DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021
(CHOICE BASED CREDIT SYSTEM)
(REVISED)
For the Batch Admitted in the Academic Year 2024-2025

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1109	Problem Solving and Programming in C	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1110	Programming in C Laboratory	ESC	4	0	0	4	2
9	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**31**	**19**	**0**	**12**	**25**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
7	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**29**	**20**	**1**	**8**	**25**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	CS1302	Data Structures	ESC	3	3	0	0	3
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course – II	PEC	3	3	0	0	3
5	---	Professional Elective Course – III	PEC	3	3	0	0	3
6	---	Open Elective Course – I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course – V	PEC	3	3	0	0	3
6	---	Open Elective Course – II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	4	0	0	4	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**30**	**18**	**0**	**12**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 182

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
3	HS1201	Professional English	HSMC	3	3	0	0	3
4	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
5	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
6	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
7	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1109	Problem Solving and Programming in C	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1110	Programming in C Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
13	CS1302	Data Structures	ESC	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
2	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
3	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
4	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
5	ME1401	Thermal Engineering	PCC	3	3	0	0	3
6	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	3	2
5	ME1709	Technical Seminar - III	EEC	4	0	0	4	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing#	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology#	EEC	3	1	0	2	2
9	MV0003	Electrical Harness and Routing Design for Electric Vehicles#	EEC	3	1	0	2	2
10	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS108	Introduction to Python Programming	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	7	-	-	-	-	-	3	14	7.69
2	BSC	12	4	4	4	-	-	-	-	24	13.19
3	ESC	9	11	8	5	-	-	-	-	33	18.13
4	PCC	-	3	9	16	18	15	13	-	74	40.66
5	PEC	-	-	-	-	3	6	6	3	18	9.89
6	OEC	-	-	-	-	-	3	3	-	6	3.30
7	EEC	-	-	1	-	-	2	-	10	13	7.14
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**25**	**25**	**22**	**25**	**21**	**26**	**22**	**16**	**182**	**100**

HSMC - Humanities and Social Sciences including Management Courses
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Professional Core Courses
EEC - Employability Enhancement Courses
PEC - Professional Elective Courses
OEC - Open Elective Courses
IS - Internship
AC - Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	7	2	-	-	-	-	9
2	II	7	2	-	-	-	-	9
3	III	5	3	-	-	-	-	8
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**44**	**16**	**1**	**1**	**1**	**1**	**64**

HOD **Dean - Academics** **Principal**

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021
(CHOICE BASED CREDIT SYSTEM)
(REVISED)
For the Batch Admitted in the Academic Year 2023-2024

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
9	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**31**	**19**	**0**	**12**	**25**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	PH1254	Materials Science	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
7	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**29**	**20**	**1**	**8**	**25**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	ME1401	Thermal Engineering	PCC	3	3	0	0	3
4	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course – II	PEC	3	3	0	0	3
5	---	Professional Elective Course – III	PEC	3	3	0	0	3
6	---	Open Elective Course – I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course – V	PEC	3	3	0	0	3
6	---	Open Elective Course – II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	4	0	0	4	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**30**	**18**	**0**	**12**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6^{th} semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 182

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
3	HS1201	Professional English	HSMC	3	3	0	0	3
4	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
5	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
6	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	PH1254	Materials Science	BSC	3	3	0	0	3
7	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
8	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
2	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
3	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	3	2
5	ME1709	Technical Seminar - III	EEC	4	0	0	4	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing[#]	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology[#]	EEC	3	1	0	2	2
9	MV0003	Electrical Harness and Routing Design for Electric Vehicles[#]	EEC	3	1	0	2	2
10	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

[#] Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS102	Programming and Data Structures	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	7	-	-	-	-	-	3	14	7.69
2	BSC	12	7	4	4	-	-	-	-	27	14.84
3	ESC	9	11	8	5	-	-	-	-	33	18.13
4	PCC	-	-	9	16	18	15	13	-	71	39.01
5	PEC	-	-	-	-	3	6	6	3	18	9.89
6	OEC	-	-	-	-	-	3	3	-	6	3.30
7	EEC	-	-	1	-	-	2	-	10	13	7.14
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**25**	**25**	**22**	**25**	**21**	**26**	**22**	**16**	**182**	**100**

HSMC - Humanities and Social Sciences including Management Courses
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Professional Core Courses
EEC - Employability Enhancement Courses
PEC - Professional Elective Courses
OEC - Open Elective Courses
IS - Internship
AC - Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	7	2	-	-	-	-	9
2	II	7	2	-	-	-	-	9
3	III	5	3	-	-	-	-	8
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**44**	**16**	**1**	**1**	**1**	**1**	**64**

HOD **Dean - Academics** **Principal**

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021
(CHOICE BASED CREDIT SYSTEM)
(REVISED)
For the Batch Admitted in the Academic Year 2022-2026

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**30**	**18**	**0**	**12**	**24**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	PH1254	Materials Science	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
7	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**29**	**20**	**1**	**8**	**25**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
6	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**28**	**17**	**1**	**10**	**23**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	ME1401	Thermal Engineering	PCC	3	3	0	0	3
4	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course – II	PEC	3	3	0	0	3
5	---	Professional Elective Course – III	PEC	3	3	0	0	3
6	---	Open Elective Course – I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course – V	PEC	3	3	0	0	3
6	---	Open Elective Course – II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	4	0	0	4	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**30**	**18**	**0**	**12**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6^{th} semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 182

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
3	HS1201	Professional English	HSMC	3	3	0	0	3
4	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
5	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
6	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	PH1254	Materials Science	BSC	3	3	0	0	3
7	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
8	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
2	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
3	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	3	2
5	ME1709	Technical Seminar - III	EEC	4	0	0	4	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing[#]	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology[#]	EEC	3	1	0	2	2
9	MV0003	Electrical Harness and Routing Design for Electric Vehicles[#]	EEC	3	1	0	2	2
10	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

[#] Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)
SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS102	Programming and Data Structures	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	3	7	1	-	-	-	-	3	14	7.69
2	BSC	12	7	4	4	-	-	-	-	27	14.84
3	ESC	9	11	8	5	-	-	-	-	33	18.13
4	PCC	-	-	9	16	18	15	13	-	71	39.01
5	PEC	-	-	-	-	3	6	6	3	18	9.89
6	OEC	-	-	-	-	-	3	3	-	6	3.30
7	EEC	-	-	1	-	-	2	-	10	13	7.14
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**24**	**25**	**23**	**25**	**21**	**26**	**22**	**16**	**182**	**100**

