cavitation - acoustic grating: wavelength and velocity of ultrasonic waves in liquids – applications: welding, machining, cleaning, soldering and mixing (qualitative) - SONAR – ultrasonic flaw detector - ultrasonography.

UNIT IV QUANTUM PHYSICS **9**

Black body radiation – Planck's radiation law – Deduction of Wien's displacement law and Rayleigh Jean's law - Compton effect, Photoelectric effect (qualitative) – matter waves – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – scanning tunneling

microscope.

UNIT V CRYSTAL PHYSICS **9**

Crystalline and amorphous materials – unit cell, crystal systems, Bravais lattices, Crystal planes, directions and Miller indices – Characteristics of crystal structures: SC, BCC, FCC and HCP structures - crystal imperfections: point, line and surface defects – crystal growth : epitaxial and lithography techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Recall the basics of properties of matter, thermal physics and ultrasonics, to improve their engineering knowledge.

CO2: Define the advanced physics concepts of quantum theory and the characteristics of crystalline materials.

CO3: Illustrate Bending of beams, thermal behavior and ultrasonic devices to assess societal and safety issues.

CO4: Summarize the dual aspects of matter, crystal structures and imperfections of crystals.

CO5: Apply the moduli of elasticity of different materials, thermal energy, ultrasonics, scanning tunneling microscope and crystal growth techniques in engineering fields.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam.T., Engineering Physics, Oxford University Press, 2015.
2. Gaur, R.K & Gupta.S.L, Engineering Physics, Dhanpat Rai Publishers, 2016.
3. Pandey.B.K, & Chaturvedi.S, Engineering Physics, Cengage Learning India. 2012.
4. Shatendra Sharma & Jyotsna Sharma, Engineering Physics, Pearson India Pvt Ltd., 2018

REFERENCES:

1. Halliday.D, Resnick, R. & Walker. J, "Principles of Physics", Wiley, 2015.
2. Malik H K & Singh A K, "Engineering Physics", McGraw Hill Education (India Pvt. Ltd.) 2nd edition 2018.
3. Serway.R.A. & Jewett, J.W, "Physics for Scientists and Engineers", Cengage Learning India. 2010.
4. Tiper.P.A. & Mosca.G, Physics for Scientists and Engineers with Modern Physics.

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	2	2	-

CO3	2	1	-	-	-	-	-	-	-	-	-	1	1	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO	2	1	-	-	-	-	-	-	-	-	-	1	2	2	-

CH22101 ENGINEERING CHEMISTRY **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To make the students conversant with water treatment methods and electrochemistry concept
- To gain basic knowledge of corrosion and protection methods
- To understand the basic concepts and synthesis of various engineering materials, nano materials and fuels
- To familiarise the students with the principles, working process and application of energy storage devices

UNIT I WATER TREATMENT **9**

Water: Sources, impurities - Hardness of water: Types - Estimation of hardness (EDTA method) - Disadvantages of hard water in boilers (Scale, Sludge) – Softening methods: Internal treatment (Calgon, Sodium Aluminate) and External treatment (Demineralisation process). Domestic water treatment – Desalination of brackish water: RO and Solar desalination method.

UNIT II ELECTROCHEMISTRY AND CORROSION **12**

Electrochemical cell – Free energy and emf – Nernst equation and applications – Oxidation and reduction potential – Standard electrodes: Standard Hydrogen electrode, Saturated calomel electrode, Glass electrode – pH measurement – Conductometric titration (acid-base, precipitation) and Potentiometric titrations: Redox titration (Fe^{2+} x $Cr_2O_7^{2-}$).

Corrosion – Types: Chemical corrosion and Electrochemical corrosion – Corrosion control methods: Sacrificial anodic and Impressed current Cathodic protection method

UNIT III FUELS AND COMBUSTION **8**

Fuels - classification of fuels – Comparison of solid, liquid and gaseous fuel - Solid fuel - coal - analysis of coal (proximate only) – Liquid fuel - Petroleum – Refining of petroleum - manufacture of synthetic petrol (Bergius process) – Biodiesel – preparation, properties and uses. Gaseous fuel – CNG, LPG.

Combustion – Calorific value – Types (Gross and Net calorific value) – Dulong's formula – GCV and LCV calculation using Dulong's formula. Flue gas – Analysis of flue gas by Orsat method.

UNIT IV ENERGY STORAGE DEVICES **8**

Batteries – Types (Primary and Secondary) - Lead acid battery, Lithium ion battery - Super capacitors – Storage principle, types and examples – Electric vehicle – working principle - Fuel cells – microbial fuel cell and polymer membrane fuel cell.

Nanomaterials in energy storage – CNT –Types, properties and applications.

UNIT V ENGINEERING MATERIALS **8**

Abrasives – Types: Natural and Artificial – SiC – preparation, properties and uses. Refractories – Types Acidic, Basic, Neutral – Refractoriness, RUL. Cement – Manufacture – Special cement – white cement and water proof cement. Glass – Manufacture, properties and uses

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Recall the basic concepts of water softening, nano materials and batteries

CO2: Summarize the types of corrosion, fuels and energy storage devices

CO3: Explain the basic principles of electrochemistry and engineering materials

CO4: Identify suitable methods for water treatment, fuel and corrosion control

CO5: Apply the knowledge of engineering materials, fuels and energy storage devices for material selection and also in energy sectors

TEXT BOOKS:

5. P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015.
6. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
7. Sivasankar B. ''Engineering chemistry'', Tata McGraw Hill Publishing company Ltd, New Delhi, 2008.

REFERENCES:

5. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
6. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi 2015.
7. B.S.Murty, P.Shankar, Baldev Raj, B B Rath and James Murday, '' Text book of nano science and technology'' Universities press.

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	0	1
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	1	0
CO3	3	2	2	1	-	-	1	-	-	-	-	1	-	2	0

CO4	3	2	2	1	-	-	2	-	-	-	-	1	-	1	2
CO5	3	2	2	1	-	-	2	-	-	-	-	1	-	1	0
CO	3	2	2	1	-	-	2	-	-	-	-	1	-	1	1

CS22101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION TO COMPUTERS AND PROBLEM SOLVING STRATEGIES 9

Introduction- Components and functions of a computer system- Hardware and Software. Problem solving strategies- Program design tools: Algorithms, Flow charts, Pseudo code

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS AND CONTROL FLOW 10

Features of Python -Variables and Identifiers – Data types: Numbers, Strings, Boolean, Tuples, List, Dictionary, Sets - Input operation - Comments, Reserved words, Indentation - Operators and Expressions – Type Conversion - Selection / Conditional Branching Statements - Basic Loop Structures / Iterative Statements - Nested Loops – break statement – continue statement – pass statement

UNIT III FUNCTIONS AND STRINGS 9

Functions: Function Definition, function call- variable scope and lifetime – return statements. Strings: Definition, operations (concatenation, appending, multiply, slicing) - immutability, comparison, iterations, string methods

UNIT IV LIST, TUPLES AND DICTIONARIES 9

Lists: Access, updating values- nested, cloning- list operations- list methods- looping in list. Tuples: Tuple operations- nested tuple; Dictionaries- Creating, Accessing, adding, modifying, deleting items

UNIT V FILES, EXCEPTIONS AND PACKAGES 8

Files: Types of files, Opening and closing Files, Reading and writing files, File positions, Renaming and deleting files. Exceptions: Errors and exceptions, Handling exceptions, Packages

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- Describe the algorithmic solutions to simple and complex computational problems
- Apply functions, modules and packages in Python program and use conditionals and loops for solving problems
- Analyze conditional branching statements
- Evaluate python programs
- Develop programs using compound data types and files

TEXT BOOKS

1. Reema Thareja, "Python Programming Using Problem Solving Approach", 13th Edition, Oxford University Press, 2022.

REFERENCES

1. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
2. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
3. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
4. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
5. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
6. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
7. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.
8. https://www.python.org/

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
CO	3	3	3	3	-	-	-	-	-	-	-	1	3	-	-

GE3152	HERITAGE OF TAMIL	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To help students understand the values of Tamil Language, basic language families in India and types of Tamil literature.
- To facilitate the students to understand Tamil heritage of rock arts, paintings and musical instruments in their economic life.
- To facilitate the students in understanding the harmony existing in Tamils martial arts.
- To create an awareness on concept of Thinai Tamils and its values.
- To understand the contribution and Influence of Tamils in Indian culture.

UNIT I LANGUAGE AND LITERATURE 3

Environment – Ecosytem – Structure and function of an ecosystem – Energy flow in an ecosystem – Food chain and food web –. Biodiversity – Types – Values, threats and conservation of biodiversity – Endangered and endemic species – Hot spot of biodiversity – Biodiversity at state level, national level and global level.

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

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

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

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

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

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

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the importance of Tamil Language and types of Tamil literature.

CO2: Illustrate their knowledge in rock art paintings to modern art.

CO3: Demonstrate a strong foundational knowledge in martial arts.

CO4: Explain the concept of Thinai Tamils and its values

CO5: Describe the contribution of Tamils in Indian culture.

TEXT & REFERENCE BOOKS:

1. jkpof tuyhW – kf;fSk; gz;ghLk; Nf. Nf. gps;is (ntspaPL : jkpo;ehL ghlE}y; kw;Wk; fy;tpay; gzpfs; fofk;.
2. Dr.K.K.Pillay, “Social Life of Tamils”, A joint publication of TNTB & ESC and RMRL.
3. Dr.S.Singaravelu, “Social Life of the Tamils - The Classical Period”, International Institute of Tamil Studies.
4. Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, “Historical Heritage of the Tamils”, International Institute of Tamil Studies.
5. Dr.M.Valarmathi, “ The Contributions of the Tamils to Indian Culture”, International Institute of Tamil Studies.
6. Dr.K.K.Pillay, “Studies in the History of India with Special Reference to Tamil Nadu”.

GE3152	தமிழர் மரபு	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- தமிழ் மொழியின் மதிப்புகள், இந்தியாவில் உள்ள அடிப்படை மொழிக்குடும்பங்கள் மற்றும் தமிழ் இலக்கிய வகைகளை மாணவர்கள் புரிந்துகொள்ள உதவுதல்.
- மாணவர்கள் பாறை ஓவியங்கள், சிற்பக்கலைகள் மற்றும் இசைக்கருவிகளின் வழி தமிழ் பாரம்பரியத்தைப் புரிந்துகொள்ள வசதி செய்தல்
- தமிழர்களின் கலை மற்றும் வீர விளையாட்டுகளைப் புரிந்து கொள்வதற்கு மாணவர்களுக்கு உதவுதல்.
- தமிழர்களின் திணைக் கருத்துக்கள் மற்றும் அவர்களின் வாழ்க்கை நெறிகளைப் பற்றி மாணவர்களுக்கு விழிப்புணர்வை ஏற்படுத்துதல்
- இந்திய கலாச்சாரத்தில் தமிழர்களின் பங்களிப்பையும் அதன் தாக்கத்தையும் மாணவர்கள் புரிந்துகொள்ள செய்தல்.

அலகு I மொழி மற்றும் இலக்கியம் 3

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

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை. 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் 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, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுக்கள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள். 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்கு தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

இப்பாடத் திட்டத்தின் மூலம் மாணவர்கள் பெறும் பயன்கள்:

CO1: தமிழ் மொழியின் முக்கியத்துவம் மற்றும் இலக்கிய வகைகளை விவரிக்க முடியும்.

CO2: பாறை ஓவியங்கள் முதல் நவீன கலைகள் வரை அவர்களின் அறிவை விவரிக்க முடியும்.

CO3: தற்காப்புக் கலைகளின் வலுவான அடித்தள அறிவை விவரிக்க முடியும்.

CO4: தமிழர்களின் திணைக் கருத்துக்கள் மற்றும் அதன் மதிப்புகளை விளக்க முடியும்.

CO5: இந்திய கலாச்சாரத்தில் தமிழர்களின் பங்களிப்பை விவரிக்க இயலும்.

TEXT & REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்.
2. Dr.K.K.Pillay, “Social Life of Tamils”, A joint publication of TNTB & ESC and RMRL.
3. Dr.S.Singaravelu, “Social Life of the Tamils - The Classical Period”, International Institute of Tamil Studies.
4. Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, “Historical Heritage of the Tamils”, International Institute of Tamil Studies.
5. Dr.M.Valarmathi, “ The Contributions of the Tamils to Indian Culture”, International Institute of Tamil Studies.
6. Dr.K.K.Pillay, “Studies in the History of India with Special Reference to Tamil Nadu”.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

EN22101	COMMUNICATIVE ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To guide the learners on the basics of language including vocabulary and grammar
- To develop the receptive skills of the learners: Reading and Listening
- To develop the productive skills of the learners: Writing and Speaking
- To make the learners realize the importance of accuracy and fluency
- To help the learners use the language in real situations

UNIT I VOCABULARY AND LANGUAGE STUDY **6**

Vocabulary – Synonyms and Antonyms, Word building – Prefixes and Suffixes – Word formation- Definitions - One word substitutes - Reading for vocabulary and language development- Note making and Summarising - Developing Hints.

UNIT II READING AND LANGUAGE DEVELOPMENT **6**

Parts of speech, Types of sentences – Statement, Interrogative, Imperative, Exclamatory, Wh-questions, **Yes** or **No** questions and tag questions, Formal Letters – Academic, Official, and Business Letters

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT **6**

Tense and Voice, Auxiliary verbs (be, do, have), Modal verbs - *Types of Reading* : Intensive Reading and Extensive Reading- *Strategies*: Predicting- Skimming and Scanning -Reading for facts - Understanding the parts of paragraph- Learning the transitional signals used in the passage to classify the text

UNIT IV FUNDAMENTALS OF WRITING **6**

Punctuation and Capitalization- **Sentence formation**: Word order-Completion of sentences-Conjunctions-Transitional signals- sentence and sentence structures- Informal Letters.

UNIT V EXTENDED WRITING **6**

Degrees of Comparison – Reported speech -**Paragraph writing**-Topic sentence, supporting sentences and concluding sentence-Informal and Formal expressions

TOTAL : 30 PERIODS

PRACTICAL EXERCISES

Listening (Receptive skill**)** *Intensive Listening: Effective and Attentive Listening*

Exercises

1) Listening for gist from recorded speeches
2) Listening for specific information from recorded conversations
3) Listening for strengthening vocabulary skills.
4) Listening to variety of situations and voices- Listening for language development

5) Listening for pronunciation: syllables, stress and intonation.

Speaking (Productive Skill)

Exercises

1) Introducing oneself and others
2) Asking for / giving personal information
3) Practicing dialogues in pairs
4) Giving directions-Informal and formal dialogues
5) Speaking in connected speech
6) Responding to questions
7) Short presentations
8) Speaking in small and big groups
9) Learning and practicing the essential qualities of a good speaker

TOTAL: 30 PERIODS
TOTAL(T+P): 60 PERIODS

COURSE OUTCOMES:

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

CO1: Apply and practice the correct usages of language
CO2: Receive the language effectively and meaningfully through receptive skills
CO3: Produce the language appropriate to the needs and situations exercising productive skills
CO4: Transfer or interpret any piece of information with accuracy and fluency
CO5: Apply the language intellectually and confidently

TEXT BOOKS:

1. Shobha. K.N, Rayen, Joavani, Lourdes, "Communicative English", Cambridge University Press, 2018.
2. Sudharshana.N.P and Saveetha. C, "English for Technical Communication", Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Kumar, Suresh. E., "Engineering English", Orient Blackswan, Hyderabad, 2015.
2. Means, L. Thomas and Elaine Langlois, "English & Communication for Colleges", Cengage Learning, USA: 2007.
3. Greendaum, Sydney and Quirk, Randolph, "A Student's Grammar of the English Language", Pearson Education.
4. Wood F.T, "Remedial English Grammar", Macmillan, 2007.

Course outcomes	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	-	-	-	-	-	-	-	1	1	-	2	1	-	-

CO2	-	-	-	-	-	-	-	-	2	3	-	2	1	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	2	1	-	-
CO4	-	-	-	-	-	-	-	-	2	2	-	2	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	1	-	-
CO	-	-	-	-	-	-	-	-	2	2	-	2	1	-	-

BS22101 PHYSICS – CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

PHYSICS LABORATORY

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Non-uniform bending – Determination of Young's modulus.
2. SHM of Cantilever – Determination of Young's modulus.
3. Poiseuille's flow – Coefficient of viscosity of liquid
4. Torsional pendulum - Determination of Rigidity modulus.
5. Newton's ring – Radius of curvature of convex lens.
6. Lee's Disc – Determination of coefficient of thermal conductivity of bad conductor.

TOTAL: 30 PERIODS

CHEMISTRY LABORATORY

OBJECTIVES

- To inculcate experimental skills to test basic understanding of water quality parameters such as, acidity, alkalinity and hardness.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1. Determination of total hardness of water by EDTA method.
2. Conductometric titration of strong acid and strong base.

3. Determination of strength of given hydrochloric acid using pH meter.
4. Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
5. Determination of alkalinity in water sample.
6. Estimation of iron content of the given solution using potentiometer.

TOTAL: 30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Determine different moduli of elasticity used in day to day engineering applications.

CO2: Estimate the optical parameters of visible and laser sources along with their applications in various fields.

CO3: Interpret the band gap of semiconductor materials and also compressibility and viscosity of liquids.

CO4: Determine the water quality parameters of the given water sample.

CO5: Analyze quantitatively the metals (Fe, Ni,) in the any sample volumetrically as well as by using spectroanalytical methods.

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	2	1	-	1	-	-	-
CO2	3	1	-	-	-	-	-	-	2	1	-	1	-	-	-
CO3	3	1	-	-	-	-	-	-	2	1	-	1	-	-	-
CO4	3	1	-	-	-	2	2	-	1	-	-	-	-	-	-
CO5	3	1	-	-	-	2	2	-	1	-	-	-	-	-	-
CO	3	1	-	-	-	2	2	-	2	1	-	1	-	-	-

CS22102 PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

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

- To do input/output with files in Python

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing algorithms and flow charts for the same
2. Python programming using simple statements and expressions
3. Scientific problems using Conditionals and Iterative loops
4. Implementing real-time/technical applications using Lists, Tuples
5. Implementing real-time/technical applications using Sets, Dictionaries
6. Implementing programs using Functions
7. Implementing programs using Strings
8. Implementing real-time/technical applications using File handling
9. Implementing real-time/technical applications using Exception handling
10. Exploring Pygame tool
11. Developing a game activity using Pygame like bouncing ball

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs
CO3: Implement programs in Python using conditionals, loops and functions for solving problems
CO4: Process compound data using Python data structures
CO5**:** Utilize Python packages in developing software applications

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

HS22101	HIGHER ORDER THINKING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- Teaching the students the sources and dynamics of thinking.
- Teaching the students the basics of systematic and scientific thinking.
- Initiating the students into critical thinking and to use critical thinking in practical life
- Initiating students into creative thinking

UNIT I INTRODUCTION TO COGNITION, KNOWLEDGE AND THINKING **3**

Cognition - Different Cognitive functions - Cognition and intelligence - Cognitive development: till adolescence and post adolescence - possibility of true knowledge - The sources of Knowledge. Sensation, perception. Reality of perception - Concept formation, abstraction. Memory and retrieving - Introduction to thinking and types of thinking. Systematic thinking

UNIT II LOGIC AND REASONING **3**

Commonsense and scientific knowledge. Pursuit of truth.- Syllogistic Logic. Greek and Indian. - Exercises

UNIT III CRITICAL THINKING SKILLS AND DISPOSITIONS **3**

Critical Thinking Skills & Dispositions. Critical Thinking Exercises

UNIT IV ANALYSIS OF ARGUMENTS **3**

Propositions and fallacies. - Analyzing arguments. - Exercises.

UNIT V CREATIVE THINKING AND INNOVATIVE THINKING **3**

Evolution of Scientific Thinking and Paradigm Shift. - Dynamics of Thoughts: Hegel. - Convergent thinking and divergent thinking (out of the box thinking). - Problem solving and Planning.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate the sources of knowledge and the process of thinking
CO2: Demonstrate critical thinking skills and dispositions of critical thinking
CO3: Confidently engage in creative thinking and problem solving

REFERENCES:

1 Introduction to Logic, Irving M. Copi, Carl Cohen and Kenneth McMahon, Fourteenth Edition, Pearson Education Limited, 2014.
2 Teaching Thinking Skills: Theory and Practice, Joan Boykoff Baron and Robert J. Sternberg, W.H. freeman and Company, New York.
3 Cognitive Psychology, Robert J. Sternberg, Third Edition, Thomson Wadsworth, UK

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-

CO3	3	2	2	1	-	-	1	-	1	-	1	1	-	-	-
CO	3	2	2	1	-	-	2	-	2	-	1	1	-	-	-

HS22102 **UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT**

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To create an awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.

UNIT I INTRODUCTION TO VALUE EDUCATION **6**

Value Education - Definition, Concept and Need for Value Education, Basic Guidelines - The Content and Process of Value Education - Basic Guidelines for Value Education - Self exploration as a means of Value Education - Happiness and Prosperity as parts of Value Education.

UNIT II HARMONY IN THE HUMAN BEING **6**

Human Being is more than just the Body- Harmony of the Self ('I') with the Body - Understanding Myself as Co-existence of the Self and the Body - Understanding Needs of the Self and the needs of the Body - Understanding the activities in the Self and the activities in the Body.

UNIT III HARMONY IN THE FAMILY, SOCIETY AND HARMONY IN THE NATURE **6**

Family as a basic unit of Human Interaction and Values in Relationships - The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love - Comprehensive Human Goal: The Five Dimensions of Human Endeavour - Harmony in Nature: The Four Orders in Nature - The Holistic Perception of Harmony in Existence.

UNIT IV SOCIAL ETHICS **6**

The Basics for Ethical Human Conduct - Defects in Ethical Human Conduct - Holistic Alternative and Universal Order - Universal Human Order and Ethical Conduct - Human Rights violation and Social Disparities.

UNIT V PROFESSIONAL ETHICS **6**

Universal Human Values - Value based Life and Profession - Professional Ethics and Right Understanding - Competence in Professional Ethics - Issues in Professional Ethics – The Current Scenario - Vision for Holistic Technologies - Production System and Management Models.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the significance of value inputs in a classroom and start applying them in their life and profession.

CO2: Explain the role of a human being in ensuring harmony in society and nature.

CO3: Demonstrate the value of harmonious relationship based on trust and respect in their life and profession.

CO4: Compare values, skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.

CO5: Classify ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

TEXT BOOKS:

1 R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010.

2 A.N. Tripathy, "Human Values", New Age International Publishers, New Delhi, 2004.

REFERENCES:

1. Gaur. R.R., Sangal. R, Bagaria. G.P, "A Foundation Course in Value Education", Excel Books, 2009.
2. Gaur. R.R., Sangal. R, Bagaria. G.P, "Teachers Manual" Excel Books, 2009.
3. Gaur R R, R Sangal, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2009.
4. William Lilly, "Introduction to Ethic" Allied Publisher.

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-
CO2	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-
CO3	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-
CO4	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-
CO5	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-
CO	1	-	-	-	-	2	2	3	1	1	-	1	-	-	-

SEMESTER II

MA22201	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

UNIT I TESTING OF HYPOTHESIS **12**

Statistical hypothesis -Type I and Type II errors - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t distribution for single mean and equality of means - Test based on F distribution for equality of variances - Chi square test for single variance and goodness of fit - Independence of attributes - Contingency table : Analysis of r × c tables.

UNIT II DESIGN OF EXPERIMENTS **12**

General principles – Analysis of variance (ANOVA) - One way classification - Completely randomized design (CRD) – Two way classification - Randomized block design (RBD) – Three way classification -Latin square design(LSD) – Two factor experiments: 2^2 factorial design

UNIT III NUMERICAL SOLUTION OF EQUATIONS **12**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel .

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION **12**

Newton's forward and backward interpolation – Interpolation with unequal intervals - Lagrange's interpolation- Divided differences - Newton's divided difference - Approximation of derivates using interpolation polynomials – Numerical integration using Trapezoidal and

Simpson's 1/3, 3/8 rules- Numerical double integration: Trapezoidal and Simpson's rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Define the basic concepts of statistical tests, ANOVA, iterative methods, interpolations and ODE.

CO2: Discuss the techniques of statistical tests and design of experiments.

CO3: Explain the solution of equations, ODE, single and multistep methods, interpolations, differentiation and integration.

CO4: Apply the concept of testing of hypothesis and design of experiment in real life.

CO5: Apply numerical techniques in system of equations, differential equations, interpolation, differentiation and integration.

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics, 4th Edition, Tata McGraw Hill Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2012.

Course outcom	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3

es															
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	2	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	2	-

ES22202	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic circuit components.
- To educate on the working principles and applications of electrical machines.
- To explain the construction and working of semiconductor devices
- To educate on logic gates, flip flops and registers
- To introduce the functional elements and working of measuring instruments.

UNIT I INTRODUCTION TO ELECTRICAL ENGINEERNG **9**

Introduction-Conductors, semiconductors and Insulators-Electrostatics – Electric Current-Electromotive Force-Electric Power- Ohm's Law-Basic circuit components-Electromagnetism related laws-Kirchhoff's Laws.

UNIT II ELECTRICAL MACHINES **9**

Construction, working principle and types of DC Generator – Motor- single phase Transformer - single phase and three phase Induction motor -Applications

UNIT III ANALOG ELECTRONICS **9**

Classification of Semiconductors– Construction , Characteristics and working -PN Junction Diode- Zener Diode - Bipolar Junction Transistor-IGBT- SCR- MOSFET.

UNIT IV DIGITAL ELECTRONICS **9**

Review of number systems, binary codes- Boolean Algebra-Logic gates-Implementation of Boolean expression using K-map –Types of flip flops, Registers.

UNIT V MEASUREMENTS AND INSTRUMENTATION **9**

Functional elements of an instrument –Static and dynamic characteristics of instruments, Errors, Principles of electrical indicating instruments- Types of indicating instruments -Moving Coil and Moving Iron instruments- DSO -Transducers-Resistive Transducers

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the basic laws to determine circuit parameters

CO2: Explain the construction, working and application of electrical machines.