HSMC - Humanities and Social Sciences including Management Courses
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Professional Core Courses
EEC - Employability Enhancement Courses
PEC - Professional Elective Courses
OEC - Open Elective Courses
IS - Internship
AC - Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	6	2	-	-	-	-	8
2	II	7	2	-	-	-	-	9
3	III	6	3	-	-	-	-	9
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**44**	**16**	**1**	**1**	**1**	**1**	**64**

HOD **Dean - Academics** **Principal**

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021
(CHOICE BASED CREDIT SYSTEM)
(REVISED)
For the Batch Admitted in the Academic Year 2021-2025

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**30**	**18**	**0**	**12**	**24**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	PH1254	Materials Science	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
PRACTICALS								
7	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
8	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**28**	**19**	**1**	**8**	**24**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	ME1401	Thermal Engineering	PCC	3	3	0	0	3
4	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course – II	PEC	3	3	0	0	3
5	---	Professional Elective Course – III	PEC	3	3	0	0	3
6	---	Open Elective Course – I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course – V	PEC	3	3	0	0	3
6	---	Open Elective Course – II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	4	0	0	4	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**30**	**18**	**0**	**12**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6^{th} semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 180

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	HS1201	Professional English	HSMC	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
4	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	PH1254	Materials Science	BSC	3	3	0	0	3
7	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
8	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
2	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
3	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	3	2
5	ME1709	Technical Seminar - III	EEC	4	0	0	4	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing[#]	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology[#]	EEC	3	1	0	2	2
9	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

[#] Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS102	Programming and Data Structures	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	3	6	0	-	-	-	-	3	12	6.67
2	BSC	12	7	4	4	-	-	-	-	27	15.00
3	ESC	9	11	8	5	-	-	-	-	33	18.33
4	PCC	-	-	9	16	18	15	13	-	71	39.45
5	PEC	-	-	-	-	3	6	6	3	18	10.00
6	OEC	-	-	-	-	-	3	3	-	6	3.33
7	EEC	-	-	1	-	-	2	-	10	13	7.22
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**24**	**24**	**22**	**25**	**21**	**26**	**22**	**16**	**180**	**100**

HSMC - Humanities and Social Sciences including Management Courses
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Professional Core Courses
EEC - Employability Enhancement Courses
PEC - Professional Elective Courses
OEC - Open Elective Courses
IS - Internship
AC - Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	6	2	-	-	-	-	8
2	II	6	2	-	-	-	-	8
3	III	5	3	-	-	-	-	8
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**42**	**16**	**1**	**1**	**1**	**1**	**62**

HOD **Dean - Academics** **Principal**

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT - I SHARING INFORMATION RELATED TO ONESELF/ FAMILY & FRIENDS **9**

Reading - critical reading - finding key information in a given text - shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts - short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development - voices - Wh - Questions- asking and answering - yes or no questions - parts of speech. Vocabulary development - prefixes - suffixes - articles - Polite Expressions. CO1

UNIT - II GENERAL READING AND FREE WRITING **9**

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations); Reading Comprehension Texts with varied question types - Writing - paragraph writing - topic sentence - main ideas - free writing, short narrative descriptions using some suggested vocabulary and structures -. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking - describing a simple process - asking and answering questions - Language development - prepositions, clauses. Vocabulary development - guessing meanings of words in context - use of sequence words. CO2

UNIT - III GRAMMAR AND LANGUAGE DEVELOPMENT **9**

Reading - short texts and longer passages (close reading) & making a critical analysis of the given text Writing - types of paragraph and writing essays - rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking - role plays - asking about routine actions and expressing opinions. Language development - degrees of comparison - pronouns - Direct vs. Indirect Questions. Vocabulary development - idioms and phrases- cause & effect expressions, adverbs. CO3

UNIT - IV READING AND LANGUAGE DEVELOPMENT **9**

Reading- comprehension-reading longer texts - reading different types of texts- magazines. Writing - letter writing, informal or personal letters - e-mails - conventions of personal email - Listening: Listening comprehension (IELTS, TOEFL and others). Speaking - Speaking about friends/places/hobbies - Language development - Tenses- simple present-simple past - present continuous and past continuous- conditionals - if, unless, in case, when and others Vocabulary development - synonyms - antonyms - Single word substitutes - Collocations. CO4

UNIT - V EXTENDED WRITING **9**

Reading: Reading for comparisons and contrast and other deeper levels of meaning - Writing - brainstorming - writing short essays - developing an outline- identifying main and subordinate ideas - dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs - present/past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.

CO2 Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

CO3 Read different genres of texts adopting various reading strategies.

CO4 Listen/view and comprehend different spoken discourses/excerpts in different accents

CO5 Identify topics and formulate questions for productive inquiry

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2021.
2. Sanjay Kumar & Pushp Lata, Communication Skills, Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.

REFERENCE BOOKS:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges, Cengage Learning ,USA: 2007.
3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005.
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013.
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020.

MA1102 ENGINEERING MATHEMATICS - I

L	T	P	C
4	0	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of single variable and multivariable calculus which plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT - I MATRICES **12**

Eigen values and Eigenvectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigenvectors - Cayley-Hamilton theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms CO1

UNIT - II CALCULUS OF ONE VARIABLE **12**

Limit of a function - Continuity - Derivatives - Differentiation rules - Interval of increasing and decreasing functions - Maxima and Minima - Intervals of concavity and convexity. CO2

UNIT - III CALCULUS 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 - Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers. CO3

UNIT - IV INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals. CO4

UNIT - V MULTIPLE INTEGRALS 12

Double integrals - Change of order of integration - Double integrals in polar coordinates - Area enclosed by plane curves - Change of variables from Cartesian to polar in double integrals - Triple integrals - Volume of solids. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Have a clear idea of matrix algebra pertaining to Eigen values and Eigenvectors in addition to dealing with quadratic forms.

CO2 Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.

CO3 Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.

CO4 Understand the concept of integration through the fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.

CO5 Do double and triple integration so that they can handle integrals of higher order which are applied in the engineering field.

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units II & IV - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS:

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. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics - I, McGraw Hill Education; First edition 2017

PH1103	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

To make the students conversant with

- Elastic properties of materials and various moduli of elasticity.
- Principles of laser and fiber optics and its various technological applications.
- Thermal conduction in solids, heat exchangers and its applications in various devices.
- Quantum concepts to explain black body radiation, Compton effect and matter waves.
- Various crystal structures, Miller indices and crystal growth techniques.

UNIT - I PROPERTIES OF MATTER **9**

Elasticity - Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength - torsional stress and deformations - twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - Practical applications of modulus of elasticity - I shaped girders - stress due to bending in beams. CO1

UNIT - II LASER AND FIBER OPTICS THERMAL PHYSICS **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation - resonant cavity, optical amplification (qualitative) - Nd-YAG Laser-Semiconductor lasers: homo junction and hetero junction - Industrial and medical applications of Laser - Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) - losses associated with optical fibers - Fabrication of Optical fiber - Double crucible method - fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber - Endoscopy - Fiber optic communication system. CO2

UNIT - III LASER AND FIBER OPTICS THERMAL PHYSICS **9**

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conductions in solids - thermal conductivity - Rectilinear flow of heat- conduction through compound media (series and parallel) - Lee's disc method: theory and experiment - Radial flow of heat - thermal insulation - applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters. CO3

UNIT IV QUANTUM PHYSICS **9**

Black body radiation - Planck's theory (derivation) - Compton effect: theory and experimental verification - wave particle duality - electron diffraction - concept of wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - particle in a one-dimensional rigid box - Electron microscope - tunnelling (qualitative) - scanning tunnelling microscope - Applications of electron microscopy. CO4

UNIT V CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - Graphite structure - crystal imperfections: point defects, line defects - Burger vectors, stacking faults - growth of single crystals: solution and melt growth techniques - Epitaxial growth-Applications of Single crystal (Qualitative). CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

CO1 The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young's modulus by various methods.

CO2 Principle of laser, Einstein's coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.

CO3 The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee's disc method and radial flow of heat.

CO4 The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunnelling electron microscopy and its applications.

CO5 The importance of various crystal structures, Miller indices and various growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2013.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2014.

CY1104 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

OBJECTIVES

To make the students conversant with

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys
- Various types of fuels, applications and combustion
- Conventional and non-conventional energy sources and energy storage device

UNIT – I WATER AND ITS TREATMENT **9**

Hardness of water - Types - Expression of hardness - Units - Estimation of hardness by EDTA method - Numerical problems on EDTA method - Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) - Treatment of boiler feed water - Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment - Ion exchange process, Zeolite process - Desalination of brackish water by Reverse Osmosis. CO1

UNIT – II SURFACE CHEMISTRY AND CATALYSIS **9**

Surface chemistry : Types of adsorption - Adsorption of gases on solids - Adsorption of solute from solutions - Adsorption isotherms - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm - Kinetics of uni-molecular surface reactions - Adsorption in chromatography - Applications of adsorption in pollution abatement using PAC. CO2

Catalysis: Catalyst - Types of catalysis - Criteria - Contact theory - Catalytic poisoning and catalytic promoters - Industrial applications of catalysts - Catalytic convertor - Auto catalysis - Enzyme catalysis - Michaelis-Menten equation.

UNIT – III PHASE RULE AND ALLOYS 9

Phase rule: Introduction - Definition of terms with examples - One component system - Water system - Reduced phase rule - Thermal analysis and cooling curves - Two component systems - Lead-silver system - Pattinson process.
Alloys: Introduction - Definition - Properties of alloys - Significance of alloying - Functions and effect of alloying elements - Nichrome, Alnico, Stainless steel (18/8) - Heat treatment of steel - Non-ferrous alloys - Brass and bronze. CO3

UNIT – IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - Comparison of solid, liquid, gaseous fuels - Coal - Analysis of coal (proximate and ultimate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum - Cracking - Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) - Knocking - Octane number - Diesel oil - Cetane number - Compressed natural gas (CNG) - Liquefied petroleum gases (LPG) - Power alcohol and biodiesel. CO4
Combustion of fuels: Introduction - Calorific value - Higher and lower calorific values - Theoretical calculation of calorific value - Ignition temperature - Spontaneous ignition temperature - Explosive range - Flue gas analysis by Orsat Method.

UNIT – V NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear energy - Fission and fusion reactions - Differences - Chain reactions - Nuclear reactors - Classification of reactors - Light water nuclear reactor for power generation - Breeder reactor - Solar energy conversion - Solar cells - Wind energy - Fuel cells - Hydrogen-oxygen fuel cell. CO5
Batteries - Types of batteries - Alkaline batteries - Lead-acid, Nickel-cadmium and Lithium batteries.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.

CO2 Understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.

CO3 Recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.

CO4 Identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.

CO5 Understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

TEXT BOOKS:

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi(2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd., Chennai, (2009).

REFERENCE BOOKS:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media, New Delhi., (2010).
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

GE1105 PROBLEM SOLVING AND PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT - I ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi. CO1

UNIT - II INTRODUCTION TO PYTHON **9**

Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs. CO2

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

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search. CO3

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

Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram. CO4

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

Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(), readline(), readlines(),write(), writelines(), tell(), seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop algorithmic solutions to simple computational problems
CO2 Develop simple console application in python
CO3 Develop python program by applying control structure and decompose program into functions.
CO4 Represent compound data using python lists, tuples, and dictionaries.
CO5 Read and write data from/to files in Python.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016
2. (http://greenteapress.com/wp/thinkpython/)
3. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python - Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS:

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction.

GE1106 ENGINEERING GRAPHICS

L	T	P	C
2	0	4	4

OBJECTIVES

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To inculcate drawing practice in standardized form whenever technical drawing is needed.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning. **1**

UNIT - I PLANE CURVES AND FREEHAND SKETCHING 7 + 12

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloidal curves - construction of involutes of square and circle - Drawing of tangents and normal to the above curves. CO1

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three-Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects (Draw without using drawing instruments)

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

Orthographic projection - principles-Principal planes - First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. CO2
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT - III PROJECTION OF SOLIDS 5 + 12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes when the solid is simply suspended by rotating object method. CO3

UNIT - IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5 + 12

Sectioning of simple solids like prisms, pyramids, cylinder, and cone in a simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other - obtaining true shape of section. CO4
Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones - Graphically finding the shortest distance connecting two points.

UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 12

Principles of isometric projection - isometric scale -Isometric projections and isometric views of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. CO5
Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method.