CO3: Explain the construction and working of semiconductor devices.

CO4: Interpret the function of combinational and sequential circuits.

CO5: Interpret the operating principles of measuring instruments.

TEXT BOOKS:

1. M .S.Sukhja ,T.K.Nagsarkar "Basic Electrical and Electronics Engineering" Oxford Higher Education First Edition ,2018.
2. S. Salivahanan, R.Rengaraj "Basic Electrical and Instrumentation Engineering" McGraw Hill Education ,First Edition,2019.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Elecronics Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.
3. V. K. Mehta, Rohit Mehta "Basic Electrical Engineering", S.Chand & Company Pvt. Ltd, New Delhi, 2012.

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	1	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	1	1	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	1	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	1	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	1	-	-
CO	3	2	2	2	-	-	-	-	-	-	-	1	1	-	-

ME22201 **ENGINEERING GRAPHICS**

L	T	P	C
2	0	2	3

Course Objectives

1 To draw the engineering curves.

2 To draw orthographic projection of points and lines

3 To draw orthographic projection of solids and section of solids.

4 To draw the development of surfaces

5 To draw the isometric projections of simple solids and freehand sketch of simple objects.

CONCEPTS AND CONVENTIONS

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

UNIT – I PLANE CURVES 12

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

UNIT – II PROJECTION OF POINTS, LINES AND PLANES 12

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

Projection of planes (polygonal and circular surfaces) inclined to any one principal plane.

UNIT – III PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to any one of the principal planes by rotating object method.

UNIT – IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

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

UNIT – V ISOMETRIC PROJECTIONS AND FREEHAND SKETCHING 12

Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids & cylinders, in simple vertical positions.

Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three dimensional modeling of projection of simple objects by CAD Software (Demonstration purpose only).

Total 60

OUTCOMES: At the end of the course the students would be able to

CO1 Recall the existing national standards and interpret a given three dimensional drawing .

CO2 Interpret graphics as the basic communication and methodology of the design process

CO3 Acquire visualization skills through the concept of projection

CO4	Develop the sectioned solids and discover its true shape
CO5	Develop imagination of physical objects to be represented on paper for engineering communication.

Textbooks:

1. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
2. Jeyapoovan T., “Engineering Graphics using AutoCAD”, Vikas Publishing House, 7th Edition, 2015.

References:

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.
2. Julyes Jai Singh S., “Engineering Graphics”, SRM tri sea publishers, Nagercoil,7th Edition,2015.
3. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
4. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
5. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.

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

ME22202 **ENGINEERING MECHANICS**

L	T	P	C
2	1	0	3

Course Objectives

1. To Learn the use scalar and vector analytical techniques for analyzing forces in statically
2. To determine the structures of the beams and columns.

3	To introduce the equilibrium of rigid bodies
4	To study and understand the distributed forces, surface, loading on beam and intensity.
5	To understand the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.

UNIT – I STATICS OF PARTICLES **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles , - Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in a Plane, Lami's theorem, Parallelogram law of forces, triangular law, Rectangular Components of a Force, Resultant of Forces, Resolution of a coplanar Forces.

UNIT – II EQUILIBRIUM OF RIGID BODIES **9**

Principle of Transmissibility, Equivalent Forces, Equilibrium of a Particles in two dimension, Forces in Space, Varignon's theorem, Equilibrium of a Particle in Space. Types of beams, Distributed Loads on Beams, type of supports and reaction.

UNIT – III DISTRIBUTED FORCES **9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Theorems of Pappus-Guldinus, Centre of Gravity of a Three Dimensional Body, Centroid of a Volume, Composite Bodies, Moments of Inertia of Areas and Mass, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem.

UNIT –IV FRICTION **9**

Frictional force, static, dynamic & limiting friction, normal reaction, angle of repose, coefficient of friction, laws of static friction, laws of dynamic friction, equilibrium of a body on a rough inclined plane-, Rolling Resistance, Ladder friction.

UNIT – V DYNAMICS OF PARTICLES **9**

Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium- D'Alembert principle—Work- energy method, Principle of Impulse and Momentum, Collision of elastic bodies, coefficient of restitution -Newton's law of collision of elastic bodies, direct impact of elastic bodies.

Total 45

OUTCOMES: At the end of the course the students would be able to

1	Illustrate the vectorial and scalar representation of forces and moments.
2	Analyse the rigid body in equilibrium.
3	Evaluate the properties of distributed forces.

4 Determine the friction and the effects by the laws of friction.

5 Calculate dynamic forces exerted in rigid body.

Textbooks:

1 K.V. Natarajan, "Engineering mechanics", Dhanalakshmi publications, 33th edition, 2019.

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

References:

1 Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11thEdition, 2017.

2 Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.

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

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

5 Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.

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

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

GE3252	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To facilitate the students to understand weaving and ceramic technology of sangam Age.k2
- To create an awareness on structural design of Tamils during sangam age.
- To help students to distinguish between all the levels of manufacturing technology in ancient period.
- To understand the ancient Knowledge of agriculture and irrigation technology.
- To enable the students to understand the digitalization of Tamil language.

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the importance of weaving and ceramic technology of sangam Age.

CO2: Illustrate the knowledge on structural design of Tamils during sangam age.

CO3: Demonstrate a strong foundational knowledge in manufacturing technology of ancient Tamils.

CO4: Desck8ribe the importance of ancient agriculture and irrigation technology of Tamils.

CO5: Explain the concept of digitalization of Tamil language.

TEXT & REFERENCE BOOKS:

1. கணிணித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
2. கீழடி – வைகை நதிக்கரயில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு) / Keeladi - 'Sangam City Civilization on the banks of river Vaigai', Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
3. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு) / "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
4. Dr.K.K.Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
5. Dr.S.Singaravelu, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies.
6. R.Balakrishnan, "Journey of Civilization Indus to Vaigai", RMRL.

GE3252	தமிழரும் தொழில் நுட்பமும்	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- சங்க காலத்தின் நெசவு மற்றும் பீங்கான் தொழில் நுட்பத்தை மாணவர்கள் புரிந்துகொள்ள வசதி செய்தல்.
- சங்க காலத் தமிழர்களின் வடிவமைப்பு தொழில்நுட்பம் பற்றிய விழிப்புணர்வை ஏற்படுத்துதல்.
- பண்டைய கால உற்பத்தி தொழில்நுட்பத்தின் அனைத்து நிலைகளையும் வேறுபடுத்தி அறிய மாணவர்களுக்கு உதவுதல்.
- விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் பண்டைய அறிவைப் புரிந்துக் கொள்ள செய்தல்.
- தமிழ் மொழியின் டிஜிட்டல் மயமாக்கல் பற்றிப் புரிந்துக் கொள்ள செய்தல்.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் **3**

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

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம **3**

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

அலகு III உற்பத்தித் தொழில் நுட்பம் **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல்,

எ.ஃ.கு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள்- கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் - எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம **3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்கான வடிவமைக்கபட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் **3**

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

TOTAL: 15 PERIODS

COURSE OUTCOMES:

இப்பாடத் திட்டத்தின் மூலம் மாணவர்கள் பெறும் பயன்கள்:

CO1: சங்க காலத்தின் நெசவு மற்றும் பீங்கான் தொழில் நுட்பத்தின் முக்கியத்துவத்தை விவரிக்க முடியும்.

CO2: சங்க காலத் தமிழர்களின் வடிவமைப்பு தொழில்நுட்பம் பற்றிய அறிவை விளக்க முடியும்.

CO3: பண்டைய தமிழர்களின் உற்பத்தி தொழில்நுட்பம் பற்றிய வலுவான அடித்தள அறிவை வெளிப்படுத்த முடியும்.

CO4: தமிழர்களின் விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் பண்டைய அறிவை விவரிக்க முடியும்.

CO5: தமிழ் மொழியின் டிஜிட்டல் மயமாக்கல் பற்றிய கருத்தை விளக்க முடியும்.

TEXT & REFERENCE BOOKS:

1. கணிணித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
2. கீழடி – வைகை நதிக்கரயில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு) / Keeladi - 'Sangam City Civilization on the banks of river Vaigai', Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
3. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு) / "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
4. Dr.K.K.Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
5. Dr.S.Singaravelu, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies.
6. R.Balakrishnan, "Journey of Civilization Indus to Vaigai", RMRL.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

CO2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

EN22201	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To widen strategies and skills to augment ability to read and comprehend engineering and technology texts.
- To develop writing skill to make technical presentations.
- To draft convincing job applications and effective reports..
- To strengthen listening skills to comprehend technical lectures and talks in their areas of specialization.
- To cultivate speaking skills both technical and general.

UNIT I LANGUAGE STUDY **12**

Technical Vocabulary- synonyms, antonyms, prefix and suffix, word formation, Homonyms and Homophones - puzzles,- Reading: skimming a reading passage – scanning for specific information- Instruction- Interpreting – Writing: Recommendation- Checklist.

UNIT II READING AND STUDY SKILLS **6**

Active and Passive voice- Extended Definitions- Imperatives- Numerical Adjectives- Purpose Statement – Reading: Critical reading- Newspaper articles- journal reports- editorials and opinion blogs - Report Writing: Fire Accident, Industrial visit, Project report, feasibility report, survey report, business report.

UNIT III WRITING SKILLS- INTRODUCTION TO PROFESSIONAL WRITING **6**

Error Spotting/Common Errors- Concord-Compound words- Abbreviations and Acronyms- Discourse Markers - Finding key information – shifting facts from opinion- interpreting visual material- making inference from the reading passage - Interpretation of charts- - Minutes of the meeting- Paraphrasing- Proposal writing.

UNIT IV TECHNICAL WRITING AND GRAMMAR **6**

If Conditional Clauses- Prepositional Phrases- Fixed and semi fixed expressions- -e-mail communication- reading the attachment files having a poem /joke / proverb/sending their responses through e-mail.- Job application letter and Resume/CV/ Bio-data.

UNIT V EXTENDED WRITING AND LANGUAGE STUDY **6**

Articles- Cause and Effect expressions- Collocations- Sequencing words- Reading longer technical texts and taking down notes- Structure of Essay- Types of Essay: Narrative essay- Descriptive Essay- Analytical Essay- Cause and Effect Essay – Compare and contrast essays.

TOTAL – 30 PERIODS

PRACTICAL EXERCISES

Listening Skills – Listening for professional Development

Listening to UPSC Toppers Mock Interviews- Listening to debates/discussions/different viewpoints /scientific lectures/event narrations/documentaries/telephonic conversations

Speaking Skills –emphasizing communicative establishment

Seeking Information -asking and giving directions- narrating personal experiences/ events- answering interview questions- picture description- presenting a product and giving instruction to use a product – mini presentations-role plays- speaking in formal and informal situations- speaking about one's locations - speaking about great personalities –describing a simple process- telephone skills and etiquette

TOTAL: 30 PERIODS

TOTAL (T+P) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Infer advanced technical texts from varied technical genres to expand engineering knowledge and explore more ideas.

CO2: Analyze technical contents written on par with international standards and rewrite contents using the right vocabulary without grammatical errors to make their articles published in reputed journals.

CO3: Present reports and job letters utilizing the required format prescribed on par with international standards using the exact vocabulary to make their works worthy to be read .

CO4: Employ the language tones and styles appropriately in interviews and Group Discussions effortlessly following the strategies expected by the corporate world

CO5: Appraise the need for new products and write feasibility and survey reports following the format prescribed in a way to create awareness.

TEXT BOOKS:

1. Mike Markrl, " Technical Communication", Palgrave Macmillan, London, 2012.
2. Sumant,S and Joyce Pereira, "Technical English II", Chennai: Vijay Nicole Imprints Private Limited, 2014.
3. Kumar, Sanjay and Pushp Lata, "Communication Skills: A Workbook", New Delhi: OUP, 2018.

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma, "Communication Skills", New Delhi: OUP, 2018.
2. Rizvi M, Ashraf, " Effective Technical Communication", New Delhi: Tata McGraw-Hill Publishing Company Limited, 2007.

Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

PH22204 **MATERIAL SCIENCE** **L T P C**

2 0 2 3

COURSE OBJECTIVES:

- To understand the concepts of light, electron transport properties and the essential principles of semiconductors.
- To become proficient in magnetic properties of materials
- To know the basics of the functioning of advanced engineering materials
- To induce the students to design new structures that serve humanity by applying the knowledge gained during the course.

UNIT I PHOTONICS **6**

Interference – Air wedge – LASER – population inversion - Einstein coefficient's –NdYAG Laser - CO_2 laser – semiconductor laser – Optical fibre – Total internal reflection – propagation of light – Numerical Aperture and Acceptance angle – Fiber optic communication system – Endoscopy.

UNIT II ELECTRICAL PROPERTIES OF MATERIALS **6**

Classical free electron theory - Expression for electrical conductivity and Thermal conductivity, Wiedemann-Franz law – Success and failures - Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Band theory of solids - Electron effective mass – concept of hole.

UNIT III SEMICONDUCTING MATERIALS **6**

Semiconductors –direct and indirect band gap semiconductors – Intrinsic semiconductors Carrier concentration, band gap in intrinsic semiconductors – extrinsic semiconductors - N-type & P-type semiconductors – Variation of carrier concentration and Fermi level with temperature - Hall effect - measurement of Hall coefficient - applications

UNIT IV MAGNETIC PROPERTIES OF MATERIALS 6

Magnetic dipole moment – atomic magnetic moment, permeability, susceptibility- Magnetic material classification: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism – Domain Theory- B-H curve – Hard and soft magnetic materials – Magnetic storage devices: Magnetic hard disc with GMR sensor.

UNIT V ADVANCED ENGINEERING MATERIALS 6

Composites - definition and classification - Fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) - Metallic glasses - Shape memory alloys - Ceramics - Classification - Properties – Nanomaterials – mechanical properties – industrial applications.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Recall the basic concepts of light, electron transport properties of conductors and basic principles of semiconductors

CO2: Define the magnetic parameters and the principles of advanced engineering materials

CO3: Illustrate laser and fibre optics, classical and quantum concepts of conducting materials, physics of semiconducting materials.

CO4: Summarize the theories of magnetic materials and functioning of magnetic devices

CO5: Develop the applications of fibre optics, moduli of elasticity and thermal energy, behavior of conductors, semiconductors, magnetic and advanced engineering materials in various engineering fields.

TEXT BOOKS:

1. Gaur, R.K & Gupta.S.L, Engineering Physics, Dhanpat Rai Publishers, 2016.
2. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley 2012.
3. Kasap,S.O. Principles of Electronic Materials and Devices, McGraw-Hill Education, 2017.
4. Kittel, C. Introduction to Solid State Physics. Wiley, 2017.

REFERENCES:

1. Raghavan, V. ―Materials Science and Engineering – A first course. PHI Learning, 2015.
2. Balasubramaniam, R. ―Callister's Materials Science and Engineering‖. Wiley India Pvt. Ltd., 2014.

3. Rogers, B., Adams, J. & Pennathur, S. Nanotechnology: Understanding Small Systems, CRC Press, 2014.

LIST OF EXPERIMENTS

1. Uniform bending – Determination of Young's modulus
2. Air-wedge – Thickness of thin wire
3. Spectrometer – Grating
4. LASER – Wavelength and particle size determination
5. Optical fibre – Acceptance angle and Numerical aperture
6. Band gap determination

TOTAL:30 PERIODS

TOTAL (T+P) = 60 PERIODS

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	2	-
CO5	3	3	-	-	-	-	-	-	2	1	-	1	-	1	-
CO	2	1	-	-	-	-	-	-	2	1	-	1	-	2	-

CH22201 ENVIRONMENT AND SUSTAINABILITY

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To understand the concept of ecosystem and biodiversity.
- To conversant with various types of pollution and its effects.
- To obtain knowledge on natural resources and its exploitation.
- To understand the social issues related to environment and methods to protect.

- To gain knowledge on sustainability and environment.

UNIT I ECOSYSTEM AND BIODIVERSITY **6**

Environment – Ecosytem – Structure and function of an ecosystem – Energy flow in an ecosystem – Food chain and food web –.Biodiversity – Types – Values, threats and conservation of biodiversity – Endangered and endemic species – Hot spot of biodiversity – Biodiversity at state level, national level and global level.

UNIT II NATURAL RESOURCES **6**

Introduction – Forest resources – Uses and Overexploitation - Deforestation – causes and consequences – Water resources – effect of over utilisation of water – Food resources – Impacts of modern agriculture (pesticides, fertilizers, water logging, salinity) – Sustainable Energy resources – Wind, Solar, hydroelectric power, geothermal – Land resources – Desertification, soil erosion – Role of an individual in the conservation of natural resources.

Case study – Deforestation, water conflicts, fertilizer and pesticide problem.

UNIT III ENVIRONMENTAL POLLUTION AND MANAGEMENT **7**

Definition, causes, effects and control measures of air pollution, water pollution, noise pollution, thermal pollution and marine pollution – Waste water treatment - Waste management – solid waste, bio waste, e-waste - Disaster management – Flood, cyclone, earthquake

UNIT IV SOCIAL ISSUES AND HUMAN HEALTH **6**

Population explosion and its effects on environment — variation of population among nations - Environmental issues and Human health – Food adulteration – Risk of food adulteration – Detection and prevention of food adulteration - COVID-19 – Human rights – Value education

UNIT V SUSTAINABLE DEVELOPMENT AND ENVIRONMENT **5**

Sustainable development – needs and challenges — Goals – Aspects of sustainable development – Assessment of sustainability - Environmental ethics – Green chemistry – Eco mark, Eco products – EIA – Regional and local environmental issues and possible solutions - Role of engineering in environment and human health

TOTAL: 30PERIODS

COURSE OUTCOMES:

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

CO1: Recall the basic concepts of environment and sustainable development.

CO2: Summarize the types of pollution, various natural resources and food adulterants.

CO3: Explain the methods for waste management and detection of adulterants.

CO4: Apply the gained knowledge to overcome various issues related to health and environment.

CO5: Identify suitable methods for local environmental issues and sustainability.

TEXT BOOKS:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, New Delhi, 2017.
2. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2ndEdition, Pearson Education, 2015.

REFERENCES:

1. Erach Bharucha, "Text book of Environmental studies" Universities Press (I) PVT LTD, Hyderabad, 2015.
2. Rajagopalan. R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2015.
3. G. Tyler Miller and Scott E. Spoolman, ―"Environmental Science", Cengage Learning India PVT LTD, 2014.

EXPERIMENTS

1. Determination of DO content of waste water sample (Winkler's method).
2. Determination of chloride content of water sample by Argentometric method
3. Estimation of copper content in water by Iodometry.
4. Determination of Ca / Mg in waste water sample
5. Detection of adulterant in ghee/edible oil/coconut oil.
6. Detection of adulterant in sugar/honey/chilli powder.

TOTAL:30 PERIODS

TOTAL (T+P) = 60 PERIODS

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

ME22203	COMPUTER AIDED DESIGN AND DRAFTING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives

1 To learn the standard drawing practices using fits and tolerances.

2 To prepare assembly drawings both manually and using standard CAD packages.

3 To Preparing standard drawing layout for modeled parts.

4 To Preparing standard drawing layout for assemblies with BoM.

5 To acquaint the skills and practical experience in handling 2D drafting and 3D modelling software systems.

PART – I DRAWING STANDARDS & FITS AND TOLERANCES 12

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions - Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerancing, Introduction to SP46-2003.

PART - II 2D DRAFTING 48

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.

1. Bearings – Bush Bearing,
2. Valves – Safety and Non-return Valves.
3. Couplings – Flange couplings.
4. Joints – Universal, Knuckle, Gib & Cotter, Sleeve & Cotter joints.
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box,
6. Machine Components – Screw Jack, Machine Vice, Plummer Block.
7. Prepare the relevant views of the parts of a given assembly drawing needed for the purpose of production.

Total 60

OUTCOMES: At the end of the course the students would be able to

1 Apply standard drawing practices using fits and tolerances.

2 Sketch orthogonal views of machine components.

3 Sketch orthogonal views of assembled components.

4 Prepare standard drawing layout for assembled parts.

5 Prepare bill of materials for assembled drawing.

Textbooks:

1 P.S. Gill, "A Textbook of Machine Drawing", S.K. Kataria & Sons, 2013.

2 N. D. Bhatt and V.M. Panchal, "Machine Drawing", 45th Edition, Charator Publishers,2016

References:

1 Goutam Pohit and Goutam Ghosh, "Machine Drawing with AutoCAD", 1st Edition,Pearson Education, 2014

2 Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2012

3 N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata McGrawHill,2014

4 S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2013.

5 K.L. Narayana, "Production Drawing". New Age International Pvt Ltd; Third edition, 2014.

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

ES22203 ENGINEERING PRACTICES LABORATORY

L	T	P	C
0	0	4	2

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

1 Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in commonhousehold wood work.

2 Wiring various electrical joints in common household electrical wire work.

3 Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal

work.

4 Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

PART I CIVIL ENGINEERING PRACTICES 15

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

WOOD WORK:
- ❖ Sawing,
- ❖ Planning and
- ❖ Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

PART II MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:
- ❖ Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- ❖ Practicing gas welding.

BASIC MACHINING WORK:
- ❖ Perform turning operation in the given work piece.
- ❖ Perform drilling operation in the given work piece.
- ❖ Performing tapping operation in the given work piece.

ASSEMBLY WORK
- ❖ Assembling a centrifugal pump.
- ❖ Assembling a household mixer.

SHEET METAL WORK:
- ❖ Making of a square tray

GROUP – B (ELECTRICAL AND ELECTRONICS)

PART-I ELECTRICAL ENGINEERING PRACTICES 15

- ❖ One lamp controlled by one switch.
- ❖ Series and parallel wiring.
- ❖ Staircase wiring.
- ❖ Fluorescent Lamp wiring.
- ❖ Residential wiring.
- ❖ Iron Box wiring and assembly.

PART-II ELECTRONIC ENGINEERING PRACTICES 15

- Introduction to electronic components and equipment's
- Calculation of resistance using colour coding
- Verify the logic gates AND, OR, EX-OR and NOT.
- Measurement of AC signal parameters using CRO
- Soldering simple electronic circuits on a small PCB and checking continuity.

Total 60

COURSE OUTCOMES: At the end of the course the students would be able to

CO1 Prepare various pipe and furniture fittings used in common household.

CO2 Perform the given metal joining and metal removal operation in the given work piece as per the dimensions.

CO3 Apply the fundamental concepts involved in Electrical Engineering

CO4 Explain the basic electrical wiring procedures.

CO5 Assemble basic electronic components.

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

MA22304	Transforms and Partial Differential Equations	L	T	P	C
	Common to CIVIL and MECHANICAL	3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To familiarize the basic concepts of Laplace transform and inverse Laplace transform techniques used in wide variety of situations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **12**

Degree and order of partial differential equations -First order linear partial differential equations - Lagrange's linear equation: Method of grouping and method of multipliers - Homogeneous linear partial differential equations of second and higher order with constant coefficients with functions $e^{ax+by}, \sin(ax+by), \cos(ax+by)$.

UNIT II FOURIER SERIES **12**

Conditions for a Fourier expansion: Dirichlet's conditions –Fourier series - Euler's Formulae– General Fourier series for functions of polynomials in the interval $(0,2\pi)$ and $(0,2l)$ - Functions having points of continuity and discontinuity - Half range series: Half range sine and cosine series (polynomials only) – Root mean square value.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of PDE of second order – One-dimensional wave equation: Fourier series solutions of one-dimensional wave equation with zero initial velocity– Fourier series solutions of one-dimensional wave equation with zero initial displacement - One dimensional equation of heat conduction – Steady state conditions with zero boundary conditions.

UNIT IV LAPLACE TRANSFORM **12**

Definition of the Laplace Transform -Existence conditions – Transforms of elementary functions $t^n, e^{at}, e^{-at}, sinat, cosat, sinhat, coshat$ – Transform of unit step function and unit impulse function – Basic properties : Linear, Change of scale, First Shifting theorem (Statement only) –Problems based on properties- Differentiation of Transform:$L[t\,f(t)]$- Integration of Transform: $L\left[\frac{f(t)}{t}\right]$– Initial and final value theorems(Statement only)– Problems based on Initial and final value theorems - Laplace Transform of periodic functions.

UNIT V INVERSE LAPLACE TRANSFORM **12**

Inverse Laplace Transform– Inverse Laplace Transform of elementary functions – Basic properties: Linear, First Shifting theorem, Change of scale (Statement only) - Problems based on properties - Convolution theorem(Statement only) – Inverse Laplace Transform using Convolution theorem.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Solve the standard partial differential equations.

CO2: Find the Fourier series for periodic functions.

CO3: Apply Fourier series in one dimensional heat and wave equations.

CO4: Determine the Laplace transforms for functions.

CO5: Apply inverse Laplace transforms in engineering fields.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

REFERENCES:

1. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Srimanta Pal, Suboth C. Bhunia, " Engineering Mathematics", Oxford University Press, New Delhi, 2015,
4. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics" 5th Edition, Narosa Publishing House Pvt.Ltd., New Delhi, 2016.
5. 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 outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-

ME22301	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

Course Objectives

1 Impart knowledge on the basics and application of zeroth and first law of thermodynamics.

2 Impart knowledge on the second law of thermodynamics in analyzing the performance of thermal devices.

3 Impart knowledge on availability and applications of second law of thermodynamics

4 Impart the various properties of steam through steam tables and Mollier chart.

5 Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT – I BASICS, ZEROTH AND FIRST LAW 12

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 12

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 - Tds Equations - Entropy change for a pure substance. Principle of increase in entropy,

UNIT – III PROPERTIES OF PURE SUBSTANCES 12

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT – IV GAS MIXTURES AND THERMODYNAMIC RELATIONS 12

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Principle of Corresponding states - Maxwell relations - TdS Equations - heat capacities relations - Joule-Thomson experiment - Clausius-Clapeyron equation.

UNIT – V PSYCHROMETRY 12

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 60

COURSE OUTCOMES: At the end of the course the students would be able to

1 List the fundamental concepts in Thermodynamics and classify the thermodynamic processes around them. (Un)

2	Classify and apply Laws of Thermodynamics in practical situations when called for. (Un)
3	Apply mathematical fundamentals to analyse the properties of steam, gas and gas mixtures.
4	Apply various thermodynamic relations, tables and charts for problem solving.
5	Apply different psychometric process and adapt the same for computing the properties of air-vapour mixture.