TOTAL PERIODS: 90

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the fundamentals and standards of Engineering graphics.
CO2 Perform freehand sketching of basic geometrical constructions and multiple views of objects.
CO3 Understand the concept of orthographic projections of lines and plane surfaces.
CO4 Draw projections of the section of solids and development of surfaces.
CO5 Visualize and to project isometric and perspective sections of simple solids.

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty ninth edition 2017
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.
3. S. Ramachandran and K. Pandian, "Engineering Graphics" Airwalk Publications; 8th edition 2014

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. 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.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

GE1109 PROBLEM SOLVING AND PROGRAMMING IN C

L	T	P	C
3	0	0	3

(Common to all branches of B.E./B.Tech Programmes)

OBJECTIVES

- To know the problem solving and develop C Programs using basic programming constructs.
- To develop C programs using decision control and looping statements, functions and arrays.
- To develop applications in C using strings and pointers
- To develop applications in C using structures and union
- To develop applications using sequential and random-access file processing.

UNIT- I PROBLEM SOLVING AND BASICS OF C PROGRAMMING **9**

Introduction, Algorithms, building blocks of algorithms, Algorithmic problem-solving steps; Simple Strategies and notation for developing algorithms: Control flow, Flow charts, Pseudo codes, Programming languages; Introduction to C; Structure of a C Program; Compiling and Executing C Programmes, C Tokens and character set, Keywords, Identifiers, Basic Data types, Variables, Constants, Input/Output statements, Operators, Type conversion and Type Casting. CO1

UNIT – II DECISION CONTROL, LOOPING STATEMENTS, FUNCTIONS AND ARRAYS **9**

Conditional Branching statements, Iterative statements, Nested loops, The Break and continue statements, Goto statements; Introduction to Functions: Function declaration, Function definition, Function call, return statement, passing parameters to the function, Recursive Functions; Introduction to Arrays: Declaration, Accessing the Elements, storing values, operations on arrays, Passing Arrays to functions, two-dimensional array, Multidimensional arrays. CO2

UNIT – III STRINGS AND POINTERS **9**

String: Introduction to String, Suppressing Input, String Taxonomy, String operation; Pointers: Introduction to Pointers, declaring pointers variables, Pointer expression and Pointer arithmetic, passing arguments to Function using Pointers, Pointers and Arrays, Array of pointers; Function Pointers, Pointers to Pointers, memory allocation in C Programs, Dynamic memory allocation; Drawbacks of pointers. CO3

UNIT – IV STRUCTURES, UNIONS AND ENUMERATED DATA TYPE **9**

Structure: declaration and initialization, accessing members of structure; Nested structures; Array of structures; Structures and functions; Self-referential structures; Union: declaration and initialization, Accessing members of Union; Array of Union variable; Unions inside Structures, Structures inside unions, Enumerated Data type. CO4

UNIT – V FILE PROCESSING **9**

Introduction to files, using files in C, read data from files, Writing Data to files, Detecting the End of file, Error Handling during file operations; Accepting Command line arguments, Function for selecting a record randomly, Remove and renaming the File, Creating temporary file, Preprocessor directives. CO5

TOTAL PERIODS: 45

TEXT BOOKS

1. Reema Thareja, Programming in C, Oxford University Press, Third Edition, 2023.
2. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill, 2017.
3. Kernighan, B.W and Ritchie, D.M, The C Programming language, Second Edition, Pearson Education, 2015.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, How to Program, Ninth edition, Pearson Publication 2022.
2. Dhabal Prasad Sethi and Manoranjan, Concepts and Techniques of Programming In C, Wiley India,2020.
3. Mamta Bhusry, C Concepts & Programming, Wiley India, 2019
4. Dr. Rupinder Singh, Inderpreet Kaur, and Davinder Kaur, C programming Beginners guide, Notion Press, 2020.
5. M.T. Somashekara, D. S. Guru and K. S. Manjunatha, Problem Solving with C, PHI Learning, 2018.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple applications in C using basic constructs.
CO2 Design and implement applications using arrays, strings and functions.
CO3 Develop and implement applications in C using pointers.
CO4 Develop applications in C using structures and union.
CO5 Design applications using sequential and random-access file processing.

GE1209	**தமிழர் மரபு**	**L**	**T**	**P**	**C**
	(Common for all Branches of B.E. / B. Tech Programmes)	**1**	**0**	**0**	**1**

அலகு - I மொழி மற்றும் இலக்கியம் **3**

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

அலகு - II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசை 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 விளையாட்டுகள்.

அலகு - IV தமிழர்களின் திணைக் கோட்பாடுகள் **3**

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

அலகு - V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு **3**

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

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

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

GE1209	HERITAGE OF TAMILS	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	1	0	0	1

UNIT – I LANGUAGE AND LITERATURE 3

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

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

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

UNIT – III FOLK AND MARTIAL ARTS 3

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

UNIT – IV THINAI CONCEPT OF TAMILS 3

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

UNIT – V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3 **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 PERIODS : 15

TEXT CUM REFERENCE BOOKS

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

GE1107 PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs .
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems
3. Scientific problem-solving using decision making and looping. CO1
   - Armstrong number, palindrome of a number, Perfect number.
4. Simple programming for one dimensional and two-dimensional arrays.
   - Transpose, addition, multiplication, scalar, determinant of a matrix
5. Program to explore string functions and recursive functions. CO2

6. Utilizing 'Functions' in Python
   - Find mean, median, mode for the given set of numbers in a list.
   - Write a function dups to find all duplicates in the list.
   - Write a function unique to find all the unique elements of a list.
   - Write function to compute gcd, lcm of two numbers.
7. Demonstrate the use of Dictionaries and tuples with sample programs.
8. Implement Searching Operations: Linear and Binary Search.
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.
10. Find the most frequent words in a text of file using command line arguments.
11. Demonstrate Exceptions in Python. CO3
12. Applications**:** Implementing GUI using turtle, pygame.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple console applications through python with control structure and functions

CO2 Use python built in data structures like lists, tuples, and dictionaries for representing compound data.

CO3 Read and write data from/to files in Python and applications of python.

REFERENCE BOOKS:

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES:

1. http://www.edx.org

BS1108 PHYSICS AND CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The properties of matter
- The optical properties, characteristics of lasers & optical fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS – PHYSICS

A minimum of 5 experiments to be performed from the given list

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.

3. Determination of wavelength of mercury spectra using Spectrometer and grating.
4. Determination of dispersive power of prism using Spectrometer.
5. (a) Determination of wavelength and particle size using a laser.
   (b) Determination of numerical aperture and acceptance angle of an optical fibre.
   (c) Determination of width of the groove of compact disc using laser
6. Determination of Young's modulus of the material of the given beam by uniform bending method.
7. Determination of energy band gap of the semiconductor.
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.

Demonstration Experiment

1. Determination of thickness of a thin sheet / wire - Air wedge method

LIST OF EXPERIMENTS – CHEMISTRY

A minimum of 5 experiments to be performed from the given list

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
10. Conductometric titration of strong acid vs strong base.

Demonstration Experiments

1. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
2. Estimation of sodium and potassium present in water using flame photometer.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concept about the basic properties of matter like stress, strain and types of moduli.
Understand the procedure to estimate the amount of dissolved oxygen present in the water.

CO2 Understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
Understand the concept about measuring the conductance of strong acid and strong base and mixture of acids by using conductivity meter.

CO3 Understand the thermal properties of solids and to calculate thermal conductivity of a bad conductor.
Understand the principle and procedure involved in the amount of chloride present in the given sample of water.

CO4 Understand the concept of microscope and its applications in determining the moduli.
Understand the concept of determining the emf values by using potentiometer.

CO5 Calculate the particle size of poly crystalline solids.
Understand the concept of determining the pH value and strength of a given acid sample by using pH meter.

GE1110	PROGRAMMING IN C LABORATORY	L	T	P	C
	(Common to all branches of B.E./B.Tech Programmes)	3	0	0	3

OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing.

LIST OF EXPERIMENTS

1. C programming using simple statements and expressions.
2. Scientific problem-solving using decision making and looping.
3. Generating different patterns using multiple control statements. CO1
4. Problems solving using one dimensional array.
5. Mathematical problem solving using two dimensional arrays.
6. Solving problems using string functions.
7. Solving problems with user defined functions.
8. Solving problems using recursive function. CO2
9. Solving problems with dynamic memory allocation.
10. Realtime application using structures and unions.
11. Realtime problem solving using sequential and random-access file.
12. Solving problems with command line argument. CO2

TOTAL PERIODS: 60

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by Jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
4. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
5. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
6. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop C programs for simple applications making use of basic constructs.
CO2 Develop C programs involving string, functions, recursion, pointers, andstructures.
CO3 Design applications using sequential and random-access fileprocessing.

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

The course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT – I INTRODUCTION PROFESSIONAL ENGLISH **9**

Listening: Listening to technical talks with comprehension tasks - Speaking - conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading - reading short technical texts from journals- newspapers - Writing- purpose statements - extended definitions - writing instructions - checklists-recommendations - Vocabulary Development - technical vocabulary Language Development - tenses - subject verb agreement - compound words CO1

UNIT – II READING AND STUDY SKILLS **9**

Listening - Listening comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). - Speaking - describing a process - Reading: Practice in chunking and speed reading – Paragraphing - Writing- interpreting charts, graphs - Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs - easily confused words Language Development- impersonal passive voice, numerical adjectives. CO2

UNIT – III TECHNICAL WRITING AND GRAMMAR **9**

Listening - listening to conversation - effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking - mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis. CO3

UNIT – IV REPORT WRITING **9**

Listening - Model debates & documentaries and making notes. Speaking - expressing agreement/ disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette - job application - cover letter - Résumé preparation (via email and hard copy) - analytical essays and issue based essays - Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals. CO4

UNIT – V GROUP DISCUSSION AND JOBAPPLICATIONS **9**

Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking - participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others) - Writing reports- minutes of a meeting- accident and survey - Writing a letter/ sending an email to the Editor - cause and effect sentences - Vocabulary Development - verbal analogies. Language Development - reported speech. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.

CO2 Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

CO3 Read different genres of texts adopting various reading strategies.

CO4 Listen/view and comprehend different spoken discourses/excerpts in different accents

CO5 Identify topics and formulate questions for productive inquiry

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS:

1. Raman, Meenakshi and Sharma, Sangeetha, Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad, 2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading

MA1202 ENGINEERING MATHEMATICS – II

L	T	P	C
4	0	0	4

OBJECTIVES

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform. Vector calculus can be widely used for modelling the various laws of physics.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT - I ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters- Homogenous equation of Euler‘s and Legendre‘s type - System of simultaneous first order linear differential equations with constant coefficients CO1

UNIT - II VECTOR CALCULUS **12**

Gradient and directional derivative - Divergence and curl - Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems - Verification and simple application in evaluating line, surface and volume integrals. CO2

UNIT - III COMPLEX VARIABLES **12**

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-R equations) - Properties - Harmonic conjugates - Construction of analytic function (Milne-Thomphson method) - Conformal mapping - Standard transformations $W = Z + C$, CZ, $1/Z$ - Bilinear transformation. CO3

UNIT - IV COMPLEX INTEGRATION **12**

Cauchy integral theorem - Cauchy integral formula - Taylor and Laurent series - Singularities - Residues - Cauchy Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semi circular contour(excluding poles on the real line) CO4

UNIT - V LAPLACE TRANSFORMS **12**

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - transforms of derivatives and integrals -Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem - Application to solution of linear second order ordinary differential equations with constant coefficients. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

CO1 The students were imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems

CO2 The student were acquainted with the concepts of vector calculus-like Gradient, Divergence, Curl, Directional derivative, Irrational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.

CO3 To develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current .

CO4 The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.

CO5 To make the students to appreciate the purpose of using transforms to create new domain in which it is easier to handle the problem that is being investigated.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. T. Veerarajan. Engineering Mathematics - II, McGraw Hill Education; First edition 2017.