Textbooks

1	Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2	Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,8th Edition, 2015.

References

1	Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai
2	Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
3	Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4	Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 7th Edition, Wiley Eastern, 2009.
5	Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	-	-	-	-	-	-	-	1	1	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	1	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	2	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	1	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	2	3	-
CO	3	2	2	-	-	-	-	-	-	-	-	1	1	2	-

ES22303	MANUFACTURING PROCESS	L	T	P	C
		3	0	0	3

Course Objectives:

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

1. To understand the working principles of various metal casting processes and metal joining processes
2. To learn the working principles of bulk deformation of metals. and sheet metal forming process.
3. To study and practice the working principles of plastics moulding.
4. To study various terminologies used in production technology.
5. To learn the basic concepts used in construction of various machine tools.

UNIT – I CASTING PROCESSES & PLASTIC MOLDING 9

Sand Casting – Sand Mould – Type of patterns - Molding sand Properties and testing – Cores –Types and applications –Defects in Sand casting process-remedies.

Molding of thermoplastics & Thermosetting polymers– working principles and typical applications – injection molding –Compression molding, Transfer Molding – Extrusion – Thermoforming – Bonding of Thermoplastics.

UNIT – II FORMING PROCESS 9

Hot working and cold working of metals – Forging processes –cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Principle of rod and wire drawing – Tube drawing.

Sheet metal characteristics – Typical shearing, bending and drawing operations

UNIT – III METAL JOINING PROCESS 9

Fusion welding processes – Oxy fuel welding – – Filler and Flux materials-–Arc welding, Electrodes, Coating and specifications – – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding — Resistance welding Processes -Electron beam welding – Laser beam Welding.

UNIT – IV FUNDAMENTALS OF MACHINING AND MACHINING OPERATION 9

Mechanics of chip formation, single point cutting tool, Types of chip, cutting tools – nomenclature.Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments. Capstan and turret lathes– automatic lathe: single spindle– multi spindle.

UNIT – V MILLING, GRINDING & DRILLING MACHINES 9

Milling Machines: Classification, constructional features, milling cutters nomenclature, milling operations..

Grinding Machines: Types of abrasives, bonding process, grinding wheel types. Classification, constructional features of grinding machines (Centre-less, cylindrical and surface grinding).

Drilling Machine: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature.

Total 45

COURSE OUTCOMES: At the end of the course the students would be able to

CO1 Explain the principle of different metal casting processes.

CO2 Describe the various metal joining processes.

CO3	Outline the various sheet metal forming process.
CO4	Explain basic concepts used in construction of various machine tools.
CO5	Classify various mechanisms underlying the working of various machine tools.

Textbooks:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006
2. P.N.Rao Manufacturing Technology Volume 1&2 Mc Grawhill Education 2017

References:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing ,Eight Edition ,Prentice – Hall of India, 1997.
4. HajraChouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
5. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	-	-	-	-	-	1	-	1	-	2	-
CO2	3	3	2	-	-	-	-	-	-	1	-	1	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	1	-	1	-
CO4	3	3	2	-	-	-	-	-	-	1	-	1	-	1	-
CO5	3	3	2	-	-	-	-	-	-	1	-	1	-	1	-
CO	3	2	2	-	-	-	-	-	-	1	-	1	-	2	-

ME22302	FLUID MECHANICS AND MACHINERY	L	T	P	C
		2	1	2	4

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

1	To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2	To impart basic knowledge of the dynamics of fluids
3	To expose to the applications of the conservation laws to flow measurements and flow through pipes (both laminar and turbulent)
4	To expose to principles of dimensional analysis and similitude to simple problems and use dimensionless parameters.
5	To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT – I FLUID STATICS **9**

Fluid statics: Physical properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric gauge and vacuum pressure –measurement of pressure. Manometers Piezometer, U-tube, inverted and differential manometers. Pascal's law, hydrostatic law.

UNIT – II FLUID KINEMATICS AND DYNAMICS **12**

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, three dimensional flow. Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line. Closed conduit flow: Darcy Weisbach equation- Minor losses in pipes

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 - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Specific speed - Performance curves for turbines - Governing of 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.

Practical: **30**

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 and drawing the characteristic curves of Gear pump/ reciprocating pump/ centrifugal pump/ submergible pump
5. Conducting performance test on Pelton wheel./ Francis turbine./ Kaplan turbine.

Total **75**

COURSE OUTCOMES: At the end of the course the students would be able to

CO1	Describe the properties and behaviour of fluid in static conditions.
CO2	Explain the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
CO3	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
CO4	Explain the working principles of various turbines and design the various types of turbines
CO5	Explain the working principles of centrifugal, reciprocating and rotary pumps

Textbooks:

1. R. K. Bansal, Fluid Mechanics and Hydraulic Machines (10th edition), Laxmi Publications (P). ltd; New Delhi, 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014

References:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019) .
3. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
4. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
5. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	-	-	-	-	1	1	-	1	-	2	-
CO2	3	3	3	-	-	-	-	-	2	1	-	1	-	2	-
CO3	3	3	2	-	-	-	-	-	1	1	-	2	-	2	-
CO4	3	3	3	-	-	-	-	-	2	1	-	1	-	1	-
CO5	3	3	3	-	-	-	-	-	2	1	-	1	-	2	-
CO	3	2	2	-	-	-	-	-	2	1	-	1	-	2	-

		L	T	P	C
EE22308	**ELECTRICAL DRIVES AND CONTROL**	**2**	**1**	**2**	**4**

Course Objectives

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

1 To understand the basic concepts of different types of electrical machines and their performance

2 To study the drive motor characteristic

3 To study the different methods of starting D.C motors and induction motors

4 To study the conventional and solid-state DC drives

5 To study the conventional and solid-state AC drives

UNIT – I INTRODUCTION **9**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT – II DRIVE MOTOR CHARACTERISTICS **12**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

UNIT – III STARTING METHODS **7**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT – IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES **9**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications

UNIT – V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES **8**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

Practical **30**

List of Experiments:

1. Determination of performance characteristics by conducting oad test on DC Shunt & DC Series motor
2. Determination of performance characteristics by conducting Speed control test of three phase slip ring Induction Motor
3. Determination of performance characteristics by conducting Load test on a single phase induction motor

4. Speed control of DC shunt motor (Armature, Field control)
5. V curves and inverted V curves of synchronous Motor
6. Load test on three phase squirrel cage Induction motor

Total **75**

COURSE OUTCOMES: At the end of the course the students would be able to

1	Infer the basic concepts of electric drives and the factors influencing the electric drives.
2	Compare different electrical motors and its characteristics.
3	Demonstrate different starting methods for electrical motors.
4	Illustrate conventional and solid state speed control of DC drives.
5	Illustrate conventional and solid state speed control of AC drives.

Text Books:

1	Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2006 2.
2	Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

References:

1	Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2	Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012
3	Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1		-	-	-	-	-	1	1	-	1	-	2	-
CO2	3	1	2	-	-	-	-	-	2	2	-	1	-	2	-
CO3	2	1	1	-	-	-	-	-	2	1	-	1	-	1	-
CO4	1	2	2	-	-	-	-	-	2	1	-	1	-	2	-
CO5	1	2	2	-	-	-	-	-	2	1	-	1	-	2	-
CO	3	2	2	-	-	-	-	-	2	1	-	1	-	2	-

ME22304	MANUFACTURING PROCESS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives

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

1. Selecting appropriate tools, equipment's and machines to complete a given job.
2. Performing various welding process using GMAW.
3. Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling.
4. Fabricating gears using gear making machines.
5. Analyzing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Metal Arc Welding machine.
2. Casting aluminum parts using stir casting machine.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Grinding components using cylindrical, surface, and centerless grinding machine.

Total 60

OUTCOMES: At the end of the course the students would be able to

CO1 Select appropriate tools, equipment and machines to complete a given job.

CO2 Perform various welding process using GMAW.

CO3 Perform various machining process such as rolling, drawing, turning, shaping, drilling, milling.

CO4 Fabricate gears using gear making machines.

CO5 Analyse the defects in the cast and machined components.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	-	-	-	-	1	-	1	1	-	1	1	1	-
CO2	3	1	-	-	-	-	1	-	1	1	-	1	1	1	-
CO3	3	1	-	-	-	-	1	-	1	1	-	1	1	1	-
CO4	3	1	-	-	-	-	1	-	1	1	-	1	1	1	-
CO5	3	1	-	-	-	-	1	-	1	1	-	1	1	1	-
CO	3	1	-	-	-	-	1	-	1	1	-	1	1	1	-

SD22303 **CODING SKILLS AND SOFT SKILLS TRAINING – PHASE I**

L	T	P	C
0	0	4	2

Objectives:

1. To make the students to solve basic programming logics.
2. To help the students develop logics using decision control statements.
3. To make the students develop logics using looping statements and arrays and to help them know how automation is implemented in industries.
4. To train the students for effective communication and identify the common errors in formal writings.
5. To guide and motivate the students for setting their goals with positive thinking.

Unit I **Fundamentals in Programming** **8**

Output of Programs: I/O Functions, Data types, Constants, Operators – Mathematical Problems – Debugging – Puzzles - Company Specific Programming Examples.

Unit II **Conditional Control Statements** **10**

Logic Building Using Conditional Control Statements – Output of Programs – Mathematical Problems - Puzzles – Company Specific Programming Examples

Unit III **Looping Statements & Automation in Automotive Industries** **12**

Looping Statements: Number Programs – Programs on Patterns – Array Programs – Programs on Sorting and Searching - Matrix Programs – Puzzles - Output of Programs - Company Specific Programming Examples

Automation in Automotive Industries: Automotive Embedded Product development – Industrial

Automation and Control(MOOC)

Unit IV Communication in General 15

Introduction to communication-Types of communication – Effective Communication-Barriers to communication. **Language Study:** Vocabulary-Formation of sentences-Sentence and sentence structures-Common errors – Writing paragraphs & essays. **Professional writing**: Job application & Resume writing

Unit V Personality Development 15

Study of personality & ways to improve. **Soft Skills**: Self-evaluation / self-awareness – Goal setting and positive thinking – Self-esteem and confidence – Public speaking – Extempore – Body language and Observation skills

Suggestive Assessment Methods:

1) Pre Assessment Test – To check the student's previous knowledge in C Programming in written mode.
2) Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.
3) Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.
4) Model Exam for coding skills will be conducted for 100 marks which are then calculated to 20.
5) A test for Communication skills will be conducted for 100 marks which will be then calculated to 40.
6) For assignments, students should attend all the practice tests conducted online on Hacker Rank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
7) The total of 100 marks obtained from the tests will be then calculated to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

Outcomes

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

CO 1	Solve problems on basic I/O constructs.
CO 2	Develop problem solving skills using control statements and arrays.
CO 3	Implement automation in machines.
CO4	Avoid / fix the common errors they commit in academic and professional writings and prepare standard resumes and update the same for future career.
CO5	Recognize the value of self-evaluation and grow with self-confidence.

Text Books

1. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.

Reference Books

1. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.
2. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
3. E Balagurusamy, “Programming in ANSI C”, Eighth edition, Mc GrawHill Publications, 2019.
4. S.Sobana, R.Manivannan, G.Immanuel,‘Communication and Soft Skills’ VK Publications’, 2016.
5. Yanja Dajsuren and Mark Van Den Brand, “Automative Systems and Software Engineering: State of the Art and Future Trends”, First Edition, Springer Publications, 2019.

CO PO Mapping:

Course outcomes	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	-	1	1	1	-	-	-	1	2	-	-	1	1
CO2	3	2	2	-	1	1	1	-	-	-	1	2	-	-	1	1
CO3	3	2	2	-	1	1	1	-	-	-	1	2	1	-	1	1
CO4	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-	-
CO5	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-	-
CO	3	2	2	-	1	1	1	1	2	3	1	2	1	-	1	1

AC22301 CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

Course Objectives

1 Teach history and philosophy of Indian Constitution.

2 Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.

3 Summarize powers and functions of Indian government.

4 Explain emergency rule.

5 Explain structure and functions of local administration.

UNIT – I INTRODUCTION **6**

History of Making of the Indian Constitution - Drafting Committee - Philosophy of the Indian Constitution –

Preamble - Salient Features

UNIT – II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 6

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Fundamental Duties

UNIT – III ORGANISATIONS OF GOVERNANCE 7

Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges - Qualifications, Powers and Functions.

UNIT – IV EMERGENCY PROVISIONS 4

Emergency Provisions - National Emergency, President Rule, Financial Emergency.

UNIT – V LOCAL ADMINISTRATION 7

District's Administration head - Role and Importance –Municipalities - Introduction- Mayor and role of Elected Representative - CEO of Municipal Corporation -Pachayati raj – Introduction - PRI- Zila Pachayat- Elected officials and their roles.

Total: 30 periods

OUTCOMES: At the end of the course the students would be able to

1. Able to understand history and philosophy of Indian Constitution.
2. Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
3. Able to understand powers and functions of Indian government.
4. Able to understand emergency rule.
5. Able to understand structure and functions of local administration.

Textbooks:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

References:

1. M.V.Pylee, "Introduction to the Constitution of India",4th Edition, Vikas publication,2005.
2. Durga Das Basu (DD Basu), "Introduction to the constitution of India", (Student Edition),19th Edition, Prentice-Hall EEE, 2008.
3. Merunandan, "Multiple Choice Questions on Constitution of India", 2nd Edition, Meraga

publication, 2007.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	-	-	1	1	-	1	-	-	-	1	1	-	2
CO2	-	1	-	-	-	1	-	1	-	-	-	-	1	-	2
CO3	-	1	-	-	-	1	-	1	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
CO5	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
CO	-	1	-	-	1	1	-	1	-	-	-	1	1	-	2

HS22301 **VALUE EDUCATION - I**

L	T	P	C
1	0	0	0

Course Objectives

1 To give the students a deeper understanding about the purpose of life.

2 To animate the students to have a noble vision and a right value system for their life.

3 To help the students to set short term and long term goals in their life.

UNIT – I My Life and My Place in the Universe **4**

Value of my life – My Uniqueness, strengths and weakness – My self-esteem and confidence – My identity in the universe.

UNIT – II My Life and the Other **4**

Realising the need to relate with other persons and nature – My refined manners and conduct in relationships – Basic communication and relationship skills – Mature relationship attitudes.

UNIT – III My Life is My Responsibility **3**

Personal autonomy – developing a value system and moral reasoning skills – setting goals for life.

UNIT – IV Understanding My Education and Developing Maturity **4**

Importance of my Engineering education – Managing emotions - personal problem solving skills.

Total **15**

OUTCOMES: At the end of the course the students would be able to

1 Explain the importance of value based living.

2 Set realistic goals and start working towards them.

3 Apply the interpersonal skills in their personal and professional life.

4 Emerge as responsible citizens with a clear conviction to be a role model in the society.

References:

1. David Brooks. The Social Animal: The Hidden Sources of Love, Character, and Achievement. Random House, 2011.
2. Mani Jacob. Resource Book for Value Education. Institute of Value Education, 2002.
3. Eddie de Jong. Goal Setting for Success. CreateSpace Independent Publishing, 2014.
4. Dr.Abdul kalam. My Journey-Transforming Dreams into Actions. Rupa Publications, 2013.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	1	1	2	-	2	2		
CO2	-	-	-	-	-	2	-	1	1	2	-	2	2		
CO3	-	-	-	-	-	2	-	1	1	2	-	2	2		
CO4	-	-	-	-	-	2	-	1	1	2	-	2	2		
CO	-	-	-	-	-	2	-	1	1	2	-	2	2		

SEMESTER IV

		L	T	P	C
ME22403	**ENGINEERING MATERIALS AND METALLURGY**	**3**	**0**	**0**	**3**

Course Objectives

1 Constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.

2 Selecting and applying various heat treatment processes and its microstructure formation.

3 Applying the different types of ferrous and non-ferrous alloys and their uses in engineering field.

4 Applying the different polymer, ceramics and composites and their uses in engineering field.

5 Applying 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 Al_2O_3, SiC, Si_3N_4, PSZ and SIALON - Composites- Matrix and reinforcement Materials- applications of Composites - Nano composites.

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

OUTCOMES: At the end of the course the students would be able to

CO1. Interpret the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.

CO2. Outline the various heat treatment process and its microstructure formation.

CO3. Illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.

CO4. Explain the different polymer, ceramics and composites and their uses in engineering field.

CO5. Summarize the various testing procedures and failure mechanism in engineering field.

Textbooks:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
2. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994

References:

1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. Amandeep Singh Wadhwa, andHarvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
3. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2006.
4. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 1999.
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian edition 2007.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	2	-	-	1	-	-	1	-	2	-	2	2
CO2	3	2	2	1	-	-	1	-	-	1	-	2	-	2	1
CO3	3	1	3	2	-	-	-	-	-	1	-	2	-	2	1
CO4	3	1	3	-	-	-	-	-	-	-	-	2	-	2	1
CO5	3	3	3	2	-	-	-	-	-	1	-	2	-	-	1
CO	3	2	3	2	-	-	1	-	-	1	-	2	-	2	1

ME22401	THERMAL ENGINEERING	L	T	P	C
		2	1	2	4

Course Objectives

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

1. To predict the operation of thermodynamic cycles and performance of Internal Combustion(IC) engines and Gas Turbines.
2. To learn the working of IC engines and various auxiliary systems present in IC engines
3. To learn the performance of steam turbines through velocity triangles
4. To learn the working of various air compressors
5. To understand the fundamentals of refrigeration and air conditioning

UNIT – I GAS AND STEAM POWER CYCLES 9

Air Standard Cycles — Otto, Diesel, Dual, Brayton — Cycle Analysis, Performance and Comparison — Rankine, reheat and regenerative cycle.

UNIT – II INTERNAL COMBUSTION ENGINES 9

Classification – Components and their function. Valve timing diagram and port timing diagram – actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System – Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems.

UNIT – III 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 simple and multi-stage turbines, speed regulations –Governors.

UNIT – IV AIR COMPRESSOR 9

Classification and comparison, working principle, work of compression — with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT – V REFRIGERATION AND AIR CONDITIONING 9

Refrigerants – Vapour compression refrigeration cycle – Performance calculations – working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems (Description only). Air conditioning system – Processes, Types and Working Principles. – Concept of RSHF, GSHF, ESHF.

Practical 30

List of Experiments:

1. Valve Timing and Port Timing diagrams.
2. Performance Test on four – stroke Diesel Engine.
3. Heat Balance Test on 4 – stroke Diesel Engine.

4. Morse Test on Multi-Cylinder Petrol Engine.
5. Determination of Flash Point and Fire Point of various fuels / lubricants
6. Performance test on a two stage Reciprocating Air compressor
7. Performance and Energy Balance Test on a Steam Generator.

Total **75**

COURSE OUTCOMES: At the end of the course the students would be able to

CO1	Make use of the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles.
CO2	Outline the working of IC engines and various auxiliary systems present in IC engines
CO3	Experiment with the steam turbine and determine its performance and understand the need for governing and compounding of turbines
CO4	Experiment with various air compressors and determine its performance.
CO5	Apply the thermodynamics concept for calculating the cooling/heating load for different applications.

Textbooks:

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V , " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

References:

1. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
2. Domkundwar, Kothandaraman, &Domkundwar, " A Course in Thermal Engineering", 6th Edition, DhanpatRai& Sons, 2011.
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
4. Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
5. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

CO1	3	2	2	1	-	-	-	-	1	1	-	1	1	2	-
CO2	3	3	2	1	-	-	-	-	2	1	-	1	1	2	-
CO3	3	3	2	1	-	-	-	-	2	1	-	1	2	1	-
CO4	3	3	2	-	-	-	-	-	2	1	-	1	2	1	-
CO5	3	3	2	1	-	-	-	-	2	2	-	1	2	1	-
CO	3	2	2	1	-	-	-	-	2	1	-	1	1	2	-

ME22402 **STRENGTH OF MATERIALS**

L	T	P	C
2	1	2	4

Course Objectives

1 To understand the concepts of stress, strain, principal stresses and principal planes

2 To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.

3 To determine stresses and deformation in circular shafts and helical spring due to torsion.

4 To compute slopes and deflections in determinate beams by various methods.

5 To study the stresses and deformations induced in thin and thick shells.

UNIT – I STRESS, STRAIN AND DEFORMATION OF SOLIDS **9**

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT – II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM **9**

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT – III TORSION **9**

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT – IV DEFLECTION OF BEAMS **9**

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT – V THIN CYLINDERS, SPHERES AND THICK CYLINDERS **9**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.

Practical **30**

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs

Total **75**

OUTCOMES: At the end of the course the students would be able to

1 Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

2. Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

3. Apply basic equation of simple torsion in designing of shafts and helical spring

4. Construct the slope and deflection in beams using different methods.

5. Identify and design thin and thick shells for the applied internal and external pressures.

Textbooks:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016

2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

References:

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2002

2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing ‘co. Ltd., New Delhi, 2005

3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013

4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	-	-	-	-	2	1	-	2	2	1	-
CO2	3	2	2	-	-	-	-	-	2	1	-	3	2	2	-
CO3	3	1	3	-	-	-	-	-	2	1	-	3	2	3	-
CO4	3	2	2	-	-	-	-	-	2	-	-	2	2	3	-
CO5	3	1	2	-	-	-	-	-	2	1	-	2	2	3	-
CO	3	2	2	-	-	-	-	-	2	1	-	2	2	1	-

ME22404	MECHANICS OF MACHINES	L	T	P	C
		2	1	2	4

Course Objectives

1	Applying the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
2	Applying the basic concepts of toothed gearing and kinematics of gear trains
3	Analyzing the effects of friction in machine elements
4	Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
5	Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

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– relative velocity methods – – cams – classifications – displacement diagrams - layout of plate cam profiles.

UNIT – II GEARS AND GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT – III FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Introduction to friction aspects in brakes.

UNIT – IV FORCE ANALYSIS 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.

UNIT – V BALANCING AND VIBRATION 9

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

PRACTICAL - 30

LIST OF EXPERIMENTS

1. Determination of moment of inertia of flywheel and axle system.
2. Determination of mass moment of inertia of a body about its axis of symmetry.
3. Undamped free vibrations of a single degree freedom spring-mass system.
4. Torsional Vibration of single rotor shaft system.
5. Dynamic analysis of CAM mechanism.
6. Experiment on Governor.
7. Experiment on motorized gyroscope.
8. Determination of critical speed of shafts.

Total **60**

OUTCOMES: At the end of the course the students would be able to

CO1. Apply the basic components of mechanisms, analyze the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.

CO2. Apply the basic concepts of toothed gearing and kinematics of gear trains

CO3. Develope the effects of friction in machine elements

CO4. Organize the force-motion relationship in components subjected to external forces and analyze of standard mechanisms.

CO5. Utilize the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

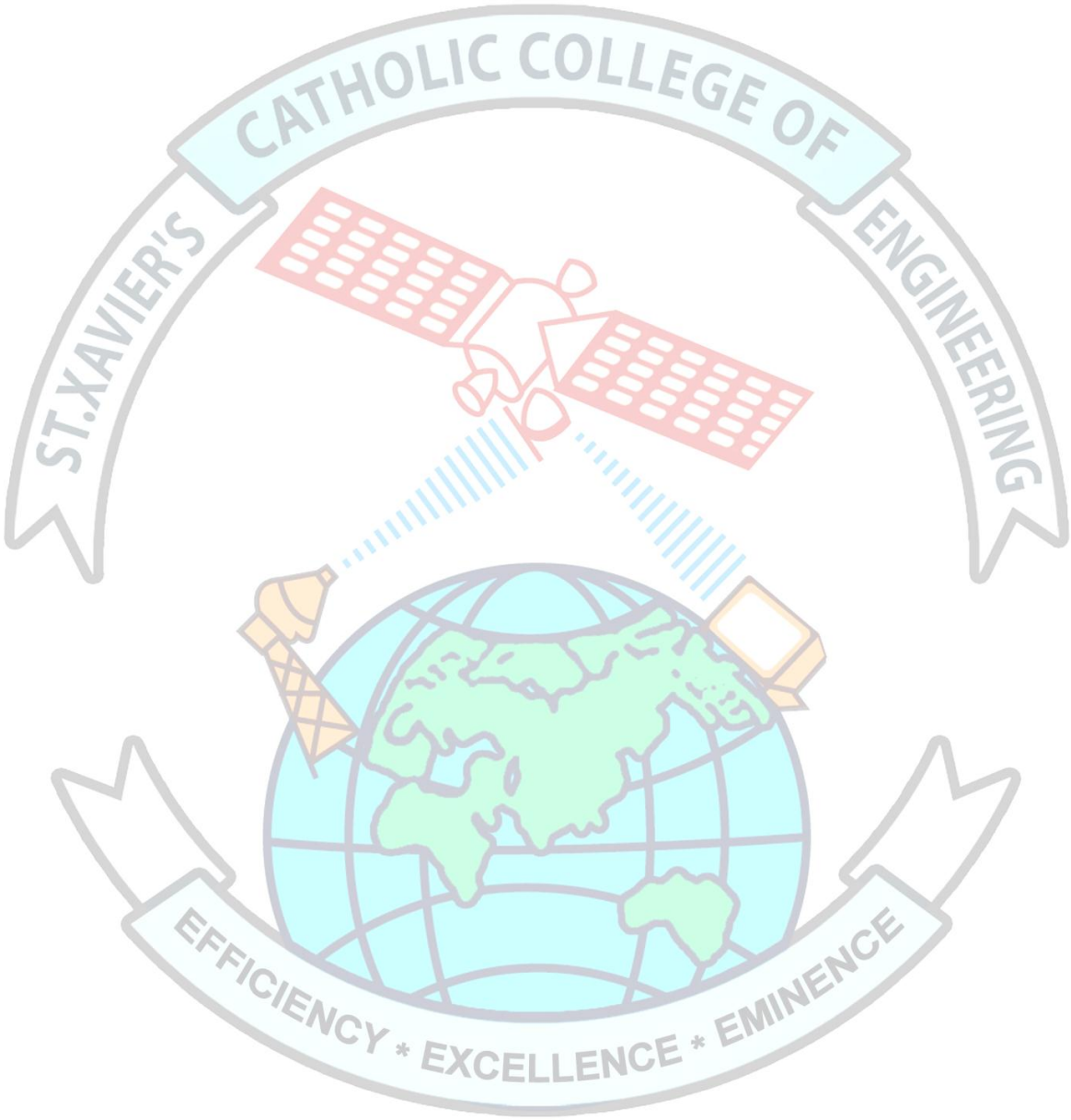
Textbooks:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.

References:

1. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.
3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
5. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	2	-	-	1	1	1	-	1	3	-	1
CO2	3	2	2	1	2	-	-	1	1	1	-	1	3	-	1
CO3	3	2	2	1	2	-	-	1	1	1	-	1	3	-	1
CO4	3	2	2	-	2	-	-	1	1	-	-	1	3	-	1
CO5	3	2	2	1	2	-	-	1	-	1	-	1	3	-	1
CO	3	2	2	1	2	-	-	1	1	1	-	1	3	-	1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ME22405	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	2	4

Course Objectives

1. Explain the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Apply the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
3. Interpret the various tolerance symbols give n in engineering drawings to choose the appropriate manufacturing process.
4. Apply the principles and methods of form and surface metrology for the intended applications.
5. Use advanced measurements for quality control in manufacturing industries.

UNIT – I BASICS OF METROLOGY 9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

UNIT – II MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope.

UNIT – III TOLERANCE ANALYSIS 9

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, 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 micrometres; 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.

PRACTICAL 30

LIST OF EXPERIMENTS

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.

3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.
4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.
5. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.
6. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

Total **75**

OUTCOMES: At the end of the course the students would be able to

1	Explain the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2	Extend the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
3	Interpret the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4	Outline the principles and methods of form and surface metrology.
5	Summarize the advances in measurements for quality control in manufacturing Industries.

Textbooks:

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

References:

1. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical Laboratory Guide No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013 .
5. Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley &Sons, 2015.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	2		-	-	2	2		-	1	-	1	1
CO2	2	1	3	2		-	-	-	2	2	-	1	3	3	
CO3	2	2	2	2		-	-	-	-	-	-	1	3	2	-

CO4	1	3	-	3	2	-	-	-	-	-	-	1	3	3	-
CO5	1	1	-	3	3	-	-	-	-	-	-	1	3	3	-
CO	2	2	2	3	2	-	-	2	2	2	-	1	3	2	1

SD22403 CODING SKILLS AND SOFT SKILLS TRAINING – PHASE II

L	T	P	C
0	0	4	2

Objectives

1. To help students on developing modular applications in using functions.
2. To train them on building logics using strings and pointers.
3. To make them develop applications in using user defined data types and to make them know how automation is implemented in industries.
4. To train the students on speaking skills for group discussions.
5. To set them correctly on the track of presentation skills and management skills.

Unit I Functions **10**

Logic Building Using Functions – Programs on Recursion – Puzzles - Output of Programs - Company Specific Programming Examples

Unit II Strings and Pointers **10**

Logic Building Using Strings – Programs on Strings - Logic Building Using Pointers – Puzzles - Output of Programs - Company Specific Examples

Unit III User Defined Data types & Automation in Automotive Industries **10**

User Defined Data types: Working with User Defined Data types – Puzzles - Output of Programs - Company Specific Examples

Automation in Automotive Industries: Embedded Firmware Development – Core of the Embedded System – General Purpose and Domain Specific Processors, ASICs, PLDs, COTS.

Unit IV Communication Skills / Language Skills **15**

Receptive Skills and productive skills - Skills together - Integration of skills - Input and output **Receptive Skills**: Listening and Reading - Lead-in - Pre-existent knowledge - General understanding of the audio or the written text - Discussion in pairs or small groups – feedback - Text-related task in detail - Focus on aspects of language in the text. **Productive Skills**: Speaking and Writing - lead-in - engaging students with the topic - setting the task - role-play - Monitoring the task - Giving the

feedback-positive- task-related follow up - repetition / re-setting of task. **Activities:** Pronunciation: syllable, stress, intonation - Writing memos, e-mails and formal letters - Oral presentations / seminars - Written and Oral Descriptions Group discussions.

Unit V Soft Skills: Search and find for Career Developments 15

Self-motivation: Interpersonal relationship - Attitudes and interpersonal integrity – Time management – prioritizing - Leadership quality – **In the team:** Team building and Team work - Memory technique **Problem solving**: – emotional intelligence – positive attitude towards life – taking up initiatives – developing mind set –openness to feed back – adaptability – active listening – work ethics. **Presentation of skills**: creative thinking – critical thinking – logical thinking - decision making. **Management ability:** empathy – selflessness – humility – cultural respectfulness – versatility – generosity – trustworthiness – planning and executing – target achievement – listening to others' views – friendliness - active participation – empowering healthy atmosphere – exchange of ideas – mediation – negotiation – qualities – updating the knowledge – pre-work for performance – respect for rules and regulations

Suggestive Assessment Methods:

1) Pre Assessment Test – To check the student's previous knowledge in C Programming in written mode.
2) Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.
3) Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.
4) Model Exam for coding skills will be conducted for 100 marks which are then reduced to 20
5) A test for Communication skills will be conducted for 100 marks which will be then calculated to 40.
6) For assignments, students should attend all the practice tests conducted online on HackerRank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
7) The total of 100 marks obtained from the tests will be then reduced to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

Outcomes

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

CO 1 Develop and implement modular applications in functions.

CO 2 Design and implement applications using strings and user defined data types.

CO 3 Implement automation in machines.

CO4 Practice both receptive skills (listening and reading) and productive skills (writing and speaking) and speak English with standard pronunciation using correct stress and

intonation.

CO5	Practice team building and team work procedures and develop memory techniques and Manage abilities like empathy, selflessness, cultural respectfulness and trustworthiness preparing themselves for target achievement.

Text Books

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

Reference Books

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.
2. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
3. E Balagurusamy, "Programming in ANSI C", Eighth edition, Mc GrawHill Publications, 2019.
4. S.Sobana, R.Manivannan, G.Immanuel,'Communication and Soft Skills' VK Publications', 2016.
5. Yanja Dajsuren and Mark Van Den Brand, "Automative Systems and Software Engineering: State of the Art and Future Trends", First Edition, Springer Publications, 2019.

CO PO Mapping:

Course outcomes	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	2	-	1	1	1	-	-	-	1	2	-	-	1	1
CO2	3	2	2	-	1	1	1	-	-	-	1	2	-	-	1	1
CO3	3	2	2	-	1	1	1	-	-	-	1	2	1	-	1	1
CO4	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-	-
CO5	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-	-
CO	3	2	2	-	1	1	1	1	2	3	1	2	1	-	1	1

AC22401 **INDUSTRIAL SAFETY ENGINEERING**

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

Course Objectives

1 Explaining the fundamental concept and principles of industrial safety

2 Applying the principles of maintenance engineering.

3 Analyzing the wear and its reduction.

4 Evaluating faults in various tools, equipments and machines.

5 Applying periodic maintenance procedures in preventive maintenance.

UNIT – I INDUSTRIAL SAFETY 6

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT – II MAINTENANCE ENGINEERING 6

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT – III WEAR AND CORROSION AND THEIR PREVENTION 6

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT – IV FAULT TRACING 6

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V PERIODIC AND PREVENTIVE MAINTENANCE 6

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.

Total 30

OUTCOMES: At the end of the course the students would be able to

1. Explain the fundamental concept and principles of industrial safety
2. Apply the principles of maintenance engineering.

3. Analyze the wear and its reduction.
4. Evaluate faults in various tools, equipments and machines
5. Apply periodic maintenance procedures in preventive maintenance.

Textbooks:

1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

References:

1. Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
2. Garg, HP, Maintenance Engineering, S. Chand Publishing.
3. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
4. R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
5. W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO2	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO3	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO4	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO5	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1

SEMESTER V

ME22502	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- To learn the various steps involved in the Design Process.
- To Learn designing couplings for various applications.
- To Learn the design of temporary and permanent Joints.
- To Learn designing helical, leaf springs and flywheels for various applications.
- To Learn designing and select sliding and rolling contact bearings. (Use of PSG Design Data book is permitted)

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 –Design for finite and infinite life under variable loading.

UNIT II DESIGN KEY AND COUPLING 9

Types of key- forces- Strength-Design of key – Coupling – Types –Requirements- Rigid Coupling- Design of sleeve or muff coupling, Design of Clamp coupling, Design of Flange coupling – Flexible coupling – Design of Bushed pin type flexible coupling- Universal (or Hooke's) Coupling.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading- Knuckle joints– Welded joints- Types- merits and demerits- Strength of transverse and parallel fillet welded joints-stress concentration factors -Eccentrically loaded welded joints -Polar moment of inertia and Section modulus of welds.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Types of springs, materials for helical springs- terms used in compression spring-design of helical and concentric springs–surge in springs, Design of laminated springs - rubber springs –Flywheel- Coefficient of fluctuation of speed and energy – Design of Flywheels considering stresses in rims and arms for engines

UNIT V DESIGN OF BEARINGS 9

Sliding contact and rolling contact bearings –material used- merits and demerits-Assumptions in hydrodynamic lubricated bearings-Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, Heat generated -- Selection of Rolling Contact bearings- Bearing life- Reliability of bearing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply the concepts of design of machine members subjected to static and variable loads.
CO2:	Apply the concepts of design to keys and couplings.
CO3:	Apply the concepts of design to temporary and permanent joints.
CO4:	Apply the concept of design to helical, leaf springs and flywheels,
CO5:	Apply the concepts of design to bearings.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", Fourth Edition, Tata McGraw-Hill Book Co, 2016.
2. R.S. Khurmi, "Machine Design", 25th Revised edition, S. Chand, 2005.

REFERENCES:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010 ,
2. Ansel C. Ugural, "Mechanical Engineering Design ", Third Edition, CRC Press, 2021.
3. P.C. Gope, "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi,2012.
4. R.B. Patel, "Design of Machine Elements", MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
5. Sundararajamoorthy T. V. Shanmugam. N, "Machine Design", Anuradha Publications,Chennai, 2015.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	-	-	-	-	-	2	-	-	2	2	-
CO2	2	2	3	-	-	-	-	-	-	1	-	-	2	2	-
CO3	2	1	2	1	-	-	-	-	-	2	-	-	1	1	-
CO4	3	2	2	-	-	-	-	-	-	2	-	-	1	1	-
CO5	1	2	1	-	-	-	-	-	-	1	-	-	1	2	-
CO	2	2	2	1	-	-	-	-	-	2	-	-	1	2	-

ME22503	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide students with knowledge on applying fluid power in process, construction, and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system
- To develop a measurable degree of competence in the design, construction, and operation of fluid power circuits

UNIT I FLUID POWER PRINCIPLES 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

Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors

Control Components: Direction Control, Flow control, and pressure control valves – Types, Construction, and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Layout of Hydraulic system, Accumulators, Applications of Accumulators, Hydraulic circuits using accumulators Intensifiers, Meter in and Meter out circuits Industrial hydraulic circuits – Regenerative, Pressure Intensifier circuits, Hydro pneumatic circuits Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission.

UNIT IV PNEUMATIC AND ELECTRO-PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air Control Valves, Quick Exhaust Valves, Pneumatic actuators, Layout of Pneumatic system. Design of Pneumatic circuit – Cascade method – Electro-Pneumatic System – Elements

UNIT V TROUBLESHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Troubleshooting, and Remedies in Hydraulic and Pneumatic systems.

Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press, and Forklift applications.

Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low-cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the Fluid power and operation of different types of pumps

CO2: Summarize the features and functions of Hydraulic motors, actuators and Flow control valves

CO3: Construct different types of Hydraulic circuits and systems

CO4: Construct different types of pneumatic circuits and systems

CO5: Analyze the various troubleshooting methods and applications of hydraulic and pneumatic systems

TEXT BOOKS:

1. Elanchezhian, "Fluid Power with Applications", Seventh edition, Pearson Education 2008.
2. Majumdar S.R., "Oil Hydraulics Systems - Principles and Maintenance", Tata McGraw-Hill, 2015.

REFERENCES:

6. Sivaraman, Ilango "Introduction to hydraulics and pneumatics", Third edition, PHI learning, 2017.
7. Jagadeesha T., " Hydraulics and Pneumatics ", I.K. International Publishing House Pvt. Limited, 2015.
8. Majumdar S.R., "Industrial hydraulics and pneumatics", Nirali Prakashan , 2019
9. James R Daines, Martha J Daines, " Fluid Power: Hydraulics and Pneumatics ", Fifth edition, Goodheart-Willcox Publisher, 2023.
10. Andrew Parr, " Hydraulics and Pneumatics: A Technician's and Engineer's Guide ", Elsevier Science, 2013.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3

ME22501 **HEAT TRANSFER**

L	T	P	C
2	1	2	4

COURSEOBJECTIVES:

- To apply the principal mechanism of heat transfer under steady state conditions.
- To apply the principal mechanism of heat transfer under transient conditions.
- To apply the fundamental concept and principles in convective heat transfer.
- To apply the theory of phase change heat transfer and design a heat exchangers.
- To apply the fundamental concept and principles in radiation heat transfer.

UNIT – I CONDUCTION 10

Fundamental: Modes of heat transfer, effect of temperature on thermal conductivity of different solids, liquids and gases, derivation of generalized equation in Cartesian, cylindrical and spherical coordinates. General laws of heat transfer

Conduction: Fourier's law, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient

UNIT – II TRANSIENT HEAT CONDUCTION AND EXTENDED SURFACE 8

Transient heat conduction- lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances.

Heat transfer from extended surface: Types of fin, heat flow through rectangular fin, infinitely long fin and fin insulated at the tip, efficiency and effectiveness of fin.

UNIT – III CONVECTION 9

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT – IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's 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. Fundamentals of Heat Pipes and its applications.

UNIT – V RADIATION 9

Introduction to Thermal Radiation - Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation and radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES

List of Experiments:

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils, and water.
3. Determination of heat transfer coefficient of air under natural convection and forced convection.
4. Heat transfer from pin-fin under natural and forced convection.
5. Determination of heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.
6. Determination of Stefan – Boltzmann constant.
7. Determination of emissivity of a grey surface.

30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the fundamental equations of heat transfer by conduction for plane and composite systems.

CO2: Apply the fundamental equations of heat transfer by conduction for extended surfaces, semi and infinite solids under steady state and transient conditions.

CO3: Apply the fundamental equations of heat transfer for free, forced and mixed convection over surfaces of different forms and orientation.

CO4: Apply the theoretical concepts of phase change during boiling and condensation, calculate the heat transfer of different types of heat exchangers and heat pipes.

CO5: Calculate the heat transfer by radiation from surfaces of different colours and orientation, show its electrical analogy and radiation shields

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Academic Science, 2017.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" –Fifth Edition, Tata McGraw Hill, 2013.

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, Seventh Edition, 2014.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4. John H Lienhard ., " A Heat Transfer Textbook ", Fifth edition, Dover Publications., 2019.
5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1
CO	3	3	3	2	-	-	-	-	-	-	-	-	3	2	1

SD22503	Coding Skills and Soft Skills Training – Phase III	L	T	P	C
		0	0	4	2

Objectives:

- To make the students to develop logics using basic Programming Logics, Decisional Statements, Arrays and Strings.
- To help the students to know how to use classes and objects and implement programs using OOPs concepts.
- To guide students in CNC Part Programming.
- To train the students on interview skills with mock interviews and updated / enhanced resumes
- To prepare students for taking initiatives and decision making with critical thinking

Unit I **BASIC PROGRAMMING CONSTRUCTS & SOFT SKILLS: TIME MANAGEMENT** **12**

Structured vs Object oriented programming language – Output of programs on basic I/O functions – Logic building using Decisional Statements – Programs on Patterns and Numbers - Debugging – Puzzles - Company specific programming examples.

Soft Skills: Time management: Prioritizing – Delegation - Decision-making - Goal setting – Multitasking - Problem solving - Strategic thinking - Scheduling – Planning - to-do lists and checklists - Evaluating urgent tasks - Auditing and improving workflows - Filtering notifications - Setting thoughtful deadlines – Evaluating the work done schedules – Grouping similar tasks – Learn to say ‘no’.

Unit II **PROGRAMMING USING FUNCTIONS AND ARRAYS & SOFT SKILLS: STRESS MANAGEMENT AND EMOTIONAL QUOTIENT** **12**

Logic building using modular approach – Programming using Friend Function – Programs on Matrices and Strings – Puzzles – Output of programs - Company specific programming examples.

Soft Skills: Stress management: Using guided meditation - Maintain physical exercise and good nutrition - Manage social media time - Connect with others – read and relax. **Emotional Quotient**: Overcoming challenges – defusing conflict - Self-awareness - Self-regulation - Professional etiquette – Avoiding doubt – Introducing others – Courteousness – Non-interruption – Avoiding gossip.

Unit III **IMPLEMENTING OOPS CONCEPTS & SOFT SKILLS: VALUES OF LIFE AND BEHAVIOURAL ATTITUDES** **12**

Discussion on basics of OOPs Concepts – Solving problems based on Data Members and Member Functions – Programs based on Construction and Destruction of Objects - Puzzles - Output of Programs – Understanding Access Specifiers – Company specific programming examples.

Soft Skills: Values of life: Loyalty to others and responsibilities – Living with Spirituality – Maintaining humility – Possessing compassion – Proving being honest – developing kindness – Learning to have integrity – Embracing responsibility. **Behavioural attitudes:** Behaving with sportive attitude – Respecting the freedom of the others – Being bold – Enhancing fun and joy.

Unit IV **LOGIC BUILDING USING INHERITANCE, ABSTRACTION, POLYMORPHISM AND ENCAPSULATION & SOFT SKILLS:** **12**

EMPLOYERS EXPECTATIONS AND RESUME ENHANCEMENT

Understanding Super class and Derived Class – Logic building based on inheritance – Programming using Pure Virtual Function and Abstract Classes- The Final Keyword – Programming Using Function Overloading and Overriding – Understanding Encapsulation - Puzzles - Output of Programs – Company specific programming examples.

Soft Skills: Employers expectations: Contributing to the team – Being with stability – Developing the ability to grow - Improving the productivity. **Resume enhancement:** Select the best template for your skills, experience, and goals Adding skills to be an expert - Robusting and compelling objective – Displaying online presence - Quantifying accomplishments various roles.

Unit V **COMPUTER INTEGRATED MANUFACTURING & SOFT SKILLS: INTERVIEW SKILLS** **12**

Computer Integrated Manufacturing: Introduction to SIM and Automation – NC & CNC Machines – Constructional Features of CNC Machines .

Soft Skills: Interview Skills: Clarifying interview questions - Communicate nonverbally - Knowing the resume thoroughly - Leveraging knowledge of the company and interviewer - Mock interviews – Getting rehearsed before moving for interviews.

Suggestive Assessment Methods:

8) Pre Assessment Test – To check the student's previous knowledge in Programming skills.
9) Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.
10) Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.
11) Model Exam for coding skills will be conducted for 100 marks which are then calculated to 20.
12) A test for Soft Skills will be conducted for 100 marks which will be then calculated to 40.
13) For assignments, students should attend all the practice tests conducted online on HackerRank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
14) The total of 100 marks obtained from the tests will be then calculated to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

Outcomes

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

CO 1 Develop programs using Functions, Strings and Arrays.

CO 2 Develop applications using OOPs Concepts.

CO 3 Construct Part Programs Using ISO format for given simple components.

CO4 Apply all the interview skills learned with updated resumes and language skills balancing technical skills and interpersonal skills

CO5 Attend different job interviews with emotional balance and achieve the target with right planning and unique solutions

Text Books

3. Balagurusamy E, "Object Oriented Programing with C++", Eighth Edition, Tata McGraw Hill Education Pvt.Ltd, 2020.
4. Anthony Williams, "C++ Concurrency in Action", Second Edition, Manning Publications, 2019.

Reference Books

6. Bjarne Stroustrup, "A Tour of C++, Second Edition", Pearson Education, 2018.
7. Scott Meyers, "Effective Modern C++", O'REILLY Publication, December 2014.
8. Bjarne Stroustrup, "The C++ Programming Language", Fourth Edition, Pearson Education, 2013.
9. S.Sobana, R.Manivannan, G.Immanuel,"Communication and Soft Skills" VK Publications', 2016.
10. Mikell P. Groover, Automation, "Production Systems, and Computer Integrated Manufacturing", Fourth Edition, Pearson Education, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	1	1	1	-	-	-	1	2	2	-	-
CO2	2	2	2	-	1	1	1	-	-	-	1	2	2	-	-
CO3	2	2	2	-	1	1	1	-	-	-	1	2	2	-	-
CO4	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-
CO	2	2	2	-	1	1	1	1	2	3	1	2	2	-	-

ME22504 **TECHNICAL SEMINAR**

L	T	P	C
0	0	2	1

Course Objectives

- To Enhance the ability of self-study
- To Improve the presentation and communication skills
- To Increase the breadth of knowledge.

GUIDELINES

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic	You are requested to select an area of interest, topic and state an objective	2nd week	5 % Based on clarity of thought, current relevance Stating an and clarity in writing

Collecting Information about your area & topic	1. List 2 journals 2. List 2 conferences, symposia or workshops 3. List 3 web presences (mailing lists, forums, news sites) 4. List 3 authors who publish regularly in your area.	3rd Week	5 % (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective collect 10	Students have to provide a complete list of references you will be using based on your objective Search various digital libraries and Google Scholar When picking papers to read - try to Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them. Favour more recent papers.	4th Week	10 % (the list of standard papers and reason for selection)
Draft outline and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	6th week	10% (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	7th week	10% (Clarity, purpose and conclusion)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	9th week	10% (this component will be evaluated based on the linking and classification among the papers)
Final Draft	Complete the final draft of your paper 13th week 10% (formatting, English, Clarity and linking)	11th Week	10% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	12th to 14th Week	40% (based on presentation and Viva-voce)

Total: 30 hrs

OUTCOMES: At the end of the course the students would be able to

1 Identify and choose appropriate topic of relevance.

2 Assimilate literature on technical articles of specified topic and develop

3 Prepare technical report for the given task.

4 Design, develop and deliver presentation on specified technical topic

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	1				1	2	1	2	3	2	1
CO2	3	3	3	3	1				2	2	1	2	3	2	1
CO3	3	3	3	2	1				2	2	1	2	3	2	1
CO4	3	3	3	2	1				1	3	1	2	3	2	1
CO	3	3	3	2	1				2	2	1	2	3	2	1

ME22505 INPLANT/INDUSTRIAL TRAINING L T P C

0 0 0 1

COURSE OBJECTIVES:

- To Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required
- To apply the technical knowledge in real industrial situations.
- To gain experience in writing technical reports/projects.
- To expose the students to experience the engineer's responsibilities and ethics.
- To promote academic, professional and/or personal development.

Inplant/Industrial Training Duration

The students may undergo Industrial training for a period as specified in the Curriculum during the summer / winter vacation. In this case, the training has to be undergone continuously for a period of at least two weeks in an organization.

METHOD OF EVALUATION

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.

• Depth of knowledge and skills. .

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

CO1: Interpret how the theoretical aspects learned in classes are integrated into the practical world.

CO2: Make use of the opportunity to learn new skills and supplement knowledge.

CO3: Develop communication and teamwork skills

CO4: Motive the student for higher education.

CO5: Formulate to learn strategies like time management, multi-tasking etc in an industrial setup

AC22501	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		2	0	0	0

COURSEOBJECTIVES:

- Explaining the types, characteristics of entrepreneurship and its role in economic development.
- Applying the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.
- Selecting the appropriate form of business ownership in setting up an enterprise.
- Applying the fundamental concepts of finance and accounting to enterprise.
- Identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.

UNIT I ENTREPRENEURSHIP **6**

Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Entrepreneurial Competencies – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth.

UNIT II BUSINESS PLAN **6**

Sources of business ideas and tests of feasibility: Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation; Project Appraisal, preparation of project report.

UNIT III SMALL SCALE INDUSTRIES **6**

Legal formalities in setting up of SSIs, Business Laws, Governmental Setup in promoting small industries, Status of Small Scale Industrial Undertakings, Steps in starting a small industry, Ownership Structures.

UNIT IV FINANCING AND ACCOUNTING **6**

Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management:

UNIT V SUPPORT TO ENTREPRENEURS **6**

Government Policy for Small Scale Enterprises – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry, Social Responsibility of Business.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the types, characteristics of entrepreneurship and its role in economic development.

CO2: Apply the theories of achievement motivation and the principles of entrepreneurship

development program.

CO3: Select the appropriate form of business ownership in setting up an enterprise.

CO4: Apply the fundamental concepts of finance and accounting to enterprise.

CO5: Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development", S.Chand & Co. Ltd. Ram Nagar NewDelhi, 2007.
2. Kurahko & Hodgetts, "Entrepreneurship – Theory, process and practices", Sixth edition, Thomson learning, , 2010.

REFERENCES:

1. Charantimath, P. M., "Entrepreneurship Development and Small Business Enterprises", Pearson, 2006.
2. Hisrich R D and Peters M P, "Entrepreneurship", Fifth Edition, Tata McGraw-Hill, 2002.
3. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" Second Edition, Dream tech, 2006.
4. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
5. Singh, A. K., "Entrepreneurship Development and Management", University Science Press, 2009.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	-	-	1	-	1	2	1	2	-	1	-	-	-
CO2	-	-	1	-	1	1	1	2	2	2	-	1	-	2	-
CO3	-	-	1	-	-	2	1	1	1	1	-	1	-	2	-
CO4	1	-	1	-	-	2	1	-	1	1	1	-	-	-	-
CO5	-	1	-	1	-	1	1	-	1	1	-	1	-	2	-
CO	1	1	1	1	1	2	1	2	1	1	1	1	-	2	-

3-High, 2- Medium, 1-Low

HS22501 **VALUE EDUCATION II** **L T P C**

1 0 0 0

COURSEOBJECTIVES:

- To impart knowledge on essential qualities to become a good leader
- To prepare them to have the ability to relate with others and contribute to industrial and human development
- To teach the significance of being responsible citizens of the society

UNIT I UNDERSTANDING THE SOCIETY AND BECOMING A LEADER 3

Problems of our society and their causes – styles of leadership – qualities and skills of leadership.