PH1254 MATERIALS SCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the essential principles of materials science for mechanical and related engineering applications

UNIT - I PHASE DIAGRAMS **9**

Solid solutions - Hume Rothery's rules - the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - free energy composition curves for binary systems - microstructural change during cooling. CO1

UNIT - II FERROUS ALLOYS **9**

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws of diffusion- mechanisms of diffusion, temperature dependence of diffusivity - steady and non-steady state diffusion - factors that influence diffusion - Properties and applications of copper alloys, aluminium alloys and titanium alloys. Phase transformations - T-T-T-diagram for eutectoid steel - pearlitic, baintic and martensitic transformations - tempering of martensite. CO2

UNIT - III MECHANICAL PROPERTIES **9**

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination- Fatigue failure - fatigue tests - hardness - Rockwell and Brinell hardness - Knoop and Vickers micro hardness. Steps in materials selection process, Factors influencing materials selection, Case studies CO3

UNIT - IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS **9**

Ferromagnetism - domain theory - types of energy - hysteresis - hard and soft magnetic materials - ferrites - dielectric materials - types of polarization – Langevin - Debye equation - frequency effects on polarization - dielectric breakdown - insulating materials - Ferroelectric materials - superconducting materials and their properties. CO4

UNIT - V NEW MATERIALS **9**

Historical perspective- Material properties and qualities, Classification of Materials - Ceramics - types and applications - composites: classification, role of matrix and reinforcement, processing of fibre reinforced plastics - metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications – nano materials: preparation (bottom up and top down approaches), properties and applications. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the various forms of solid solutions, equilibrium, and different phase diagrams and their applications in materials system.

CO2 Understand the Fe - Fe_3C phase diagram, invariant reactions, diffusion of solids, mechanism, factors that influence diffusion, properties of copper, aluminium and titanium alloys and various microstructures of ferrous and their alloys.

CO3 Understand the mechanical properties of materials, measurement and materials selections process and their case studies.

CO4 Understand the properties of different types of magnetic materials - Ferromagnetic, Anti ferro magnetic, Ferrites. Understand the phenomenon of superconductivity, and its properties of superconductors and .the properties of dielectric materials, various types of polarization and loss in dielectric materials.

CO5 Understand the importance of various newer materials, like ceramics, composite materials, metallic glass, SMA, Nano materials. Their historical perspective, properties, classification and fabrication and apply to develop alloys of various composition with desirable properties

TEXT BOOKS:

1. Balasubramaniam, R. Callister's Materials Science and Engineering. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
3. Raghavan, V. Materials Science and Engineering: A First course. PHI Learning, 2015.

REFERENCE BOOKS:

1. Askeland, D. Materials Science and Engineering. Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. Materials Science and Engineering. Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT - I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY **11**

Definition, scope and importance of environment - need for public awareness - Role of Individual in Environment protection - Concept of an ecosystem-structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem.

Biodiversity-definition-genetic species and ecosystem diversity. Value of biodiversity-consumptive use, productive use, social, ethical, aesthetic and option values. - Biodiversity at global, national and local levels - India as a mega-diversity nation - Hot spots of biodiversity. Threats to biodiversity-habitat loss, poaching of wild life, human-wildlife conflicts. Wildlife protection act and forest conservation act. Endangered and endemic species. Conservation of biodiversity in-situ and ex-situ conservation of biodiversity. CO1

UNIT - II ENVIRONMENTAL POLLUTION **9**

Definition - causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes- problems of e-waste - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake, cyclone, Tsunami and landslides. Field study of local polluted site - Urban / Rural / Industrial / Agricultural. CO2

UNIT - III NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and overutilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets - river / forest / grassland / hill / mountain. CO3

UNIT - IV SOCIAL ISSUES AND THE ENVIRONMENT **8**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization - environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - Principles of Green Chemistry - environment CO4

protection act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - enforcement machinery involved in environmental legislation- central and state pollution control boards- National Green Tribunal - Public awareness.

UNIT - V HUMAN POPULATION AND THE ENVIRONMENT **8**

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - COVID 19 - women and child welfare - role of information technology in environment and human health - Case studies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Obtain knowledge about environment, ecosystems and biodiversity.
CO2 Take measures to control environmental pollution.
CO3 Gain knowledge about natural resources and energy sources.
CO4 Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5 Understand the impact of environment on human population.

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt, Ltd, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

BE1252 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working Principles of Electrical Machines
- Various Electronic Devices and Measuring Instruments

UNIT - I ELECTRICAL CIRCUITS **9**

Basic circuit components, Ohms Law - Kirchoff's Law - Instantaneous Power - Inductors - Capacitors - Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis - Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem, Linearity and Superposition Theorem. CO1

UNIT - II AC CIRCUITS **9**

Introduction to AC circuits - waveforms and RMS value - power and power factor, single phase and three-phase balanced circuits - Three phase loads - housing wiring, industrial wiring, materials of wiring. CO2

UNIT - III ELECTRICAL MACHINES **9**

Principles of operation and characteristics of; DC machines, Transformers (single and three phase), Synchronous machines , three phase and single phase induction motors. CO3

UNIT - IV ELECTRONIC DEVICES AND CIRCUITS **9**

Types of Materials - Silicon & Germanium - N type and P type materials - PN Junction - Forward and Reverse Bias -Semiconductor Diodes - Bipolar Junction Transistor - Characteristics - Field Effect Transistors - Transistor Biasing - Introduction to operational Amplifier - Inverting Amplifier - Non Inverting Amplifier - DAC - ADC . CO4

UNIT - V MEASUREMENTS AND INSTRUMENTATION **9**

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - Classification of instruments - Types of indicating Instruments - multimeters – Oscilloscopes - three-phase power measurements - instrument transformers (CT and PT) CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the basic laws and theorems used in Electrical circuits

CO2 Impart knowledge on single phase and three phase AC circuit and wiring

CO3 Comprehend the construction and working principle of Electrical machines

CO4 Explain the fundamentals of semiconductor and applications.

CO5 Impart knowledge on different measuring instruments

TEXT BOOKS:

1. Leonard S Bobrow, “Foundations of Electrical Engineering”, Oxford University Press, 2013 2.
2. D.P.Kothari and I.J.Nagarath, “Electrical Machines “Basic Electrical and Electronics Engineering”, McGraw Hill Education(India) Private Limited, Third Reprint, 2016 3.
3. Thereja.B.L., “Fundamentals of Electrical Engineering and Electronics”, S. Chand & Co. Ltd., 2008

REFERENCE BOOKS:

1. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007
2. John Bird, “Electrical Circuit Theory and Technology”, Elsevier, First Indian Edition, 2006
3. Allan S Moris, “Measurement and Instrumentation Principles”, Elsevier, First Indian Edition,2006
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering”, McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, “Basic Electrical Engineering”, Universities Press (India)Private Limited 2016

GE1206 ENGINEERING MECHANICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To develop capacity to predict the effect of force.
- To develop motion in the course of carrying out the design functions of Engineering.