UNIT II PRACTICING LEADERSHIP FOR SOCIAL CHANGE 4

Possible areas of changes in the society with education – Utilising Engineering education to create social changes – strategies and people movement for the change.

UNIT III BALANCING PROFESSIONAL, PERSONAL, FAMILY FOR FULLNESS OF LIFE 4

Healthy adult as an individual and family – stages of life – strategies to balance life

UNIT IV INNOVATIVE SOCIAL COMMITMENT, SPIRITUALITY AND SOCIAL NETWORKING 4

Social commitment as a healthy spirituality – systematic contribution to society and industry – Networking professionals for growth and change.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate the essential steps to become good leaders.

CO2: Identify the various societal problems and also the solution.

CO3: Realise their role and contribution to nation building.

CO4: Apply the essential steps to become value based professionals.

TEXT BOOKS:

1. Warren G.Bennis, "On Becoming a Leader", Basic Books, 2009.
2. Suresh Agarwal, "Social Problems in India. Rajat Publications", 2015.

REFERENCES:

1. Biswaranjan Mohanty, "Constitution, Government and Politics in India", New Century Publication, 2009.
2. Myles Munroe "Releasing Your Potential", Destiny Image, 2007
3. Kelsang Gyatso, "How to Solve Our Human Problems: The Four Noble Truths", Tharpa Publications 2005.
4. Ifeanyi Enoch Onuoha, "Overcoming the challenges of life", Authorhouse, 2011.
5. John c Maxwell, "Five Levels of Leadership, the Proven Steps to Maximize Your Potential", Center Street, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO2	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO3	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO4	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-

3-High, 2- Medium, 1-Low

SEMESTER VI

HS22601	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify and analyze ethical issues in engineering
- To recognize the code of ethics with appropriate perspective as per industrial standards
- To understand the ethical situations in risky situation
- To provide services in their areas of expertise
- To be aware of the role of engineers in solving global issues

UNIT I ENGINEERING ETHICS, MORAL REASONING AND ETHICAL THEORIES **10**

Senses of 'Engineering Ethics' – Variety of Moral Issues – Types of Inquiry – Social Ethics vs Scientific Ethics vs Experiential Ethics – Moral Dilemmas – Moral Autonomy – Kohlberg's Theory – Gilligan's Theory – Professions and Professionalism – Professional Ideals and Virtues – Theories about Right Action – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **8**

Role of Professional Ethics in Engineering Based Product Development – Engineering as Experimentation – Engineers as Responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – Case Study.

UNIT III ENGINEERS' RESPONSIBILITY FOR SAFETY AND RISK **8**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analyses and Reducing Risk – Case Studies.

UNIT IV RESPONSIBILITIES AND RIGHTS **9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Whistle Blowing – Employee Rights – Discrimination – Intellectual Property Rights (IPR).

UNIT V GLOBAL ISSUES AND ROLE OF ENGINEERS **10**

Multinational Corporations – Environmental Ethics – Computer Ethics – Ethics of AI – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Corporate Social Responsibility – Ethics in Engineering Practice and Research – Ethical Audit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Visualize the scope of engineering ethics and ethical decision making.
CO2: Develop a perspective on engineering as an experiment.
CO3: Detail the importance of assessing safety and risk and reducing the risk.
CO4: Realize the responsibilities and rights of engineers, employees, employers and public.
CO5: Recognize the role of ethics related to MNC, Environment, Computer, AI, and while

acting as manager, consultant, and experts.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill Education, 2017.
2. Govindarajan M, Natarajan S and Senthil Kumar V.S, “Engineering Ethics”, Prentice Hall of India Pvt. Ltd., 2015.

REFERENCES:

1. Robert McGinn R., “The Ethical Engineer: Contemporary Concepts & Cases”, Princeton University Press, February 2018.
2. Mark Coeckelbergh, “AI Ethics”, The MIT Press, April 2020.
3. Qin Zhu, Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, Fifth Edition, 2022.
4. Deborah C. Poff and Alex C. Michalos, “Encyclopedia of Business and Professional Ethics”, Springer Nature, Switzerland AG, May 2023.
5. Frederic G. Reamer, “Social Work Values and Ethics”, Columbia University Press, New York, Sixth Edition, May 2024.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-
CO	-	-	-	-	-	1.7	2.0	3.0	2.0	1.0	-	2.0	-	-	-

ME22602	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives

- To learn basic principles of finite element analysis procedure
- To apply the finite element solutions to one dimensional problem.
- To learn the theory and characteristics of finite elements that represent engineering
- Structures.
- To develop the knowledge in order to effectively evaluate structural and thermal problems.
- To solve the problems from isoperimetric formulation.

UNIT – I INTRODUCTION **9**

General description of the finite element method - Engineering applications of finite element method - Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations - Boundary conditions: Rayleigh Ritz method, Weighted Residual Methods – Point collocation, Subdomain, least squares, Galerkin's method - Displacement method of finite element formulation - Discretization process, Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes. Strain displacement relations, Stress strain relations, Plain stress and Plain strain conditions - Boundary, Initial and Eigen Value problems - Variational Formulation of Boundary Value Problems.

UNIT – II ONE DIMENSIONAL PROBLEMS **9**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements –Spring elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of solid mechanics and heat transfer. Fundamentals of vibration.

UNIT – III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS **9**

Second Order 2D Equations – Finite Element formulation – Triangular elements – Constant Strain Triangular Element – Shape functions – Element matrices and vectors – Stress strain relationship matrix – Strain displacement matrix - Stiffness matrix - Body forces and temperature effects - Fundamentals of Torsion.

UNIT – IV TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS **9**

Elasticity equations - Axisymmetric elements Equations – Finite Element formulation – Triangular elements – Constant Strain Triangular Element – Equilibrium equation – Compatibility equations – Stiffness matrix - Body forces and temperature effects – Finite Element Analysis for Shell Element – Introduction – Classification - Assumptions

UNIT – V ISOPARAMETRIC FORMULATION **9**

Natural co-ordinate systems – Isoparametric, Superparametric and subparameteric elements, Shape functions - Jacobian Matrix - Numerical integration and application to plane stress problems - Introduction to Analysis Software – commercial FEM package.

Total 45 periods

OUTCOMES: At the end of the course the students would be able to

1. Apply the concepts of mathematical modeling in engineering problems.
2. Solve one dimensional structural and heat transfer problems.
3. Solve the two-dimensional scalar problems using finite element approach.
4. Solve the two-dimensional vector problems using finite element approach.
5. Illustrate the iso-parametric formulation using finite element method.

Textbooks:

1. Reddy. J.N., "An Introduction to the Finite Element Method", Fourth Edition, Tata McGraw-Hill, 2020
2. Tirupathi Chandrupatla & Ashok Belegundu. "Introduction to Finite Elements in Engineering", Fifth Edition, Cambridge University Press, 2021.

References:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, Indian reprint 2013.
2. S. Unnikrishnan Nair & S. Somanath, "Introduction to Finite Element Analysis" Springer, 2023.
3. Seshu, P, "Finite Element Analysis", Sixth Edition Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.
4. R B Patil., "Finite Element Analysis", Tech Knowledge Publications 2022.
5. Lakshmi Narasaiha, "Finite Element Analysis", CRC Press, 2019

Mapping of Course Outcomes to Programme Outcomes

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	3	2	1	-	-	-	-	-	-	1	1	-	-
CO4	3	3	1	1	1	-	-	-	-	-	-	2	1	1	-
CO5	3	2	3	2	1	-	-	-	-	-	-	1	1	-	-
CO	3	3	3	2	1	-	-	-	-	-	-	1	1	1	-

		L	T	P	C
ME22601	**MECHATRONICS**	**3**	**0**	**2**	**4**

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

- To introduce the students about the concept of actuators, valves, control devices and the need of a mechatronic system.
- To impart basic knowledge of sensors in mechanical systems.
- To expose mechatronics systems applications in different fields of mechanical.
- To introduce the basic principles of microprocessor and programming.
- To expose the students to basic principles of programmable logic controller

UNIT – I INTRODUCTION TO MECHATRONICS 7

Introduction to Mechatronics- Systems- Concepts of Mechatronics Approach-Need for Mechatronics- Emerging area of Mechatronics- Classification of Mechatronics.

UNIT – II SENSORS AND TRANSDUCERS 10

Sensors for mechanical systems or mechanical sensors -Static and dynamic Characteristics of Sensor, Typical sensors - wire and film strain gauges, anemometers, piezo electric and magneto strictive accelerometers, potentiometric sensors, LVDT – Thermometers for different situation – thermocouples thermistors – Light sensors- CCD, CMOS sensors.

UNIT – III MICROPROCESSOR 10

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Emerging Microprocessor-Intel, Ryzen, AMD.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLER 10

Introduction – Basic structure – Input and output processing– Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT – V MECHATRONIC DESIGN 8

Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Barcode reader.

Practical: 30

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division.
2. Speed control of DC motor using PID controller.
3. Modeling and analysis of basic pneumatic and electrical circuits using FluidSim software.
4. Modeling and analysis of basic pneumatic and electrical circuits using kit.
5. Stepper motor interface-Forward direction-reverse direction

Total 75

COURSE OUTCOMES: At the end of the course the students would be able to

CO1 Interpret the basic concepts of sensors for mechatronics systems

CO2 Explain the architecture and working of microprocessors mechatronics system

CO3 Illustrate the fundamentals of different mechatronics system.

CO4 Apply programming concepts & write programs for specific application using PLC

CO5 Develop mechatronics-based systems for specific mechanical applications.

TEXT BOOKS:

1 Bolton, "Mechatronics", Prentice Hall, fifth Indian Reprint, 2013

2 Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Sixth Edition, Prentice Hall, 2013.

REFERENCES:

1 Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 2003

2 Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

3 Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Second Edition, Cl-Engineering, 2010.

4 Krishna Kant, "Microprocessors & Microcontrollers", Second Edition, Prentice Hall of India, 2020.

5 Michael B. Histand and Davis G. Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2010.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	-	2	-	1	-	-	-	-	1	1	-	-
CO2	3	1	1	-	3	-	-	-	-	-	-	-	2	-	-
CO3	3	1	1	-	1	-	-	-	-	-	-	-	2	-	-
CO4	3	1	1	-	3	-	-	-	-	-	-	1	2	-	-
CO5	3	1	2	-	1	-	1	-	-	1	-	2	1	-	-
CO	3	1	1	-	2	-	1	-	-	1	-	1	2	-	-

ME22604 **CAD/CAM LABORATORY**

L	T	P	C
0	0	4	2

Course Objectives

- To gain practical experience in handling 2D drafting and 3Dmodelling software systems
- Designing 3 Dimensional geometric models of parts, sub-assemblies, and assemblies and exporting them to drawing
- Programming G & M Code programming and simulating the CNC program and Generating

part programming data through CAM software

3D GEOMETRIC MODELLING **30**

CAD Introduction:
Sketch:
Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.
Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.
Assembly: Constraints, Exploded Views, Interference check
Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting
Creation of 3D assembly model of following machine elements using 3D Modelling software
Flange Coupling
Plummer Block
Screw Jack
Lathe Tailstock
Universal Joint
Machine Vice
Stuffing box
Crosshead
Safety Valves
Non-return valves
Connecting rod
Piston
Crankshaft
* Students may also be trained in manual drawing of some of the above components

MANUAL PART PROGRAMMING **30**

CNC Machining Centre
Linear Cutting.
Circular cutting.
Cutter Radius Compensation.
Canned Cycle Operations
Canned Cycle facing cycle
Drilling Cycle
Mirroring
Subroutine

CNC Turning Centre
Straight, Taper and Radial Turning.
Thread Cutting.
Rough and Finish Turning Cycle.
Drilling and Tapping Cycle.
Grooving cycle

COMPUTER-AIDED PART PROGRAMMING
Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.
Application of CAPP in Machining and Turning

Total: 60 periods

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

1 Design experience in handling 2D drafting and 3D modeling software systems
2 Design a 3Dimensional geometric model of parts, sub-assemblies, and assemblies and export

it to drawing

3 Demonstrate manual part programming, simulate the CNC program.

4 Program G & M Code programming and simulate the CNC program.

5 Generate part programming data through CAM software

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	-	-	3	-	-	-	2	2	-	2	1	2	-
CO2	3	1	-	-	3	-	-	-	2	2	-	2	2	2	-
CO3	3	1	-	-	3	-	-	-	2	1	-	2	2	2	-
CO4	3	1	-	-	3	-	-	-	2	2	-	2	2	2	-
CO5	3	1	-	-	3	-	-	-	2	1	-	2	2	2	-
CO	3	1	-	-	3	-	-	-	2	2	-	2	3	2	-

SD22603 Coding Skills and Quantitative Aptitude – Phase I

L	T	P	C
0	0	4	2

Objectives

- To equip the students with the foundational knowledge and practical skills in HTML and CSS.
- To empower students with the knowledge and skills of JavaScript effectively for Web Development.
- To gain hands-on experience with real-world React Applications.
- To improve aptitude, problem solving skills and reasoning ability of the students
- To demonstrate the use of mathematical reasoning by justifying through numerical skills.

UNIT I UNDERSTAND HTML FUNDAMENTALS & QA & LR **12**

A Dive into Web Creation - Basic HTML Tags - Semantic Tags - Miscellaneous Tags - Text Formatting Tags - Lists - Links and Images - Forms.

Quants: Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression), HCF & LCM, Decimal Fractions, Simplification (Including Expression & Evaluation).

Logical Reasoning: Analogy - Blood Relations/Family Tree.

UNIT 2 MASTER CSS BASICS & QA & LR **12**

Unveiling the Art of CSS - Selectors and Specificity - Box Model and Layout - Typography and Fonts - Colors and Backgrounds.

Quants: Average-Problem on Ages.

Logical Reasoning: Coding-Decoding.

UNIT 3 JAVASCRIPT EXPEDITION & ROUTING & QA & LR **12**

JavaScript Expedition - Variables and Data Types - Control Flow - Loops - Functions - Arrays & Objects - DOM Manipulation.

Quants: Ratio & Proportions - Partnership-Mixtures and Alligations.

Logical Reasoning: Cryptarithmetic Problems, Syllogisms.

UNIT 4 LEARN REACT.JS FUNDAMENTALS & QA & LR 12

Creating first React Application - JSX - React Components - State and Props - Event Handling.
Quants: Time & Work-Chain Rule-Pipes and Cisterns.
Logical Reasoning: Calendar – Clocks - Images (Mirror & Water).

UNIT 5 BUILD INTERACTIVE WEB APPLICATIONS & QA & LR 12

React Lifecycle Methods - Using Lists and Keys - React in CAD: Interactive CAD Model Viewer - Customizable Design Parameters - CAD Model Comparison and Versioning - Project Work.
Quants: Time, Speed & Distance - Problems on Trains, Boats & Streams.
Logical Reasoning: Cubes and Dices - Data Sufficiency.

Suggestive Assessment Methods:

Pre-Assessment Test – To check the student's previous knowledge in Programming skills and quantitative aptitude and logical reasoning.
Internal Assessment I for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
Internal Assessment II for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
For assignments, students should attend all the practice tests conducted online on HackerRank and google form. Each assignment will be for 100 marks and finally the total marks obtained by a student in all assignments will be reduced to 40 marks.
Thus 60 marks from internal and 40 marks from assignments will make it a total of 100.

Outcome

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

CO 1	Construct webpages using HTML and CSS.
CO 2	Construct interactive and dynamic web applications using JavaScript.
CO 3	Construct a real-world React application.
CO 4	Apply quantitative techniques to solve a variety of problems and can enhance their employability quotient and to establish a stronger connection with the technical environment in which they operate.
CO 5	Interpret solutions for problems within short duration and can also think critically and apply basic mathematics skills to interpret data, draw conclusions and solve problems.

Text Books

1. Robin Wieruch," The Road to React: with React18 and React Hooks", CreateSpace Independent Publishing Platform, 2024.
2. Stoyan Stefanov, "React: Up & Running: Building Web Applications", Second Edition , O' Reilly Publications,2021.
3. Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, Reprint, 2023.
4. Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd.,New Delhi, Reprint, 2016.

Reference Books

1. Zac Gordan, Mikall Angela Hill, RobbieAddair, "React Explained: Your Step-By-Step Guide to React", oSTraining Publishers, 2020.
2. Alex Banks, Eve Porcello, "Learning React: Functional Web Development with React and Redux", O' Reilly Publications, January 2017.
3. Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, 2016

4. Arun Sharma, “How to Prepare for Logical Reasoning,” Tata-McGraw Hill Education Series. New Delhi, 2016.
5. Sharon Weiner Green, Ira K Wolf, “Barron’s GRE,” Barron Publishers. Reprint, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	1	-	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	1	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	1	-	-
CO4	1	1	1	-	-	-	-	-	1	-	-	1	1	-	-
CO5	1	1	1	-	-	-	-	-	1	-	-	1	1	-	-
CO	3	2	2	-	2	-	-	-	-	-	-	2	1	-	-

SMESTER VII

		L	T	P	C
ME22701	**TOTAL QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**

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

1	To understand the fundamentals, evolution, principles, and benefits of Total Quality Management (TQM) and its role in enhancing product and service quality.
2	To develop leadership and strategic planning skills for enhancing customer satisfaction.
3	To equip students with the knowledge and application of traditional and modern quality tools.
4	To provide an understanding of ISO standards, sector-specific certifications, and Environmental Management Systems (EMS).

UNIT – I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM- Basic concepts of TQM.
TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT – II TQM PRINCIPLES 9

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, Plan-Do-Study-Act (PDSA) cycle, 5S and Kaizen - Supplier partnership.

UNIT – III ADVANCED QUALITY MANAGEMENT TOOLS AND TECHNIQUES 9

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 -
Failure Modes and Effects Analysis (FMEA) - Intent , Documentation, Stages: Design FMEA and Process FMEA

UNIT – IV KEY CONCEPTS IN TQM 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – Total Productive Maintenance (TPM) – Concepts, improvement needs – Performance measures- Cost of Quality - Business Process Reengineering (BPR).

UNIT – V QUALITY MANAGEMENT SYSTEM 9

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 (EMS): Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.
Total 45

OUTCOMES: At the end of the course the students would be able to

CO1 Explain the need for quality, its evolution, barriers and benefits.

CO2 Explain the principles of Quality Management and its need.

CO3 Explain the quality of a business through appropriate tools and techniques

CO4 Use appropriate tools and techniques to design the quality system

CO5 Illustrate organizational quality using recognized standards and techniques.

Textbooks:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field, MaryB.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Fifth Edition, 2018.
2. Evans. J. R. & Lindsay. W,M "The Management and Control of Quality", SouthWestern (Thomson Learning), Fifth Edition, 2012.

References:

1. Janakiraman. B and Gopal.R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2011.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2016
3. F.S. Hillier & G.J. Lieberman, " Introduction to Operations Research- Concepts and Cases" Tata McGraw Hill Ninth Edition, 2010
4. Juran J. M., Juran's Quality Handbook, McGraw-Hill, Sixth Edition, 2010.

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	-	-	-	2	-	-	-	-	3	-	-	-	3
CO2	3	2	-	-	2	-	-	-	-	-	3	-	-	-	3
CO3	2	2	-	-	2	-	-	-	-	-	3	-	-	-	3
CO4	2	2	-	-	-	3	-	-	-	-	3	-	-	-	3
CO5	2	1	-	-	-	2	2	-	-	-	3	-	-	-	3
CO	2	2	-	-	4	2	2	-	-	-	3	-	-	-	3

ME22702 SIMULATION AND ANALYSIS LABORATORY

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

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

1 To give exposure to software tools needed to analyze engineering problems.

2 To expose the students to different applications of simulation and analysis tools.

LIST OF EXPERIMENTS

A. SIMULATION

Introduction of simulation software

Simulation of cam and follower mechanism using a simulation software

Simulation of Spring-mass system using a simulation software

B. ANALYSIS
Force and Stress analysis using link elements in Trusses, cables etc.
Stress and deflection analysis in beams with different support conditions.
Stress analysis of flat plates and simple shells.
Stress analysis of axi – symmetric components.
Thermal stress and heat transfer analysis of plates.
Thermal stress analysis of cylindrical shells.
Vibration analysis of spring-mass systems.
Model analysis of Beams.
Harmonic, transient and spectrum analysis of simple systems.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1 Define and illustrate the need for simulation and analysis for real world problems.

CO2 Interpret and make use of different features in the simulation and analysis tools.

CO3 Make use of the simulation software to construct and execute mechanical engineering problems.

CO4 Model real world problems and analyze the effect of various mechanical and thermal forces through simulation.

CO5 Analyze the model and apply the results to resolve critical issues in real world engineering problems.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	3	-	-	-	-	-	2	-	3	-	-
CO2	3	2	3	3	3	-	-	-	-	-	2	-	3	-	-
CO3	3	2	3	3	3	-	-	-	-	-	2	-	3	-	-
CO4	3	2	3	3	3	-	-	-	-	-	2	-	3	-	-
CO5	3	2	3	3	3	-	-	-	-	-	2	-	3	-	-
CO	3	2	3	3	3	-	-	-	-	-	2	-	3	-	-

SD22703 Coding Skills and Quantitative Aptitude – Phase II

L	T	P	C
0	0	4	2

Objectives

To introduce foundational concepts of databases and database design principles.

To provide hands-on experience in backend development using Spring Boot.

To equip students with the skills to build RESTful web services and perform CRUD operations using JPA.

To enhance problem-solving skills through quantitative reasoning techniques.

To develop logical reasoning and safety compliance systems using advanced backend technologies.

Unit I Database Basics & Quants – Time, Speed and Distance 12

Introduction to Database- Database Design Principles – SQL Basics – Querying a Database
Quants: Time, Speed and Distance - Time, Speed & Distance - Problems on Trains-Boats & Stream

Unit 2 Developing Back End using Spring Boot & Quants – Percentage & Interest 12

Introduction to Spring Boot – Creating a simple Spring Boot Application- Bean Scopes and Life Cycle
Quants: Percentage & Interest - Percentage-Interest (Simple Interest, Compound Interest)-Profit & Loss

Unit 3 Building RESTful Web Services & Quants – Probability 12

Spring Boot Starters – Introduction to REST - Dependency Injection – Handling HTTP Methods
Quants: Probability - Probability-Permutations & Combinations

Unit 4 Data Persistence with Spring Data JPA, Repositories & Logical Reasoning 12

Path Variables and Request Parameters – Overview of JPA and Hibernate – Setting up Spring Data JPA in a Spring Boot project - Creating and using Repositories – Basic CRUD operations with JPA Repository.
Logical Reasoning: Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)- Direction sense test - Linear/Seating Arrangements - Series completion

Unit 5 Safety and Compliance System Using Spring Boot & Logical Reasoning 12

Safety Inspection Management – Incident Reporting – Compliance Tracking – Risk Assessment – Audit Trial – Notifications and Alerts.
Logical Reasoning: Logical Venn Diagram/Syllogisms - Odd man out/Finding missing elements - Crypt arithmetic Questions – Puzzles
Suggestive Assessment Methods:
Pre-Assessment Test – To check the student's previous knowledge in Programming skills and quantitative aptitude and logical reasoning.
Internal Assessment I for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
Internal Assessment II for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
Post-Assessment: Evaluating students' knowledge gained from the Coding Skill and Quantitative Aptitude – Phase II Skill Development Course.
For assignments, students should attend all the practice tests conducted online on HackerRank and google form. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
The total of 100 marks obtained from the tests will be then reduced to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

Outcomes

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

CO 1	Understand database design principles and perform SQL-based operations effectively.
CO 2	Build backend applications using Spring Boot and apply appropriate lifecycle management techniques.
CO 3	Develop and implement RESTful web services using HTTP methods and dependency injection.
CO4	Solve quantitative problems in time, speed, distance, probability, and other numerical concepts.
CO5	Design and implement safety and compliance systems and apply logical reasoning to solve complex scenarios.

Text Books

Craig Walls, "Spring Boot in Action", Manning Publishers, Sixth Edition, March 2022.
Felipe Gutierrez, "Pro Spring Boot 2: An authorative Guide to Building Microservices, Web and Enterprise Applications, and Best Practices", ApressPublishers, Second Edition, January 2018.
Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016.
Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016.

Reference Books

Alex Antonov, "Spring Boot 2.0 Cookbook", Packt Publishers, Second Edition, February 2018.
John Carnell, "Spring Microservices in Action", Manning Publishers, Second Edition, June 2021.
Anand P A, "Quantitative Aptitude," Wiley India Pvt.Ltd., New Delhi, Edition, 2016
Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi, First Edition 2016.
Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers. First Edition 1995, Reprint, 2016.

CO PO Mapping:

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	3	-	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	3	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	3	-	-
CO4	1	1	1	-	-	-	-	-	1	-	-	1	3	-	-
CO5	1	1	1	-	-	-	-	-	1	-	-	1	3	-	-
CO	3	2	2	-	2	-	-	-	-	-	-	2	3	-	-

ME22703 Product development Lab

L	T	P	C
0	0	4	2

Course Objectives

1. Encourage students to identify real-world problems and define project objectives effectively.
2. Train students to apply engineering principles, tools, and methodologies to create innovative designs.
3. Provide hands-on experience in selecting materials, components, and manufacturing processes suitable for project realization.
4. Enable students to convert conceptual designs into functional prototypes using fabrication techniques and tools.
5. Emphasize the importance of preparing detailed technical reports, drawings, and presentations to articulate project outcomes.

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry.
A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.
At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners.

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

1. Demonstrate the ability to conceptualize and design a mechanical, electrical, or multidisciplinary system.
2. Apply engineering principles, techniques, and tools for the fabrication of a functional prototype or product.
3. Analyze the feasibility of the designed system or product through appropriate simulations and testing.
4. Design a system or product and execute a project within specified constraints.
5. Develop problem-solving skills and innovative thinking through practical application of learned concepts.

COs	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	2	-	3	-	3	3	3	2	3	3	3
CO2	3	3	3	2	2	-	3	-	3	3	3	2	3	3	3
CO3	3	3	3	2	2	-	3	-	3	3	3	2	3	3	3
CO4	3	3	3	1	2	-	3	-	3	3	3	2	3	3	3
CO5	3	2	3	2	2	-	3	-	3	3	3	2	3	3	3
CO	3	3	3	2	2	-	3	-	3	3	3	2	3	3	3

SMESTER VIII

ME22801 Project Work / Internship	L	T	P	C
	0	0	16	8

Course Objective:

The primary objective of this course is to equip students with the skills necessary to identify, analyze, and solve a specific problem through systematic research and development. It aims to guide students through the entire project lifecycle—from problem identification and literature review to the successful implementation of a solution. Additionally, the course trains students in the preparation of detailed project reports and enhances their ability to effectively present and defend their work through reviews and viva voce examinations. Working in groups of 3 to 4 under the supervision of a faculty member and with the approval of the Head of the Department, students are expected to complete the project and submit a comprehensive report. Progress is monitored through at least three formal reviews, and final evaluation is carried out by both internal and external examiners based on the report and oral presentation.

Total: 240 periods

Course Outcomes:

CO1. Upon successful completion of this course, students will be able to:

CO2. Identify and define real-world problems through literature review.

CO3. Develop appropriate solutions using relevant tools, techniques, and methodologies.

CO4. Demonstrate effective teamwork skills to plan, execute, and manage project activities collaboratively

CO5. Develop a well-structured and technically sound product prototype/ project report supported by appropriate documentation.

CO6. Defend the project work the project work through formal presentations and viva voce examinations

PROFESSIONAL ELECTIVES

VERTICAL 1: THERMAL SCIENCES

ME22511	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Explaining the working of Gasoline fuel injection systems and SI combustion.
- Explaining the working of Diesel fuel injection systems and CI combustion.
- Identifying the source and measure it; explain the mechanism of emission formation and control methods.
- Selecting alternative fuel resources and its utilization techniques in IC engines.
- Explaining advanced combustion modes and future power train systems.

UNIT – I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.

UNIT – II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.

UNIT – III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Bharat Stage Emission Standards - Background, List of Bharat Stage Norms & Significance.

UNIT – IV ALTERNATIVE FUELS 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.

UNIT – V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the working of fuel injection systems and combustion.

CO2: Interpret different fuel injection system, supercharging and its effect on performance of SI and CI engine.

CO3: Group alternative fuel resources and its utilization techniques in IC engines.

CO4: Interpret the data of alternative fuels and its emission which effect the environment

CO5: Experiment advanced combustion modes and future power train systems.

TEXT BOOKS:

1. V. Ganesan, "Internal Combustion Engines", Fourth Edition, Tata McGraw Hill, 2017.
2. John B. Heywood, "Internal Combustion Engines Fundamentals", Second Edition, McGraw-Hill, 2018.

REFERENCES:

1. B.P. Pundir, "IC Engines Combustion & Emission", Narosa Publishing House, 2014.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines, Scitus Academics LLC, 2018.
4. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, "Internal Combustion Engines", DhanpatRai& Sons, 2007

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-		1					1		1	1	1	
CO2	3	2	1		1					1		1	1	1	
CO3	3	2	1		1					1		2	2	2	
CO4	3	2	1		1					1		1	2	2	
CO5	3	2	1		1					1		1	2	2	
CO	3	2	1		1					1		1	1	1	

3-High, 2- Medium, 1-Low

ME22512 REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To understand the fundamentals of refrigeration and air conditioning.
- To calculate the cooling/heating load for different applications.
- To select the appropriate equipment for various RAC applications.
- To design and implement refrigeration and air conditioning systems as per the recommended standards

UNIT – I INTRODUCTION **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. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT – III OTHER REFRIGERATION SYSTEM 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric 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 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the basic concepts of refrigeration system

CO2: Compute the performance of vapour compression refrigeration cycle.

CO3: Classify the various VARS, aircraft refrigeration system and other refrigeration system.

CO4: Apply the psychrometric principles for air-conditioning systems.

CO5: Design various components of air-conditioning systems.

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", Fourth edition, McGraw Hill, New Delhi, 2010
2. Manohar Prasad," Refrigeration and Air Conditioning", New Age Publishers, 2021.

REFERENCES:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", Fifth edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", Fourth edition, Pearson Education Asia, 2009.
4. Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,
5. Frank Kreith, Paul Norton, Shan K. Wang, "Air Conditioning and Refrigeration Engineering ", CRC Press, 2018

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

CO1	2	1										1		1	
CO2	3	2	1	1								1		1	
CO3	3	2	1									2		1	
CO4	3	2	1									1		1	
CO5	3	2	1	1		1				1		1	2	1	
CO	3	2	1	1		1				1		1	2	1	

3-High, 2- Medium, 1-Low

ME22611 TURBO MACHINES

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- Explaining the energy transfer in rotor and stator parts of the turbo machines.
- Explaining the function of various elements of centrifugal fans and blowers.
- Evaluating the working and performance of centrifugal compressor
- Analysing flow behaviour and flow losses in axial flow compressor.
- Explaining the types and working of axial and radial flow turbines.

UNIT – I WORKING PRINCIPLES **9**

Classification of Turbo machines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbo machines.

UNIT – II CENTRIFUGAL FANS AND BLOWERS **9**

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.

UNIT – III CENTRIFUGAL COMPRESSOR **9**

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT – IV AXIAL FLOW COMPRESSOR **9**

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT – V AXIAL AND RADIAL FLOW TURBINES **9**

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the energy transfer in rotor and stator parts of the turbo machines.
CO2: Classify the function of various elements of centrifugal fans and blowers
CO3: Differentiate the types and working of axial and radial flow turbines
CO4: Compute the working and performance of centrifugal compressor.
CO5: Analyse flow behaviour and flow losses in axial flow compressor.

TEXT BOOKS:

1. Ganesan, V., "Gas Turbines", Third Edition, Tata McGraw Hill, 2017.
2 Yahya, S.M., "Turbines, Compressor and Fans", Fourth Edition, Tata McGraw Hill, 2017.

REFERENCES:

1 Dixon, S.L, "Fluid Mechanics and Thermodynamics of Turbomachinery", Seventh Edition, Butterworth-Heinemann, 2014.
2 Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., Second Edition, 2008.
3 S. Larry Dixon, Cesare Hall, " Fluid Mechanics and Thermodynamics of Turbomachinery" Elsevier Science , 2013.
4 Saravanamutto, Rogers, Cohen, Straznicky, "Gas Turbine Theory" Sixth Edition, Pearson Education Ltd, 2009.
5 Seppo A. Korpela, " Principles of Turbomachinery ", Wiley ., 2019.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1								1	1		
CO2	3	2	2	2								1	2		
CO3	3	2	2	2								2	2	1	
CO4	3	2	2	2								1	2	1	
CO5	3	2	2	1								1	2	1	
CO	3	2	2	2								1	2	1	

3-High, 2- Medium, 1-Low

ME22612 GAS DYNAMICS AND JET PROPULSION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of compressible flow concepts and the use of gas tables.
- To learn the compressible flow behaviour in constant area ducts.
- Visualizing the development of shock waves and its effects.
- To learn the types of jet engines and their performance parameters.
- To learn the types of rocket engines and their performance parameters.

UNIT – I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT – II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

UNIT – III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT – IV JET PROPULSION **9**

Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

UNIT – V SPACE PROPULSION **9**

Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the fundamentals of compressible flow concepts and the use of gas tables.
CO2: Compute the compressible flow behaviour in constant area ducts.
CO3: Predict the development of shock waves and its effects.
CO4: Summarise the types of jet engines and their performance parameters.
CO5: Summarise the types of rocket engines and their performance parameters.

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2017.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", Fourth Edition, New Age International (P) Limited, 2012.

REFERENCES:

1. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", Second edition, Wiley, 2019.
2. Akihiro Sasoh ., "Fundamentals of Compressible Fluid Dynamics", Springer Nature Singapore , 2020.
3. Radhakrishnan, E., "Gas Dynamics", Printice Hall of India, 2006.
4. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison-Wesley Longman, 2010.
5. V. Babu," Fundamentals of Propulsion", Springer International Publishing, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1								1		1	
CO2	3	2	2	2	1							1		2	
CO3	3	2	2	2	2							1		2	
CO4	3	2	2	2								1		1	
CO5	3	2	2	1								1		1	
CO	3	2	2	2	1							1		1	

3-High, 2- Medium, 1-Low

ME22711	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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

Rankine cycle - improvisations, 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 Cogeneration 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 Gasifier 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 Options for Coal and Nuclear Power Plants.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the operation and maintenance of coal based thermal power plants.
CO2: Explain Diesel, Gas Turbine and Combined Cycle Power Plants.
CO3: Illustrate the operation and maintenance of Nuclear Power Plants
CO4: Explain various renewable energy sources.
CO5: Calculate energy and economic related issues in power sectors.

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Fourth Edition, Tata McGraw – Hill Publishing Company Ltd., 2017.
2. R.K. Rajput “A Textbook of Power Plant Engineering”, Fifth Edition, Laxmi Publications;

2016.

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Harish C. Rai, Shipra Rai, "Power Plant Engineering", I.K. International Publishing House Pvt. Limited, 2017.
4. Farshid Zabihian, " Power Plant Engineering", CRC Press, 2019.
5. P.K Das, A.K Das, "An Introduction to Thermal Power Plant Engineering and Operation", Notion Press, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2								1	2	1	
CO2	2	2	2	2								1	2	1	
CO3	2	2	2	2								1	2	1	
CO4	2	2	2	2								1	2	1	
CO5	2	2	2	2								1	2	1	
CO	2	2	2	2								1	2	1	

3-High, 2- Medium, 1-Low

ME22712 MEASUREMENTS AND CONTROLS

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- Identify measurement parameters and analyse errors of measurements.
- Select and apply suitable transducer for a particular measurement.
- Identify measurement parameters and select the appropriate sensor for it.
- Explain the working of various types of control systems of apply for specific applications.
- Apply the principle of automatic control systems to control various parameter(s).

UNIT – I MEASUREMENTS AND ERROR ANALYSIS 9

General concepts – Units and standards – Measuring instruments –sensitivity, readability, range, accuracy, precision – static and dynamic response – repeatability hysteresis – systematic and random errors –Statistical analysis of experimental data – Regression analysis – Curve fitting - calibration and Uncertainty.

UNIT – II TRANSDUCER VARIABLES AND MEASUREMENT SIGNALS 9

Displacement transducers – potentiometer, strain gauge – orientation of strain gauge, LVDT – variable reluctance transducers, proximity sensors, capacitance transducers, tacho generator; smart sensors, integrated sensors, radio telemetry, precision systems like video discs and drives, laser printer etc

UNIT – III PARAMETERS FOR MEASUREMENT 9

Dimension, displacement, velocity, acceleration, Impact – Force, torque, power- Pressure, Temperature, Heat Flux, Heat Transfer Coefficients, Humidity – Flow – Velocity - Time, frequency and phase angle – noise and sound level.

UNIT – IV CONTROL SYSTEMS 9

Basic elements – feedback principle, implication of measurements – Error detectors – final actuating elements – Two position, multi-position, floating, proportional controls – relays – servo amplifiers – servo motors – Electrical, magnetic, electronic control systems

UNIT – V APPLICATION OF CONTROL SYSTEMS 9

Governing of speed, kinetic and process control – pressure, temperature, fluid level, flow-thrust and flight control – photo electric controls – designing of measurement and control systems for different applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify measurement parameters and analyse errors of measurements.

CO2: Determine a suitable transducer for a particular measurement.

CO3: Identify measurement parameters and select the appropriate sensor for it.

CO4: Explain the working of various types of control systems of apply for specific applications.

CO5: Apply the principle of automatic control systems to control various parameter(s).

TEXT BOOKS:

1. Venkateshan S P, "Mechanical Measurements", Second Edition, John Wiley & Sons, Ltd, 2015.
2. William Bolton, "Instrumentation and Control Systems", Third Edition, Newnes, 2021.

REFERENCES:

1. Beckwith, Marangoni and Lienhard, Mechanical Measurements, Pearson, 2013.
2. Ernest Doebelin and Dhanesh Manik, Measurement Systems, McGraw Hill International Edition, 2017.
3. Holman J P, "Experimental Methods for Engineers", Seventh edition, McGraw Hill Int. Edition, 2017.
4. Nagrath I J, "Control Systems Engineering", New Age International Publishers, 2018.
5. Nakra B. C, and Chaudhry K.K, Instrumentation, Measurement, and Analysis, Fourth edition, Tata McGraw Hill, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2								1	2	1	
CO2	2	2	2	2								1	2	1	
CO3	2	2	2	2								1	2	1	
CO4	2	2	2	2								1	2	1	
CO5	2	2	2	2								1	2	1	
CO	2	2	2	2								1	2	1	

3-High, 2- Medium, 1-Low

VERTICAL 2: ENGINEERING DESIGN & MANUFACTURING

ME22521 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the process planning concepts to make cost estimation for various products after process planning.
- 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 - Steps involved in process planning - 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 of jigs and fixtures - Selection of quality assurance methods - Set of documents for process planning - Break-even analysis.

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 of labour cost, material cost - Allocation of overhead charges.

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 PERIODS

COURSE OUTCOMES:

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

CO1: Classify the process, equipment and tools for various industrial products.

CO2: Interpret the process planning activity chart..

CO3: Explain the methods of cost estimation.

CO4: Plan the job order cost for different type of shop floor.

CO5: Identify the machining time for various machining operations.

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science

technology Books, Dec 2002.
2. Panneerselvam, P , Sivasankaran, P , " Process planning and cost estimation ", Prentice-Hall Of India , 2016.

REFERENCES:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", Second Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", Ninth Edition, Wiley India Pvt. Limited, 2008.
3. Russell R.S and Tailor B.W, "Operations Management", Fourth Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. D.R. Kiran, "Production Planning and Control- A Comprehensive Approach", Elsevier Science, 2019.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	1	-	2	2
CO2	3	2	2	-	-	-	-	-	-	-	-	1	-	3	2
CO3	2	2	2	-	-	-	-	-	-	-	-	1	-	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	1	-	2	-
CO5	2	2	2	-	-	-	-	-	-	-	-	1	-	2	-
CO	2	2	2	-	-	-	-	-	-	-	-	1	-	2	1

3-High, 2- Medium, 1-Low

ME22522 DESIGN OF TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- 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 gears.
- To learn the design bevel and worm gears of transmission system.
- To learn the concepts of design multi and variable speed gear box for machine tool applications.
- To learn the concepts of design to brakes and clutches.

UNIT I DESIGN OF FLEXIBLE ELEMENTS 9

Types of belts - Belt materials - Tensions in a belt drive - Stresses in the belt - Design of Flat belts and pulleys - Selection of V belts and pulleys - Types of chain drives, Advantages and limitations - Design of Transmission chains and Sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Speed ratios and number of teeth - Tooth stresses - Dynamic effects - Fatigue strength - Factor of

safety - Gear materials - 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.

UNIT III BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, Tooth forces and stresses, Equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.

Worm Gear: Merits and demerits, Terminology, Thermal capacity, Materials - Forces and stresses, Efficiency, Estimating the size of the worm gear pair.

UNIT IV GEAR BOXES 9

Geometric progression - Preferred numbers - Standard step ratio - Structural formula - Ray diagram, Kinematic layout - Basic rules for optimum gear box design - Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box.

UNIT V CLUTCHES AND BRAKES 9

Functions of clutch - Friction materials - Design of plate clutches - Service factors - Cone clutch - Internal expanding rim clutches - External contracting rim clutches.

Classification of brakes - Block brakes - Band brakes - Differential band brakes - Internal expanding shoe brakes - External contracting shoe brakes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design the belt, rope and chain drives.
CO2: Design the spur and helical gears.
CO3: Design the bevel and worm gears.
CO4: Design the gear boxes for specific applications.
CO5: Design the brakes and clutches for specific applications.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", Fourth Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", Eighth Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" Eighth Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", Fourth Edition, Wiley,2005.
5. R.S. "Khurmi, J.K. Gupta "Machine Design", S. CHAND, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

CO1	3	2	3	-	-	-	-	-	-	-	-	2	3	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	1	3	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	1	3	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	1	3	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	2	3	-	-
CO	3	2	3	-	-	-	-	-	-	-	-	1	3	-	-

3-High, 2- Medium, 1-Low

ME22621 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools.
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS 9

Design and development of jigs for given component - Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs

UNIT III FIXTURES 9

Design and development of fixtures for given component - General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT V BENDING AND DRAWING DIES 9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads-ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Summarize the different methods of Locating Jigs and Fixtures and Clamping principles.

CO2: Design a jig for given component. .

CO3: Design the fixtures for given component.

CO4: Explain the press working terminologies and elements of cutting dies.

CO5: Design a die for the development of axisymmetric, rectangular and elliptic parts.

TEXTBOOKS:

1. Joshi, P.H. "Jigs and Fixtures", Third edition, Tata McGraw Hill Publishing Co., Ltd., 2017.
2. Joshi P.H "Press tools - Design and Construction", 23rd edition, Wheels publishing, 2019.

REFERENCES:

1. David Alkire Smith, David Spitler, John G. Nee, "Fundamentals of Tool Design", Fifth edition, Society of Manufacturing Engineers, 2003.
2. Donaldson, Lecain and Goold "Tool Design", Fifth Edition, Tata McGraw Hill, 2017.
3. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
4. Kempster, " Introduction To Jig And Tool Design ", Third Edition, Hoddes and Stoughton, 2004.
5. Venkataraman. K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	1	-	2	2
CO2	3	2	2	-	-	-	-	-	-	-	-	1	-	3	2
CO3	2	2	2	-	-	-	-	-	-	-	-	1	-	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	1	-	2	-
CO5	2	2	2	-	-	-	-	-	-	-	-	1	-	2	-
CO	2	2	2	-	-	-	-	-	-	-	-	1	-	2	1

3-High, 2- Medium, 1-Low

ME22622 NON-TRADITIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To classify non-traditional machining processes and describe mechanical energy based nontraditional machining 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 INTRODUCTION AND 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.

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.

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.

UNIT V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction- working principles, equipments, applications, advantages and limitations of Electro chemical spark machining, Electrical discharge diamond grinding, Abrasive jet micro machining, Ultrasonic micromachining process.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Classify different types of non-traditional machining processes and explain mechanical energy based non-traditional machining processes.

CO2: Illustrate chemical and electro chemical energy-based processes.

CO3: Explain thermo-electric energy based processes.

CO4: Outline the working principle and the process parameters of nano-finishing processes.

CO5: Explain hybrid non-traditional machining processes and differentiate non- traditional machining processes.

TEXT BOOKS:

1. Adithan. M., “Unconventional Machining Processes”, Atlantic, New Delhi, India, 2018.
2. Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES:

1. Benedict, G.F., “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., 2017.
2. Carl Sommer, “Non-Traditional Machining Handbook”, Advance Publishing, 2000,
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., “Non-traditional Micromachining Processes: Fundamentals and Applications”, Springer International Publishing., 2017,
4. Jagadeesha T., “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., 2017.

5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", Springer International Publishing., 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	-	1	-	1	-	1	1	-	1	2	2	-
CO2	3	-	1	-	1	-	1	-	1	1	-	1	2	2	-
CO3	3	-	1	-	1	-	1	-	1	1	-	1	2	2	-
CO4	3	-	2	-	1	-	1	-	1	1	-	1	2	2	-
CO5	3	-	3	-	1	-	1	-	1	1	-	1	3	3	-
CO	3	-	2	-	1	-	1	-	1	1	-	1	2	2	-

3-High, 2- Medium, 1-Low

ME22721 COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To provide the overview of evolution of automation, CIM and its principles.
- To learn the various Automation tools, include various material handling system.
- To train students to apply group technology and FMS.
- To familiarize the computer aided process planning in manufacturing.
- To introduce to basics of data transaction, information integration and control of CIM.

UNIT I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM.

UNIT II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Automated storage/Retrieval system and Carousel storage system– smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing.

UNIT III GROUP TECHNOLOGY AND FMS 9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS ─ FMS applications, Benefits.

UNIT IV PROCESS PLANNING 9

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Typical

process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

UNIT V PROCESS CONTROL AND DATA ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basics of computer aided engineering.

CO2: Classify appropriate automotive tools and material handling systems. .

CO3: Illustrate the overview of group technology, FMS and automation identification methods.

CO4: Illustrate the manufacturing of various components using computer aided process planning.

CO5: Explain the computer process control techniques.

TEXT BOOKS:

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2. August-Wilhelm Scheer, Computer Integrated Manufacturing: Computer Steered Industry Book, Springer Berlin Heidelberg, 2012.

REFERENCES:

1. A lavudeen and Venkateshwaran, "Computer Integrated Manufacturing", PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi, Ronald D. Weill, "Principles of Process Planning", Springer Netherlands , 2012.
3. James A. Retrg, Herry W. Kraebber, "Computer Integrated Manufacturing", Third Pearson Education, Asia, 2004.
4. Mikell P. Groover, Automation, "Production system and Computer integrated Manufacturing", Fourth edition, Prentice Hall of India Pvt. Ltd., 2014.
5. R adhakrishnan P, Subramanian S, Raju V, "CAD/CAM/CIM", Third edition, New Age International Publishers, 2008.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	1	-	-	-	1	-	-	1	-	2	3
CO2	3	2	2	-	1	-	-	-	1	-	-	1	-	2	3
CO3	3	2	2	-	1	-	-	-	1	-	-	1	-	2	3
CO4	3	2	2	-	1	-	-	-	1	-	-	1	-	2	3

CO5	3	2	2	-	1	-	-	-	1	-	-	1	-	2	3
CO	3	2	2	-	1	-	-	-	1	-	-	1	-	2	3

3-High, 2- Medium, 1-Low

ME22722 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the concept of production planning and control act work study.
- To apply the concept of product planning
- To analyze the production scheduling.
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production – job, batch, mass and continuous - Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect - Aesthetic aspect. Standardization, Simplification & Specialization- Break even analysis.

UNIT II WORK STUDY **9**

Method study, basic procedure – Selection - Recording of process - Critical analysis, Development - Implementation - Recording techniques - Micro motion and memo motion study – Work measurement - Techniques of work measurement - Time study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning- Need for product planning -Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT IV PRODUCTION SCHEDULING **9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Flow production scheduling-Batch production scheduling-Product sequencing -Line of balance - Material requirement planning – Dispatching - Progress reporting and expediting.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory control - Purpose of holding stock - Inventory costs - Effect of demand on inventories - Ordering procedures. Two bin system - Determination of Economic order quantity and economic lot size- ABC analysis - Introduction to computer integrated production planning systems- Kanban - Elements of JUST IN TIME SYSTEMS- Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the process planning concepts.

CO2: Illustrate how the use of work study leads to high productivity in a manufacturing unit. .

CO3: Illustrate the steps involved in product planning and the various process planning activities.

CO4: Develop a master production schedule in a manufacturing system.

CO5: Describe the recent trends in production planning and control.

TEXT BOOKS:

1. Martand Telsang, "Industrial Engineering and Production Management", Third edition, S. Chand and Company, 2018.
2. Norman Gaither, G. Frazier, "Operations Management" Ninth Edition, Thomson learning IE, 2007.

REFERENCES:

1. D.R. Kiran., " Production Planning and Control, A Comprehensive Approach", Elsevier Science, 2019.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", Eighth Edition, John Wiley and Sons, 2000.
3. Hemant Sharma, "Production Planning Control", BookRix, 2019.
4. Kanishka Bedi, "Production and Operations management", Second Edition, Oxford university press, 2007.
5. Upendra Kachru, "Production and Operations Management – Text and cases" Excel books 2007.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	2	-	-	-	-	-	-	2	1	-	-	3
CO2	2	2	1	1	-	-	-	-	-	-	2	1	-	-	3
CO3	3	2	1	2	-	-	-	-	-	-	2	1	-	-	3
CO4	3	2	1	2	-	-	-	-	-	-	2	1	-	-	3
CO5	3	2	1	2	-	-	-	-	-	-	2	1	-	-	3
CO	3	2	1	2	-	-	-	-	-	-	2	1	-	-	3

3-High, 2- Medium, 1-Low

VERTICAL 3: GREEN ENERGY TECHNOLOGIES

ME22531	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To elucidate on biomass, types, availability, and characteristics
- To understand the bio-methanation process.
- To impart knowledge on combustion of biofuels
- To describe on the significance of equivalence ratio on thermochemical conversion of biomass
- To provide insight to the possibilities of producing liquid fuels from biomass

UNIT – I INTRODUCTION **9**

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies

UNIT – II BIOMETHANATION **9**

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

UNIT – III COMBUSTION **9**

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT – IV GASIFICATION, PYROLYSIS AND CARBONISATION **9**

Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT – V LIQUIFIED BIOFUELS **9**

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Summarize the various bio-resources to convert it into useful alternative products in Indian and global scenario.
CO2:	Illustrate the objectives for the bioenergy conversion process in terms of social and economic concern.
CO3:	Demonstrate the conversion mechanism involved from biomass to useful liquid or gaseous fuels.
CO4:	Explain the various liquid and gaseous fuels through different methods from the biomass resources.
CO5:	Choose the various liquid and gaseous fuels for different applications.

TEXT BOOKS:

1. Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, “Biomass for Bioenergy and Biomaterials”, CRC Press; 2021.
2. Augustine O. Ayeni, Samuel Eshorame Sanni, Solomon U. Oranusi, “Bioenergy and

Biochemical Processing Technologies", Springer, 2022.