UNIT - I STATICS OF PARTICLES **12**

Introduction - Units and Dimensions - Laws of Mechanics - Lami’s theorem, Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility. CO1

UNIT - II EQUILIBRIUM OF RIGID BODIES **12**

Free body diagram - Types of supports -Action and reaction forces - stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Single equivalent force -Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions. CO2

UNIT - III PROPERTIES OF SURFACES AND SOLIDS **12**

Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, - Angle section, Hollow section by using standard formula - Theorems of Pappus - Area moments of inertia of plane areas - Rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Principal moments of inertia of plane areas - Principal axes of inertia-Mass moment of inertia -mass moment of inertia for prismatic, cylindrical and spherical solids from first principle - Relation to area moments of inertia. CO3

UNIT - IV DYNAMICS OF PARTICLES **12**

Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's laws of motion - Work Energy Equation- Impulse and Momentum - Impact of elastic bodies. CO4

UNIT - V FRICTION AND RIGID BODY DYNAMICS **12**

Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction - wedge friction-. Rolling resistance -Translation and rotation of rigid bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Illustrate the vectorial and scalar representation of forces and moments

CO2 Analyse the rigid body in equilibrium

CO3 Evaluate the properties of surfaces and solids

CO4 Calculate dynamic forces exerted in rigid body

CO5 Determine the friction and the effects by the laws of friction

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 12th Edition, Tata McGraw-Hill Publishing company, (2017).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2018).

REFERENCE BOOKS:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 2017.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics - Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., "Engineering Mechanics - Statics" - John Wiley & Sons, 2017.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2018.

GE1210	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	1	0	0	1

அலகு - I நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

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

அலகு - II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

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

அலகு - III உற்பத்தித் தொழில் நுட்பம் 3

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

அலகு - IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம் 3

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

அலகு - V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

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

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

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

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE1210	TAMILS AND TECHNOLOGY	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT - IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT - V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE1207 ENGINEERING PRACTICES LABORATORY L T P C 0 0 4 2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making - Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise - Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

GROUP B (ELECTRICAL & ELECTRONICS))

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of electronic components and equipments - Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of clock signal.
4. Soldering practice - Components devices and circuits - Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Fabricate carpentry components and pipe connections including plumbing works.

CO2 Use welding equipments to join the structures, carry out the basic machining operations, and make the models using sheet metal works.

CO3 Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.

CO4 Carry out basic home electrical works and appliances, measure the electrical quantities.

CO5 Elaborate on the electronic components and gates, soldering practices.

BE1258	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's voltage and current laws.
2. Verification of Thevenin's and Norton's theorem.
3. Verification of superposition theorem.
4. Verification of Maximum power transfer theorem.
5. Study of CRO and measurement of AC signals.
6. Measurement of three phase power by two-Watt meter method.
7. Characteristics of LVDT.
8. Half wave rectifier with capacitive filter.
9. Characteristics of PN Diode
10. Characteristics of BJT
11. RTD and thermistor
12. Transistor based application circuits

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand and experimentally verify the basics of electric circuit laws

CO2 Understand and apply circuit theorems and concepts in engineering applications

CO3 Analyze the AC signals, understand the three phase electric networks and study the instruments used for commercial measurement of electrical power.

CO4 Understand and analyze the characteristics of diode, transistor and implement transistor based application

CO5 Understand and analyze the characteristics of different transducers

MA1301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
4	0	0	4

OBJECTIVES

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of different equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT - I PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations (except) - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types CO1

UNIT - II FOURIER SERIES **12**

Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series - General Fourier series - Odd and even functions - Half range sine series -Half range cosine series - Complex form of Fourier series - Parseval's identity - Harmonic analysis. CO2

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

Classification of PDE - Method of separation of variables - Fourier Series Solutions of one-dimensional wave equation - One dimensional equation of heat conduction - Steady state solution of two dimensional equation of heat conduction. CO3

UNIT - IV FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem - Fourier transform pair - Fourier sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity. CO4

UNIT - V Z - TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms - Elementary properties - Inverse Z-transform (using partial fraction and residues) -Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand how to solve the partial differential equations and apply these concepts in the field of engineering.

CO2 Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.

CO3 Appreciate the physical significance of Fourier series techniques in solving one and two-dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.

CO4 Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis ,image processing etc.

CO5 Learn to use effective mathematical tools like Z- transform for solving difference equations in discrete time signals etc.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
3. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.

REFERENCE BOOKS:

1. Dass, H.K., and Er.RajnishVerma, "Higher Engineering Mathematics", S.Chand Private Ltd.,2011.
2. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012
3. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

EE1352 ELECTRICAL DRIVES AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basic concepts of different types of electrical machines.
- To impart knowledge on performance characteristics of drive motors.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state speed control of DC drives.
- To study the conventional and solid-state speed control of AC drives.

UNIT - I INTRODUCTION **8**

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. CO1

UNIT - II DRIVE MOTOR CHARACTERISTICS **9**

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 - V and inverted V curve of synchronous motor - Regulation of alternator by EMF & MMF method. CO2

UNIT - III STARTING METHODS **8**

Types of DC Motor starters - Typical control circuits for shunt and series motors - Types of A.C Motor starters - Three phase squirrel cage and slip ring induction motors. CO3

UNIT - IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES **10**

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers -applications. CO4

UNIT - V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES **10**

Speed control of three phase induction motor - Voltage control, voltage / frequency control, slip power recovery scheme - Using inverters and AC voltage regulators - applications. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the basic concepts of different types of electrical machines

CO2 Understand and analyze different drive motors characteristics

CO3 Understand the different methods of starting DC motors and induction motors

CO4 Analyze the conventional and solid-state speed control of DC drives

CO5 Analyze the 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. Vedam Subrahmanyam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

REFERENCE BOOKS:

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

CE1301 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES

- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT - I FLUID PROPERTIES AND FLOW CHARACTERISTICS **9**

Units and dimensions - Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics - concept of control volume - application of continuity equation, energy equation and momentum equation. CO1

UNIT - II FLOW THROUGH CIRCULAR CONDUITS **9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli - Boundary layer concepts - types of boundary layer thickness - Darcy Weisbach equation - friction factor- Moody diagram- commercial pipes- minor losses - Flow through pipes in series and parallel. CO2

UNIT - III DIMENSIONAL ANALYSIS **9**

Need for dimensional analysis - methods of dimensional analysis - Similitude - types of similitude - Dimensionless parameters - application of dimensionless parameters - Model analysis. CO3