REFERENCES:

1. Pratima Bajpai, "Biomass to Energy Conversion Technologies - The Road to Commercialization", Elsevier Science, 2019.
2. Abdullah M. Asiri, Anish Khan, Antonio Pizzi, Illyas M.D. Isa, Mohammad Jawaid, Naved Azum, "Advanced Technology for the Conversion of Waste Into Fuels and Chemicals", Vol. 1, Elsevier Science, 2021.
3. Chinnappan Baskar, Ranjit S. Dhillon, Shikha Baskar, "Biomass Conversion - The Interface of Biotechnology, Chemistry and Materials Science", Springer Berlin Heidelberg, 2012.
4. Gheorghe Lazaroiu, Lucian Mihaescu, "Innovative Renewable Waste Conversion Technologies", Springer International Publishing, 2021.
5. Ajay K. Dalai, Sonil Nanda, "Biomass to Bioenergy - Modern Technological Strategies for Biorefineries", Elsevier Science, 2023.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2							1	1	2		
CO2	3	3	2	1							1	1	2		
CO3	3	3	2	2							1	1	2		
CO4	3	3	2	2							1	1	2		
CO5	3	3	2	2							1	1	2		
CO	3	3	2	2							1	1	2		

3-High, 2- Medium, 1-Low

ME22532 CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To introduce climate change and carbon footprint
- To study the principle of product life cycle and Green House Gas emissions accounting
- To study the Methodology for Carbon Footprint Calculation
- To learn emission mitigation and carbon sink
- To study the case study of carbon footprint.

UNIT – I CLIMATE CHANGE AND CARBON FOOTPRINT 9

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations

UNIT – II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9

Life- cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting

- Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality- Allocation and Assessing Uncertainty-

UNIT – III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes

UNIT – IV EMISSION MITIGATION AND CARBON SINK 9

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Polcies, Institutions and international corporations – Carbon Pricing and Finance – GHG Offsetting and Green marketing.

UNIT – V CASE STUDIES 9

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management-

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the fundamentals of climatic change and carbon footprint.

CO2: Estimate the impacts of greenhouse gas effect on climatic change.

CO3: Review the effects of climatic change and identify the alternative sources to compromise the greenhouse effects.

CO4: Interpret the innovative technologies to be involved in the development of product.

CO5: Apply the standard modeling aspects and quality policy for green marketing.

TEXT BOOKS:

1. Subramanian Senthilkannan Muthu, “Assessment of Carbon Footprint in Different Industrial Sectors”, Volume 1, Springer, 2016.
2. Subramanian Senthilkannan Muthu, “Environmental Carbon Footprints - Industrial Case Studies”, Elsevier Science, 2017.

REFERENCES:

1. Subramanian, Senthil Kannan, Muthu, “Carbon Foot Print Handbook”, CRC Press, 2016.
2. Constance Blackman, “Carbon Footprinting - New Developments, Reduction Methods and Ecological Impacts”, Nova Science Publishers, Incorporated, 2014.
3. “World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard”, 2001.
4. “ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification”, International Organisation for Standardisation, 2018.
5. “IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change”,

United Framework convention on Climate Change, 2022.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2							1	1	2		1
CO2	3	3	2	1							1	1	2		2
CO3	3	3	2	2							1	1	2		2
CO4	3	3	2	2							1	1	2		2
CO5	3	3	2	2							1	1	2		2
CO	3	3	2	2							1	1	2		2

3-High, 2- Medium, 1-Low

ME22631 ENERGY CONSERVATION IN INDUSTRIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn Quantifying the energy demand and energy supply scenario of nation and explaining the need for energy auditing for becoming environmentally benign
- To Analyzing factors behind energy billing and applying the concept of demand side management for lowering energy costs
- To learn Computing the stoichiometric air requirement for any given fuel and quantifying the energy losses associated with thermal utilities of industries
- To Diagnosing the causes for under performance of various electrical utilities and suggesting remedies for improving their efficiency
- To Applying CUSUM and other financial evaluation techniques to estimating the accruable energy savings/monetary benefits for any energy efficiency project

UNIT – I INTRODUCTION **9**

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT – II ELECTRICAL SUPPLY SYSTEMS **9**

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics

UNIT - III ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES **9**

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – Waste Heat Recovery Devices.

UNIT - IV ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES **9**

Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems.

UNIT – V ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS **9**

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Define the fundamentals and necessity of energy conservation in locally and globally.

CO2: Identify the type of energy audit needed in the particular concern to avoid energy loss.

CO3: Compute the methodology of energy audit to be implemented in the particular concern.

CO4: Examine the electrical and thermal energy storage devices and measuring instruments which are using for energy auditing.

CO5: Appraise the energy managers to implement the energy economic techniques.

TEXT BOOKS:

1. Swapan Kumar Dutta, Jitendra Saxena, Binoy Krishna Choudhury, Energy Efficiency and Conservation in Metal Industries, CRC Press, 2022.
2. K. NagabhushanRaju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Distributions, 2017.

REFERENCES:

1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2. Albert Thumann and Paul Mehta D, "Handbook of Energy Engineering", Seventh Edition, The Fairmont Press, 2013.
3. Craig B. Smith, Kelly E. Parmenter "Energy Management Principles", Elsevier Science, 2015.
4. Durmus Kaya, Fatma Çanka Kılıc, Hasan Hüseyin Ozturk, " Energy Management and Energy Efficiency in Industry", Springer International Publishing, 2021.
5. Steve Doty, Wayne Turner C, Energy Management Handbook Seventh Edition, The Fairmont Press, 2009.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2							1	1	2		1
CO2	3	3	2	1							1	1	2		2
CO3	3	3	2	2							1	1	2		2
CO4	3	3	2	2							1	1	2		2
CO5	3	3	2	2							1	1	2		2
CO	3	3	2	2							1	1	2		2

3-High, 2- Medium, 1-Low

ME22632 **ENERGY STORAGE DEVICES**

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To understand the various types of energy storage devices and technologies and them comparison.
- To understand the techniques of various energy storage devices and their performances.

- To learn the basics of batteries and hybrid systems for EVs and other mobile applications.
- To learn about the renewable energy storage systems and management systems.
- To have an insight into other energy storage devices, hydrogen, and fuel cells.

UNIT – I INTRODUCTION TO ENERGY STORAGE 9

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical – Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.

UNIT – II ENERGY STORAGE SYSTEMS 9

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types - Charging and Discharging – Battery testing and performance.

UNIT – III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS 9

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby
supplies – V2G and G2V technologies – HESS.

UNIT – IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT 9

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

UNIT – V OTHER ENERGY DEVICES 9

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Outline and identify the different energy storage technologies.

CO2: Explain the methodology, importance and working of various energy storage devices.

CO3: Illustrate the importances of mobile and hybrid energy storage system.

CO4: Explain the types of renewable energy and energy management.

CO5: Apply the need for other energy devices for different applications.

TEXT BOOKS:

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", Second Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001

REFERENCES:

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", JohnWiley & Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. Aulice Scibioh M.and Viswanathan B, "Fuel Cells – principles and applications', University Press(India), 2006

5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage andConversion", Wiley Publications, 2012.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	1	-	2	-	-	-	-	-	1		1
CO2	3	2	1	1	1	-	2	-	-	-	-	-	1		1
CO3	3	2	1	1	1	-	2	-	-	-	-	-	1		1
CO4	3	2	1	1	1	-	2	-	-	-	-	-	1		1
CO5	3	2	1	1	1	-	2	-	-	-	-	-	1		1
CO	3	3	1	1	1		2						1		1

3-High, 2- Medium, 1-Low

ME22731 RENEWABLE ENERGY TECHNOLOGIES

L	T	P	C
3	0	0	3

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-Per capita 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 windfarms – 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 –- Carbonisation – 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: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the present energy status of Indian and global energy scenario.

CO2: Understand the basic principles of renewable energy systems.

CO3: Examine the components, working and technologies involved in solar, wind, ocean and bioenergy systems.

CO4: Distinguishing the different types of solar, wind, ocean and bioenergy systems.

CO5: Reviewing the technologies, advantages and applications of renewable energy systems.

TEXT BOOKS:

1. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", TataMcGraw Hill Publishing Company Ltd., New Delhi, 2009.
2. Khan, "Non-Conventional Energy Sources", Third edition, McGraw Hill Education India Private Limited; 2017.

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
3. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
4. Rai. G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2004.
5. Archana Tiwari, Taha Selim Ustun, Tolga Taner, "Renewable Energy - Technologies and Applications", IntechOpen, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1				1	2					3	2		1
CO2	3	2				1	2					3	2		1
CO3	3	2				1	1					3	1		1
CO4	2	2				1	1					3	2		1
CO5	2	1				1	2					3	2		1
CO	2	2				1	2					3	2		1

3-High, 2- Medium, 1-Low

ME22732	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To learn the green buildings concepts applicable to alternate design
- To be familiar with basic terminologies related to buildings
- To learn the building(air)conditioning techniques
- To know the methods to evaluate the performance of buildings
- To incorporate Renewable energy systems in buildings

UNIT – I INTRODUCTION **9**

Climate and Building, Historical perspective, Aspects of green building design – Sustainable Site, Water, Energy, Materials and IAQ, ECBC Standards

UNIT – II LAND SCAPE AND BUILDING ENVELOPES **9**

Energy efficient Landscape design – Microclimate, Shading, Arbors, Windbreaks, Xeriscaping, Building envelope – Thermal comfort, Psychrometry, Comfort indices, Thermal Properties of Building Materials – Thermal Resistance, Thermal Time Constant (TTC), Diurnal Heat Capacity(DHC), Thermal Lag, Decrement Factor, Effect of Solar Radiation –Processes of heat exchange of building with environment, Insulation.

UNIT – III PASSIVE HEATING AND COOLING **9**

HVAC introduction, Passive Heating – Solar radiation basics, Sun Path Diagram, Direct Heating, Indirect Heating and Isolated heating, Concept of Day lighting, Passive Cooling–Natural Ventilation(Stack and Wind),Evaporative Cooling and Radiative Cooling.

UNIT – IV THERMAL PERFORMANCE OF BUILDINGS **9**

Heat transfer due to fenestration / infiltration, Calculation of Overall Thermal Transmittance, Estimation of building loads: Steady state method, network method, numerical method, correlations, Thermal Storage integration in buildings

UNIT – V RENEWABLE ENERGY IN BUILDINGS **9**

Introduction of renewable sources in buildings, BIPV, Solar water heating, small wind turbines, stand- alone PV systems, Hybrid system–Economics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Classify climate responsive building

CO2: Relate various physical properties influencing passive building design

CO3: Relate the passive (air) conditioning techniques in energy efficient building

CO4: Illustrate the energy performance of buildings

CO5: Apply the adaptation of renewable energy systems in buildings

TEXT BOOKS:

1. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 2009.
2. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley& Sons, 2013.

REFERENCES:

1. "ASHRAE Green Guide: Design, Construction, and Operation of Sustainable Buildings", Sixth Edition, 2023.
2. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 2011
3. Ana-Maria Dabija, "Energy Efficient Building Design", Springer International Publishing, 2020.
4. Vladimir Jovanovic, "Energy-efficient Building Design in Southeast Europe", Springer Fachmedien Wiesbaden, 2019.
5. Francesco Asdrubali, Umberto Desideri "Handbook of Energy Efficiency in Buildings - A Life Cycle Approach", Elsevier Science, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1			1					2		1	1		2
CO2	3	2	2		1				1	2		1	1		2
CO3	3	2	2		1				1	2		2	2		2
CO4	3	2	2		1				1	2		1	2		2
CO5	3	2	2		1				1	2		1	2		2
CO	3	2	2		1				1	2		1	2		2

3-High, 2- Medium, 1-Low

VERTICAL 4: DIGITAL MANUFACTURING

ME22541	DIGITAL MANUFACTURING AND IOT	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To illustrate the various aspects of digital manufacturing.
- To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
- To summarize the smart manufacturing systems in the digital work environment.
- To explain the different IoT based manufacturing systems.
- To demonstrate the significance of digital manufacturing systems

UNIT – I INTRODUCTION 6

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 6

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

UNIT – III SMART FACTORY 6

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 Cybersecurity

UNIT – IV INDUSTRY 4.0 6

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 6

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.

30 PERIODS

PRACTICAL EXERCISES

DIGITAL MANUFACTURING AND IoT LABORATORY

1. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino
2. Detect the Vibration of an Object Using Arduino
3. Temperature Notification Using Arduino
4. Switch Light On and Off Based on the Input of User Using Raspberry Pi
5. Connect with the Available Wi-Fi Using Arduino

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Define the various elements in the digital manufacturing process.
CO2: Summarize the concepts involved in digital management process.
CO3: Illustrate the smart technologies in digital manufacturing process
CO4: Explain the framework of IoT based manufacturing process
CO5: Analyze how Industrial Internet o Things (IIoT) and digital twin technology combine to give a live model of a manufacturing processes

TEXT BOOKS:

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

REFERENCES:

1. Lihui Wang and Andrew YehChing Nee, "Collaborative Design and Planning for Digital Manufacturing", Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.
5. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				1	1	2		1							1
CO2	1	2		1	1	2						1			1
CO3	1	1	2	1	1	2	1	2				1	1		1
CO4			2	2	2	2		1	2	1		1	1		1
CO5	1	1	2	2	3	2	1			1		1	1		1
CO	1	1	2	1	2	2	1	1	2	1		1	1		1

3-High, 2- Medium, 1-Low

ME22542 ROBOT DESIGN, DYNAMICS, AND CONTROL

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To explain the basic concepts of robot design and control
- To expose the dynamics of robot motion
- To inculcate the various kinematics of robot motion
- To develop strategies about robot motion techniques

- To explore the design of different robot according to the need

UNIT – I INTRODUCTION 9

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Rigid-body, Degrees of Freedom, Rotation and HTMs, Homogeneous transformation matrices Forward Kinematics. (DH parameter) Inverse Kinematics, Differential kinematics Jacobian derivation Manipulability, Workspace.

UNIT – II ROBOT DESIGN 9

Lagrange Equation of motion, Kinetic and Potential energy, Manipulator Equation, Examples and properties Forward and inverse dynamics, Newton-Euler algorithm, Numerical Simulation, Discrete control and filtering, Typical actuators DC motor dynamics and limitations, Transmission dynamics and friction, Force Ellipsoid Inertia tensor, Reflected inertia.

UNIT – III ROBOT DYNAMICS 9

Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system, Actuation and Sensing, Design Considerations, under actuated robots.

UNIT – IV ROBOT CONTROLS 9

Joint PD control, selecting gains, Practical considerations, Joint PID control, Feedforward control, PD control + feedforward, Path and trajectory generation and planning, PD + gravity compensation, Inverse dynamics control, Stiffness and compliance, Impedance control, Hybrid Force/Velocity control, Adaptive control, Trajectory optimization, Optimization-based Control

UNIT – V MOTION PLANNING CONTROL 9

Motion planning control and dynamics of wheeled robot, Motion planning control and dynamics of serial and parallel manipulators, Motion planning control and dynamics of legged robot (with simple examples). Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Define the basic concepts of robotic systems
CO2: Explain the design of different types of robots
CO3: Illustrate the various dynamics and controls of robotic systems
CO4: Outline the basic motions of robots with its applications
CO5: Develop a robotic system with proper dynamics and control

TEXT BOOKS:

1. Mark W. Spong, "Robot Dynamics and Control", John Wiley & Sons, New York, 2009
2.
3. John J Craig, "Introduction to Robotics: Mechanics and Control", Fourth edition, Pearson, 2017.

REFERENCES:

1. Deb. S. R. "Robotics Technology and Flexible Automation", 2nd edition, Tata McGraw Hill publishing company limited, 2017.
2. Ankush Ghosh, Monica Bianchini, Rabindra Nath Shaw, Valentina Emilia Balas, "Artificial Intelligence for Future Generation Robotics ", Elsevier Science, 2021.
3. Frank L.Lewis, Darren M.Dawson, Chaouki T.Abdallah, "Robot Manipulator Control

Theory and Practice", MARCEL DEKKER, INC, 2004.
4. S. G. Tzafestas, "Introduction to Mobile Robot Control", Elsevier Science, 2013.
5. Alexandros Iosifidis, Anastasios Tefas, "Deep Learning for Robot Perception and Cognition", Elsevier Science, 2022.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1				1					2		1	3
CO2	2	2	1				1					2		2	3
CO3	2	2	2			1	1					1		1	3
CO4	2	2	2			1	1				1	1		1	3
CO5	2	2	1				1				1	1		2	3
CO	2	2	1			1	1				1	1		1	3

3-High, 2- Medium, 1-Low

ME22641 SENSORS, ACTUATORS AND CONTROLLERS FOR AUTOMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize the need of sensors and its characteristics
- To study the various types of sensors and its applications
- To make use of sensors for different cultural and economical needs
- To inculcate the need of sensors in various fields

UNIT – I SENSOR CLASSIFICATION, CHARACTERISTICS 9

Basics of Measurement – Classification of Errors – Error Analysis – Static and Dynamic Characteristics of Transducers – Performance Measures of Sensors – Classification of Sensors – Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM.

UNIT – II DISPLACEMENT, PROXIMITY AND RANGING SENSORS 9

Displacement Sensors – Brush Encoders - Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – Range Sensors - Ultrasonic Ranging - Reflective Beacons - Laser Range Sensor (LIDAR) – GPS - RF Beacons.

UNIT – III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage – Types, Working, Advantage, Limitation, and Applications: Load Measurement – Force and Torque Measurement - Magnetic Sensors – Types, Principle, Advantage, Limitation, and Applications - Magneto Resistive – Hall Effect, Eddy Current Sensor - Heading Sensors – Compass, Gyroscope and Inclinometers.

UNIT – IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS 9

Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistive - Acoustic, Temperature – IC, Thermistor,

RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors

UNIT – V ACTUATORS **9**

Working principle, Construction, Applications, Merits and Demerits of Actuators: D.C Motor- AC Motor- Stepper motor- Servo motor , Piezoelectric and Piezo resistive actuators, micro pumps and micro actuators with case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Define the concept of sensors and its characteristics
CO2: Classify the sensors based on their applications
CO3: Infer the performance of sensors along with its parameters
CO4: Compare the actuators according to the technical and cultural need
CO5: Utilize the components of sensors and actuators based on its applications

TEXT BOOKS:

1. Bradley D.A., and Dawson, Burd and Loader, "Mechatronics", Thomson Press India Ltd., 2004
2. Clarence W. de Silva, "Sensors and Actuators - Engineering System Instrumentation, Second Edition, CRC Press, 2015.

REFERENCES:

1. Bolton W., "Mechatronics", Thomson Press, 2003.
2. Ernest O. Doeblin, "Measurement system, Application and Design", Fiftieth Edition, Tata McGraw Hill Publishing Company Ltd., , 2004
3. David Johnson, " Programmable Controllers for Factory Automation", CRC Press, 2020.
4. H.S. Tzou, Toshio Fukuda, "Precision Sensors, Actuators and Systems", Springer Netherlands, 2012.
5. Patranabis D., "Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., 2005.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1	1									1		
CO2	1	2	1	1									1	1	
CO3	2	1	2	1								1	1	1	
CO4	1	1	2	1								1	1	1	
CO5	1		1	1								1	1	2	
CO	1	1	1	1								1	1	1	

3-High, 2- Medium, 1-Low

ME22642	3D PRINTING PROCESSES & APPLICATIONS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To Know the importance of 3D printing in Manufacturing
- To know the different 3D Printing Technologies
- To select a suitable material for 3D Printing
- To observe the different methods for Post-processing of 3D Printing parts
- To Understand the applications of 3D Printing in Automobile, Aerospace, Bio-medical etc.

UNIT – I INTRODUCTION AND BASIC PRINCIPLES 9

3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Other Related Technologies Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology, Other Associated Technologies, The Use of Layers, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World..

UNIT – II 3D PRINTING PROCESS CHAIN 9

Eight Steps in Additive Manufacture, Variations from One 3D Printing Machine to Another, Metal Systems, Maintenance of Equipment, Materials Handling Issues, Design for 3D PRINTING.

UNIT – III POWDER BED FUSION PROCESSES & EXTRUSION-BASED SYSTEMS 9

Powder Bed Fusion Processes: Introduction, SLS Process Description, Powder Handling, Approaches to Metal and Ceric Part Creation, Variants of Powder Bed Fusion Processes, Process Par3D Printing meters, Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials - Capabilities and Limitations. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Materials, Limitations of FDM, Bioextrusion, Other Systems

UNIT – IV DESIGN, GUIDELINES FOR PROCESS SELECTION 9

Design for 3D Printing - Design for Manufacturing and Assembly, Core DFM for 3D Printing Concepts and Objectives, 3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D Printing. Guidelines for Process Selection - Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control.

UNIT – V MEDICAL APPLICATIONS & FUTURE DIRECTIONS FOR 3D PRINTING 9

Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications.

Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Label the importance of 3D printing in Manufacturing

CO2: List the Different 3D Printing Technologies

CO3: Select suitable materials for 3D Printing

CO4: Illustrate the methods for Post-processing of 3D Printing parts

CO5: Identify the appropriate technologies of 3D Printing in Automobile, Aerospace and Bio-medical fields.

TEXT BOOKS:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
2. H. B. Muralidhara, Soumitra Banerjee, "3D Printing Technology and Its Diverse Applications", Apple Academic Press, 2021.

REFERENCES:

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.
2. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.
3. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
4. G. K. Awari, C. S. Thorat, Vishwjeet Ambade, D. P. Kothari, "Additive Manufacturing and 3D Printing Technology-Principles and Applications", CRC Press, 2021.
5. Richard Sheng, "3D Printing-A Revolutionary Process for Industry Applications", Elsevier Science, 2022.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1									1	1		2
CO2	2	2	1	1	2							1	1		2
CO3	2	2	2	2	2							1	1		2
CO4	2	2	2	2	2							1	1		3
CO5	1	2	2	2	2							1	1		3
CO	2	2	1	2	2							1	1		3

3-High, 2- Medium, 1-Low

ME22741 LEAN MANUFACTURING

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To list the various tools for lean manufacturing
- To apply the tools to implement LM system in an organization.
- To familiarize the different methodology of deeper understanding
- To explore the challenges in implementation of lean manufacturing in various fields

UNIT – I BASICS OF 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 INTRODUCTION TO SOME 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 UNDERSTANDING OF METHODOLOGIES 9

What is a process, Why 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

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects,

UNIT – V IMPLEMENTATION AND CHALLENGES 9

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Recall the basics of lean manufacturing techniques
CO2: Choose the appropriate methodologies in lean manufacturing
CO3: Explain the tools and elements of lean manufacturing process
CO4: Summarize the challenges in implementing the lean manufacturing techniques
CO5: Identify the proper tools in implementing lean manufacturing techniques

TEXT BOOKS:

1. Karmen Pažek, " Lean Manufacturing", IntechOpen, 2021.
2. Akhilesh N Singh, Avinash Singh, "Lean Manufacturing: Principles to Practice", Notion Press, 2018.

REFERENCES:

1. S. Vinodh, "Lean Manufacturing-Fundamentals, Tools, Approaches, and Industry 4.0 Integration", CRC Press, 2022.
2. Erick C Jones, "Quality Management for Organizations Using Lean Six Sigma Techniques", CRC Press, 2014.
3. J. Paulo Davim, " Progress in Lean Manufacturing", Springer International Publishing, 2018.
4. Fausto Pedro García Márquez, Isaac Segovia, Péter Tamás, Tamás Bányai, " Lean Manufacturing and Six Sigma-Behind the Mask", IntechOpen, 2020.
5. Manoj Tiwari, Prabir Jana, " Lean Tools in Apparel Manufacturing", Elsevier Science, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2			1								1			1
CO2	2									1	1	1			2
CO3	2			1						1	1	1			1
CO4	2		1							1	1	1			1
CO5	2										1	1			2
CO	2		1	1						1	1	1			1

ME22742 NON-DESTRUCTIVE TESTING **L T P C**
3 0 0 3

COURSEOBJECTIVES:

- To explain the need and scope of failure analysis and fundamental sources of failures.
- To familiarize about non-destructive testing and basic principles of visual inspection.
- To explore about magnetic testing and principles, techniques.
- To infuriate the principle of radiography testing and its inspection techniques and methods.
- To explain the acoustic testing principle and technique and instrumentation.

UNIT – I INTRODUCTION **9**

Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing & Assembly. Tree diagram and FMEA.

UNIT – II VISUAL INSPECTION **9**

Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations and Standards

UNIT – III MAGNETIC TESTING **9**

Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of. magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods, Applications, Limitations.

UNIT – IV RADIOGRAPHY TESTING **9**

Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques,

Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations

UNIT – V ACOUTISTIC TESTING 9

Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic examination, Replication process, Significance of Microstructure observation, Decision making, Applications, Codes and Standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Define the basic concept of failure analysis
CO2: Explain the need of testing in different engineering fields
CO3: Illustrate the different types of testing in engineering application
CO4: Summarize the need of failure analysis based on case studies
CO5: Choose the appropriate testing method to determine the modes of failure

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", Revised edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17, 1989.
2. Sayed Hemeda, Zheng-Ming Huang, " Failure Analysis", Intech Open, 2019.
3. Charles, J. Hellier, "Handbook of Non destructive evaluation", McGraw Hill, New York 2001.
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Second Edition, Wiley, New Jersey, 2005
5. J. Prasad and C. G. K. Nair, "Non-Destructive Test and Evaluation of Materials", Second Edition, Tata McGraw-Hill Education, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1		1									1	1	1	
CO2	2		1			2						1	1	2	
CO3	1		1		2	2	1					1	1	2	
CO4	2		2		2	2	1					1	1	2	
CO5	2		2		2	2	1					1	1	2	
CO	2		1		2	2	1					1	1	2	

VERTICAL 5: ELECTRIC VEHICLE TECHNOLOGY

ME22551	ADVANCED VEHICLE ENGIEERING	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To introduce the basic concepts of electric vehicle and their characteristics.
- To introduce different types of motors and the selection of motor for vehicle applications.
- To acquaint the student with different sensors and systems used in autonomous and connected vehicles.
- To give an overview of networking with sensors and systems.
- To introduce the modern methods of diagnosing on-board the vehicle troubles.

UNIT – I ELECTRIC VEHICLE ARCHITECTURE 9

EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.

UNIT – II ELECTRIC VEHICLE MOTORS 9

Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives.

UNIT – III AUTONOMOUS AND CONNECTED VEHICLES 9

Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Camera Technology,

UNIT – IV AUTOMOTIVE NETWORKING 9

Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.

UNIT – V ON-BOARD TESTING 9

Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the various energy storage technologies and vehicle performances.
CO2: Demonstrate the various motors used for electric vehicle and its characteristics
CO3: Utilize the advanced autonomous control systems used for electrical vehicles
CO4: Explain the advanced automotive networking systems
CO5: Explain the on-board testing, control and monitoring systems

TEXT BOOKS:

1. John G Hayes, G Abaas Goodarzi, Electric Powertrain, John Wiley & Sons Ltd., 2018
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities, CRC Press, 2020.

REFERENCES:

1. Dominique Paret, "Multiplexed Networks for Embedded Systems", John Wiley & Sons Ltd., 2007.
2. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms Implementational" Springer, 2011
3. Andrew M Wright, Harrison R Scott, "Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science, Engineering and Technology: Congressional Policies, Practices and Procedures), 2012
4. Heinz Heisler, "Advanced Vehicle Technology", Second Edition, Elsevier Science, 2002.
5. Advanced Motorsport Engineering: Units for Study at Level 3 by Andrew Livesey | 1 September 2011

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	3	2				2					2	1	2	
CO2	2	1	2			1	2			1		1	2	1	
CO3	2	2	1				1					1	1	1	
CO4	2	2	2			1	1					2	1	2	
CO5	3	1	2				1			1		1	1	2	
CO	2	2	2			1	2			1	1	1	1	2	-

3-High, 2- Medium, 1-Low

ME22552 HYBRID AND ELECTRIC VEHICLE TECHNOLOGY

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To introduce the concept of hybrid and electric drive trains.
- To elaborate on the types and utilisation of hybrid and electric drive trains.
- To expose on different types of AC and DC drives for electric vehicles.
- To understand and utilise different types of energy storage systems
- To introduce concept of energy management strategies and drive sizing

UNIT – I INTRODUCTION **9**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT – II HYBRID ELECTRIC DRIVE TRAINS **9**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT – III CONTROL OF AC & DC DRIVES **9**

Introduction to electric components used in hybrid and electric vehicles, Configuration, and control - DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency.

UNIT – IV ENERGY STORAGE 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices.

UNIT – V DRIVE SIZING AND ENERGY MANAGEMENT STRATEGIES 9

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, implementation issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basics of hybrid drive trains requirement for a vehicle

CO2: Explain the concept of hybrid and electric traction

CO3: Demonstrate the concept of different types of motors and their performance and their characteristics.

CO4: Illustrate a suitable energy storage system for a hybrid / electric vehicle

CO5: Identify the energy management strategies to ensure better economy and efficiency

TEXT BOOKS:

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", Second Edition, CRC Press, 2010
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2012

REFERENCES:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Chris Mi, M. Abul Masrur, "Hybrid Electric Vehicles-Principles and Applications with Practical Perspectives", Wiley, 2017.
3. Akash Kumar Bhoi, Jens Bo Holm-Nielsen, Nil Patel, Sanjeevikumar Padmanaban, "Electric Vehicles-Modern Technologies and Trends", Springer Nature Singapore, 2020.
4. Tom Denton, "Electric and Hybrid Vehicles", Routledge, 2020.
5. Michael Nikowitz, "Advanced Hybrid and Electric Vehicles-System Optimization and Vehicle Integration", Springer International Publishing, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1						1			1	1		
CO2	3	2								1		2	2		
CO3	3	2	1									1	3		
CO4	3	3							1			1	2		

CO5	3	3	1									1	3		
CO	3	3	1						1	1		1	1		

3-High, 2- Medium, 1-Low

ME22651 VEHICLE MAINTENANCE AND SAFETY

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To enable the student to understand the principles, functions and practices adapted in maintenance activities of vehicles.
- To study the power train maintenance, fault diagnosis, maintenance of Batteries
- To understand vehicle system maintenance and service of clutch, brake.
- To study the concepts of vehicle safety and regulations.
- To study and understand the simulation of safety concepts

UNIT – I INTRODUCTION 9

Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics,

UNIT – II POWER TRAIN MAINTENANCE 9

Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System,

UNIT – III VEHICLE SYSTEM MAINTENANCE 9

Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment,

UNIT – IV VEHICLE SAFETY 9

Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.

UNIT – V SIMULATION OF SAFETY CONCEPTS 9

Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, causes of rear end collision,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the vehicle health monitoring, maintenance and safety to students.

CO2: Explain the basic principle of vehicle management system.

CO3: Explain the technologies involved in vehicle components and safety system.

CO4: Interpret the potentials to solve vehicle safety and its concepts.

CO5: Demonstrate the different components through various safety mechanisms.

TEXT BOOKS:

1. Tom Denton, "Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle Maintenance and Repair", Fourth Edition, Routledge, 2016.
2. Paul S.V., "Safety Management System and Documentation Training Programme Handbook", CBS Publishers & Distributor, 2019.

REFERENCES:

1. Ed May, "Automotive Mechanics" Volume 1 and 2, Tenth edition, Mc Graw Hill Publications, 2018
2. Bosch Automotive Handbook, Tenth Edition, 2018
3. Jack Erjavek, "A systems approach to Automotive Technology", Fifth Edition, Cengage Learning, 2012
4. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", Tenth Edition, Tata McGraw Hill, 2004.
5. William M. Metts, " Vehicle Maintenance Book", Independently Published, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1						1			1	1	2	
CO2	3	2								1		2	2	1	
CO3	3	2	1									1	3	2	
CO4	3	3							1			1	2	3	
CO5	3	3	1									1	3	2	
CO	3	3	1						1	1		1	1	2	

3-High, 2- Medium, 1-Low

EE22621	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To know the EV architecture
- To inculcate the knowledge while resolving issue of Energy management system
- To study the energy storage system concepts
- To derive model for batteries and to know the different types of batteries and its charging methods
- To learn the control preliminaries for DC-DC converters.

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS 6

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics, Challenges in electric vehicle

UNIT II ENERGY MANAGEMENT STRATEGIES 6

Introduction to energy management strategies used in hybrid and electric vehicles Classification of different energy management strategies, comparison of different energy management strategies Implementation issues of energy management strategies.

UNIT III BATTERY MODELING, TYPES AND CHARGING 6

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV CONTROL PRELIMINARIES 6

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V SECURE PROJECT MANAGEMENT 4

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

30 PERIODS

PRACTICAL EXERCISES

1. Develop a model that could estimate Soc and SoH of Li-Ion Battery.
2. Modelling and thermal analysis of Li-Ion Battery.
3. Simulation of boost converter and calculating gain and phase margin from the transfer function.
4. Simulation of vector control of induction motor

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles

CO2: Apply energy management system strategies to solve problems

CO3: Explain the concepts related with batteries and parameters of battery.

CO4: Find transfer function gain margin and phase margin for boost converter.

CO5: Analyse the AC machine model in reference variable forms.

TEXT BOOKS

1. Iqbal Husain, “Electric and Hybrid Vehicles, Design Fundamentals”, Third Edition, CRC Press, 2021.
2. Teuvo Suntio, Tuomas Messo, Joonas Puukko, “Power Electronic Converters,: Dynamics and Control in Conventional and Renewable Energy Applications”, Wiley, 2017.

REFERENCES:

1. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2003.
2. C.C. Chan, K.T. Chau, “Modern Electric Vehicle Technology”, Oxford University Press,

2001.
3. Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, John Wiley & Sons, 2017.
4. Chee Mun Ong, “Dynamic Simulation of Electric Machinery using MATLAB”, Prentice Hall,2003.
5. Prathap Reddy, Atif Iqbal, Shaikh Moinoddin, Bhimireddy, “Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK”, Wiley, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	1	2	-	2	-	-	2
CO2	3	-	-	-	-	-	-	-	1	3	-	2	-	-	2
CO3	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2
CO4	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2
CO5	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2
CO	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2

3-High, 2- Medium, 1-Low

ME22751 ELECTRIC VEHICLE POWER MANAGEMENT

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To understand the concept of electric vehicles and its operations
- To present an overview of Electric Vehicle (EV), Hybrid Electric vehicle (HEV) and their architecture
- To understand the need for power electronics and motor drives
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles
- To understand the need for alternative energy storage system

UNIT – I INTRODUCTION 9

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging, Mode of discharging, C-10 test

UNIT – II BATTERY ENERGY STORAGE SYSTEMS 9

Bat Battery Basics- Different types- Battery Parameters- Battery life & safety impacts - battery management system (BMS)- battery cell balance.

UNIT – III BATTERY MANAGEMENT SYSTEMS 9

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power, Battery swapping.

UNIT – IV HEALTH ESTIMATION OF BATTERIES 9

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance.

UNIT – V ALTERNATIVE ENERGY STORAGE SYSTEMS 9

Introduction to fuel cell – Types, Operation and characteristics- proton exchange membrane (PEM) fuel cell for E-mobility– hydrogen storage systems –Super capacitors for transportation applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the concept of electric vehicle and energy storage systems

CO2: Explain the working and components of Electric Vehicle and Hybrid Electric Vehicle

CO3: Explain the principles of power converters and electrical drives

CO4: Illustrate the operation of storage systems such as battery and super capacitors

CO5: Utilize the various energy storage systems based on fuel cells and hydrogen storage

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, 2011.
2. Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2010.

REFERENCES:

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2. C.C. Chan, K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001.
3. Wie Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, John Wiley & Sons, 2017.
4. Sam Davis, "Managing Electric Vehicle Power", SAE International, 2020.
5. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer New York, 2013.

Mapping of Course Outcomes to Programme Outcomes

Course	PO	PSO

outcomes	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	-	-	-	-	-	-	2	1	2	-	-
CO2	3	3	2	2	-	-	-	-	-	-	2	1	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	2	1	2	-	-
CO4	3	3	2	2	-	-	-	-	-	-	2	1	2	-	-
CO5	3	3	2	2	-	-	-	-	-	-	2	1	2	-	-
CO	3	3	2	2	-	-	-	-	-	-	2	1	2	-	-

3-High, 2- Medium, 1-Low

ME22752 AUTONOMOUS ELECTRIC VEHICLES

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To study about the need and comparison between electric vehicles, and its importance.
- To know about the characteristics and types of electric vehicles.
- To understand the different energy storage system in electric vehicles
- To understand the characteristics and types of electric motors.
- To understand the designing concepts of electric vehicles

UNIT – I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR **9**

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients.

UNIT – II SPEED CONTROL FOR ELECTRIC DRIVES **9**

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor-.

UNIT – III FUZZY LOGIC **9**

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.

UNIT – IV FPGA AND VHDL BASICS **9**

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.

UNIT – V AUTOMOTIVE NETWORKING **9**

Overview of data communication and networking – need for In-vehicle networking – layers of OSI reference model – multiplexing and de-multiplexing model – vehicle buses

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the fundamental concepts of electric vehicles.

CO2: Explain the types and layout of electric vehicles.

CO3: Explain the different types of energy storage system.

CO4: Classify the types of electric motors based on performance and reliability.

CO5: Interpret the design consideration of electric vehicles.

TEXT BOOKS:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Second Edition, John Wiley & Sons Ltd, 2012.
2. Austin Hughes, Bill Drury, "Electric Motors and Drives: Fundamentals, Types and Applications", Fourth Edition, Newnes, 2013.

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, Second edition CRC Press, 2011.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, "Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
3. James Larminie, John Lowry, "Electric Vehicle Technology Explained" Wiley, 2003.
4. Ehsani, M, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005
5. Hussein T. Mouftah, Melike Erol-Kantarci, Sameh Sorour, " Connected and Autonomous Vehicles in Smart Cities", CRC Press, 2020.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1						1			1	1	2	1	
CO2	2								1		2	2	1	1	
CO3	2	1									1	3	2		
CO4	3							1			1	2	3		
CO5	3	1									1	3	2	1	
CO	3	1						1	1		1	1	2	1	

3-High, 2- Medium, 1-Low

VERTICAL 6: COMPUTATIONAL ENGINEERING

ME22561	COMPUTATIONAL SOLID MECHANICS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To Impart the definition and basics on theory of elasticity - Change
- To learn finite element method for static linear elasticity
- To study the Non-Linear and History depend problems
- To study time dependent and dynamic problems
- To study Structural Elements & Interfaces and contact

UNIT – I BASIC ON THEORY OF ELASTICITY 9

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium.Strain – displacement relations, Stress – strain relations, Lame's constant – cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle.

UNIT – II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY 9

Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.

UNIT – III NON LINEAR AND HISTORY DEPEND PROBLEMS 9

Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity - Large strain visco-plasticity.

UNIT – IV TIME DEPENDENT AND DYNAMIC PROBLEMS 9

First-order systems - the diffusion equation - Explicit time integration – the Newmark method - Implicit time integration - Modal analysis and modal time integration.

UNIT – V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT 9

Continuum Beams – Shells – Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Infer the fundamentals of elasticity and stress- strain relationship.
CO2: Develop a finite element method to generalize and solve linear elasticity problems
CO3: Identify the basic of Non Linear and History depend problems
CO4: Choose a method to deal with time dependent and dynamic problems
CO5: Utilize a method to solve structural element and Interfaces.

TEXT BOOKS:

1 L.S.Srinath, "Advanced Mechanics Of Solids", Third Edition 2008.

2 J.N.Reddy, "Introduction To Finite Element Method", Fourth Edition 2020.

REFERENCES:

1. Miguel Luiz Bucalem, Klaus-Jurgen Bathe, "The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution", Springer Berlin Heidelberg, 2013.
2. R.D.Cook, "Concepts and Applications of Finite Element Analysis", Fourth Edition 2001.
3. S.Timoshenko, "Theory of Elasticity", McGraw-Hill Education (India) Pvt Limited, 2010.
4. G. Ramamurty, "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Limited,2013.
5. Ben Q. Li, "Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer" Springer London, 2010.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2										1	2		
CO2	2	2	1									1	2		
CO3	2	2	1									1	2		
CO4	2	2	1									1	2		
CO5	1	2	2									1	2		
CO	2	2	1									1	2		

3-High, 2- Medium, 1-Low

ME22562 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- Exp To study the fluid flow simulation techniques and its mathematical behaviour
- To learn the Discretise 1D and 2D systems using finite difference and finite volume techniques
- To Formulate diffusion –convection problems using finite volume method
- To study the flow field for different types of grids
- To learn the need for turbulence models and its types

UNIT – I INTRODUCTION **9**

Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors

UNIT – II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION **9**

Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nickolson, and pure implicit methods, stability of schemes.

UNIT – III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.

UNIT – IV FLOW FIELD ANALYSIS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.

UNIT – V TURBULENCE MODELLING 9

Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Extend the basic, governing equation and boundary condition for fluid dynamics
CO2: Solve finite difference and finite volume method to solve diffusion problems.
CO3: Identify the schemes of finite volume methods for convection and diffusion.
CO4: Choose the various algorithms used to analyse flow fields.
CO5: Plan the different models for modelling turbulence flow.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., ”An Introduction to Computational Fluid Dynamics”: The finite volume Method, Pearson Education, 2014 .
2. Ghoshdastidar, P.S., “Computational Fluid Dynamics and Heat Transfer”, Cengage Learning, 2017.

REFERENCES:

1. John. F. Wendt, “Computational Fluid Dynamics – An Introduction”, Springer, 2013.
2. K. Muralidhar&T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.
3. Suhas V, Patankar, “Numerical Heat transfer and Fluid flow”, Taylor & Francis, 2009.
4. Atul Sharma, “Introduction to Computational Fluid Dynamics-Development, Application and Analysis”, Springer International Publishing, 2021.
5. Yogesh Jaluria, Kenneth E. Torrance, “Computational Heat Transfer”, CRC press, 2002.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

CO1	2	2										1	2	1	
CO2	2	2	1	1								1	2	1	
CO3	2	2	1	1								1	2	1	
CO4	2	2	1	1								1	2	1	
CO5	1	2	2	1								1	2		
CO	2	2	1	1								1	2	1	

3-High, 2- Medium, 1-Low

ME22661 COMPUTATIONAL BIO-MECHANICS

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To study the fundamental concepts of bio-mechanics
- To accumulate the basic properties of bio-fluid mechanics
- To understand the Constitutive equations for the properties of bio-solid mechanics
- To study the modelling and solution strategy of bio-solid and fluids
- To learn the numerical methods and ergonomics in bio-mechanics

UNIT – I BASICS OF BIO-MECHANICS **9**

Definition of bio-mechanics, perspective – vector operations – Force vectors – Moment vectors – Newton's Law – Vector operations on force vectors – Static equilibrium and free body condition- Mechanical behavior of skeleton muscles.

UNIT – II BIO FLUID MECHANICS **9**

Inherent fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers -Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Material properties and modelling of Blood vessels, Heart -Cardiac muscle characterisation, Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics

UNIT – III BIO SOLID MECHANICS **9**

Constitutive equation of viscoelasticity – Maxwell &Voight models, anisotropy, Hard Tissues - Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hills models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

UNIT – IV MODELING AND SOLUTION STRATEGIES OF SOLID AND FLUID **9**

Elastic behavior at small deformation- large deformation – rotation -Constitute model of viscous fluid Finite Element method- Newtonian – Non-Newtonian fluids – Solution deformation for deforming solids – General formulation – Linear elasticity theory – Boundary condition- Solution deformation for viscous fluids- General equation – boundary condition.

UNIT – V NUMERICAL METHODS AND ERGONOMICS **9**

Finite Element Analysis- Diffusion – Convection – Diffusion equations- finite element analysis of lumbar spine; Ergonomics -Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the basic principle of bio-mechanics

CO2: Construct the properties influencing the mechanism of bio-fluids

CO3: Organize the fundamentals of bio-solid mechanics.

CO4: Select the numerical modelling procedure for bio-fluids and solids

CO5: Model with examples for applying in computational bio-mechanics

TEXT BOOKS:

1. Ming Zhang, Yubo Fan, " Computational Biomechanics of the Musculoskeletal System", Taylor & Francis, 2014.
2. R. M. Kennedy, "A textbook of Biomedical Engineering", GTU, 2010

REFERENCES:

1. Masao Tanaka, Shigeo Wada, Masanori Nakamura, "Computational Biomechanics Theoretical Background and Biological/Biomedical Problems", Springer, 2012.
2. Subrata Pal, Textbook of Biomechanics, Viva Books Private Limited, 2009
3. Jay D. Humphrey, Sherry De Lange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer Science Business Media, 2004.
4. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007
5. Adam Wittek, Karol Miller, Martyn Nash, Poul M. F. Nielsen, " Computational Biomechanics for Medicine-Solid and Fluid Mechanics Informing Therapy", Springer International Publishing, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2										1	2		
CO2	1	2	1	1								1	2		
CO3	1	2	1	1								1	2		
CO4	1	2	1	1								1	2		
CO5	1	2	2	1								1	2		
CO	1	2	1	1								1	2		

3-High, 2- Medium, 1-Low

ME22662 COMPUTER AIDED INSPECTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the various optical measuring instruments used in industries.
- To study the importance of surface metrology and the different methods of measuring surface finish.
- To study the advanced concepts relevant to operational characteristics of CMMS.
- To study the various errors involved in precision manufacturing.

- To study the concepts of nanometrology.

UNIT – I OPTICAL DIMENSIONAL METROLOGY 9

Basic to advanced metrology evolution, Optical dimensional metrology of precision features – Machine vision, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus variation based Optical Metrology- Fringe projection method.

UNIT – II ADVANCES IN SURFACE METROLOGY 9

Surface Geometry and Its Importance in Function, Surfaces and Manufacture, Filtering – Gaussian, 2RC, Advanced Filters, Surface finish parameters – Amplitude, Spacing, Hybrid, Shape, Autocorrelation, Power Spectral Density, Bearing Area.3D areal and parametric measurement, Need for 3D surface topography measurement, Stylus instruments, Optical Instruments – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

UNIT – III COORDINATE METROLOGY 9

Coordinate measuring system – algorithms and filters, Performance evaluation, Temperature fundamentals, Environmental control, Error compensation of CMMs, Calibration and Measurement uncertainty for coordinate measuring systems,

UNIT – IV METROLOGY OF MACHINE TOOLS 9

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT – V NANOMETROLOGY 9

Precision to Nanometrology, Optical Micro-Metrology of Small Objects - White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nanofeatures, Measuring Length to Nanoscale with Interferometers and Other Devices, Nano Geometry in Macro Situations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the fundamental and applications of optical measuring instruments.

CO2: Infer the principles of various instruments used for measuring surface topography.

CO3: Discuss the basics of coordinate measuring system.

CO4: Identify the various types of errors involved during measurement.

CO5: Utilize the different technologies used for measuring nanomaterials.

TEXT BOOKS:

1. Kevin Harding, “Handbook of Optical Dimensional Metrology, Series: Series in Optics and Optoelectronics”, Taylor & Francis, 2013.
2. David J. Whitehouse, “Handbook of Surface and Nanometrology”, Second Edition, CRC Press, 2010.

REFERENCES:

1. Ammar Grous ,J, “AppliedMetrologyforManufacturingEngineering”,Wiley-ISTE,2011.
2. Dotson Connie, “DimensionalMetrology”, Cengage Learning, 2012.
3. Mark Curtis, Francis T. Farago,“ Handbook of Dimensional Measurement”, Fifth edition, Industrial Press, 2013.

4. Abdulrahman Al-Ahmari, Emad Abouel Nasr, Osama Abdulhameed, " Computer-Aided Inspection Planning-Theory and Practice", CRC Press, 2016.
5. Robert J. Hocken and Paulo H. Pereira, "Coordinate measuring machines and systems", Second Edition, CRC press, 2012.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2											1		
CO2	1	2			1							1	1		
CO3	1	2										1	1		
CO4	1	2										1	1		
CO5	1	2			1							1	1		
CO	1	2			1							1	1		

3-High, 2- Medium, 1-Low

ME22761 **CAD & CAE** **L T P C**
2 0 2 3

COURSEOBJECTIVES:

- Applying the fundamental concepts of computer graphics and its tools in a generic framework.
- Creating and manipulating geometric models using curves, surfaces, and solids.
- Applying concept of 3D modeling, visual realism, and CAD standard practices in engineering design
- Developing mathematical models for Boundary Value Problems and their numerical solution.
- Formulating solution techniques to solve non-linear problems

UNIT – I FUNDAMENTALS OF COMPUTER GRAPHICS **9**

Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation. Standards for computer graphics.

UNIT – II GEOMETRIC MODELING **9**

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).

UNIT – III VISUAL REALISM and CAD STANDARDS **9**

Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – coloring – computer animation.

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc.

UNIT – IV FINITE ELEMENT ANALYSIS **9**

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling – Element Equations – Linear and Higher order Shape functions – Bar, Beam Elements –Applications to Heat Transfer problems.

UNIT – V NON-LINEAR ANALYSIS **9**

Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and visco-plasticity, stress stiffening, contact interfaces-problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate- Introduction to Analysis Software-

30 PERIODS

PRACTICAL EXERCISES

Experiments

1. Design and animate Piston Cylinder assembly and motion study using CAD software.
2. Design and simulate Connecting rod and crank shaft using CAD software.
3. Design and simulate Two Cylinder Engine assembly using CAD software.
4. Coupled Simulation of structural /thermal analysis
5. Harmonic, Transient and spectrum analysis of simple systems.
6. buckling analysis

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Discuss the fundamental concepts of computer aid design and its applications.
- **CO2:** Manipulate basic curve representation for modelling complex shapes.
- **CO3:** Apply the various cad standards and algorithms for visual realism.
- **CO4:** Utilize the basic concepts of finite element analysis
- **CO5:** Organize the computational procedure for solving non-linear problems

TEXT BOOKS:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007
2. Seshu.P, “Textbook of Finite Element Analysis”, PHI Learning Pvt. Ltd., NewDelhi, 2012.

REFERENCES:

1. Kuang-Hua Chang, “Design Theory and Methods Using CAD/CAE-The Computer Aided Engineering Design Series”, Elsevier Science, 2014.
2. Dugan Um, “Solid Modeling and Applications-Rapid Prototyping, CAD and CAE Theory”, Springer International Publishing, 2015.
3. Foley, Wan Dam, Feiner and Hughes – “Computer graphics principles & practice”, Pearson

Education, 2003.
4. Rao, S.S., "The Finite Element Method in Engineering", Sixth Edition, Butterworth-Heinemann, 2018.
5. Reddy, J. N. "Introduction to the Finite Element Method", Fifth Edition, Tata McGrawHill, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2			1							1	2		
CO2	2	2		1	1							1	2		
CO3	2	2	1	1								1		1	
CO4	1	2	2	1								1	1	1	
CO5	1	2	2	2								1		2	
CO	2	2	2	1	1							1	2	1	

ME22762 MACHINE LEARNING FOR INTELLIGENT SYSTEMS

L	T	P	C
3	0	0	3

COURSEOBJECTIVES:

- To introduce basic machine learning techniques such as regression, classification
- To learn about clustering and segmentation
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Reinforcement learning.

UNIT – I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT – II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT – III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

UNIT – IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

UNIT – V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Infer the basic for various forms of learning, regression and classification in machine learning

CO2: Discuss and discover clustering and segmentation methods

CO3: Develop fuzzy logics concept with various examples.

CO4: Construct a mathematical modelling based on neutral network in robotics.

CO5: Solve the recurrent neural network and reinforcement learning in robotics.

TEXT BOOKS:

1. MichealNegnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, Third Edition, Addision Wesley, 2011
2. Parag kulkarni, Prachi Joshi, “Artificial Intelligence-Building Intelligent Systems”, PHI Learning, 2015.

REFERENCES:

1. Bruno Siciliano, Oussama Khatib, “Handbook of Robotics”, Second Edition, Springer, 2016.
2. Simon Haykin, “Neural Networks and Learning Machines: A Comprehensive Foundation”, Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, Fourth Edition, Sussex Wiley, 2011,
4. Ashok Kumar, C. Kishor Kumar Reddy, Marlia Mohd Hanafiah, Megha Bhushan, Nhu Gia Nguyen, P. R Anisha, “Intelligent Systems and Machine Learning for Industry Advancements, Challenges, and Practices”, CRC Press, 2022.
5. M Vinoth Kumar, Madhumathy P, R. Umamaheswari, “Machine Learning and IoT for Intelligent Systems and Smart Applications”, CRC Press, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1										1	2		
CO2	1	2	2		1							1	1		
CO3	1	1	2		1							1	1		
CO4	1	2	2									1	1		
CO5	1	1	2									1	1		
CO	1	2	2		1							1	1		

3-High, 2- Medium, 1-Low