UNIT - IV PUMPS **9**

Impact of jets - Euler's equation - Theory of roto-dynamic machines - various efficiencies - velocity components at entry and exit of the rotor - velocity triangles - Centrifugal pumps - working principle - work done by the impeller - performance curves - Reciprocating pump - working principle - Rotary pumps -classification. CO4

UNIT - V HYDRAULIC TURBINES **9**

Classification of turbines - heads and efficiencies - velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines - governing of turbines. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO2 Analyze and calculate major and minor losses associated with pipe flow in piping networks.
CO3 Mathematically predict the nature of physical quantities
CO4 Analyze critically the performance of pumps
CO5 Analyze critically the performance of turbines

TEXT BOOKS:

1. Modi P.N. and Seth, S.M., "Hydraulics and Fluid Mechanics Including Hydraulics Machines", Standard Book House, New Delhi 2019.
2. Bansal R. K., "Fluid Mechanics and Hydraulics Machines ", Lakshmi Publications India Pvt. Ltd., India 2018

REFERENCE BOOKS:

1. Kumar K. L., "Engineering Fluid Mechanics", S.Chand& Company Pvt. Ltd, 2016
2. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
3. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.

ME1301 ENGINEERING THERMODYNAMICS L T P C 3 1 0 4

OBJECTIVES

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behaviour and performance.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

UNIT - I BASIC CONCEPTS AND FIRST LAW **12**

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics - concept of temperature and thermal equilibrium- relationship between temperature scales - new temperature scales. First law of thermodynamics -application to closed and open systems - steady and unsteady flow processes. CO1

UNIT - II SECOND LAW AND AVAILABILITY ANALYSIS 12

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle and Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency. CO2

UNIT - III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 12

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. P-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles. CO3

UNIT - IV IDEAL AND REAL GASES,THERMODYNAMIC RELATIONS 12

Properties of Ideal gas - Ideal and real gas comparison - Equations of state for ideal and real gases- Reduced properties. Compressibility factor-.Principle of Corresponding states. Generalised Compressibility Chart and its use. Maxwell relations, TDS Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations. CO4

UNIT - V GAS MIXTURES AND PSYCHROMETRY 12

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture - Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. 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 CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions

CO2 Apply second law of thermodynamics to open and closed systems and calculate entropy and availability

CO3 Apply Rankine cycle to steam power plant and compare few cycle improvement methods

CO4 Derive simple thermodynamic relations of ideal and real gases

CO5 Calculate the properties of gas mixtures and moist air and its use in psychrometric processes

TEXT BOOKS:

1. R.K.Rajput, "A Text Book of Engineering Thermodynamics", Fifth Edition, 2017.
2. Yunus A. Cengel, Michael A. Boles and Mehmet Kanoglu, "Thermodynamics - An Engineering Approach", Tata McGraw-Hill, 9th edition 2019

REFERENCE BOOKS:

1. P.K. Nag, "Engineering Thermodynamics", Tata McGraw-Hill, 6th Edition, 2017
2. C.P. Arora, "Thermodynamics", Tata McGraw-Hill, 12th Edition, 2007
3. Claus Borgnakke& Richard E. Sonnatag, "Fundamental of Thermodynamics", Wiley Publications 10th Edition, 2019.
4. Chattopadhyay.P, "Engineering Thermodynamics", Oxford University Press, 2nd Edition, 2016.
5. Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey, "Fundamentals of Engineering Thermodynamics", 8th Edition, 2014.

ME1302	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I METAL CASTING PROCESSES **9**

Sand Casting: Sand Mould - Type of patterns - Pattern Materials - Pattern allowances - Moulding sand Properties and testing - Cores -Types and applications - Moulding machines - Types and applications; Melting furnaces : Blast and Cupola Furnaces; CO1
Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - CO_2 process - Stir casting; Defects in Sand casting.

UNIT - II JOINING PROCESSES **9**

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure. CO2

UNIT - III METAL FORMING PROCESSES **9**

Hot working and cold working of metals - Forging processes - Open, impression and closed die forging - forging operations. Rolling of metals- Types of Rolling - Flat strip rolling - shape rolling operations - Defects in rolled parts. Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types - Hot and Cold extrusion CO3

UNIT - IV SHEET METAL PROCESSES **9**

Sheet metal characteristics - shearing, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods -special forming processes-Working principle and applications - Hydroforming - Rubber pad forming - Metal spinning- Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming - Micro forming. CO4

UNIT - V MANUFACTURE OF PLASTIC COMPONENTS **9**

Types and characteristics of plastics - Moulding of thermoplastics - working principles and typical applications - injection moulding - Plunger and screw machines - Compression moulding, Transfer Moulding - Typical industrial applications - introduction to blow moulding - Rotational moulding - Film blowing - Extrusion - Thermoforming - Bonding of Thermoplastics. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain different metal casting processes, associated defects, merits and demerits

CO2 Understand different metal joining processes.

CO3 Summarize various hot working and cold working methods of metals.

CO4 Explain various sheet metal making processes.

CO5 Understand various methods of manufacturing plastic components.

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", Volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008.
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2013.

REFERENCE BOOKS:

1. S. Gowri, P. Hariharan, A.SureshBabu, "Manufacturing Technology I", Pearson Education, 2008.
2. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice - Hall of India, 1997.
3. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2013.
4. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
5. Sharma, P.C., "A Textbook of Production Technology", S.Chand and Co. Ltd., 2014.
6. J. Beddoes, M. Bibby., "Principles of Metal Manufacturing Processes", Elsevier India, 2011.

EE1358 ELECTRICAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Perform DC shunt and series motor characteristics and to analyse the speed control behaviour of DC shunt Motor.

CO2 Perform the characteristics of DC Shunt generator on O.C and load conditions.

CO3 Perform open circuit, short circuit and load test on single phase transformer.

CO4 Perform regulation characteristics on the alternator and to analyse the V-curve and Inverted V-curve of a synchronous motor.

CO5 Perform the speed control behaviour of an induction motor and also to know the working principles of AC and DC motor starters.

ME1307 MANUFACTURING PROCESSES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

LIST OF EXPERIMENTS

1. Machining and Machining time estimations for:

a) Taper Turning
b) External Thread cutting
c) Internal Thread Cutting
d) Eccentric Turning
e) Knurling

2. Casting and Joining processes

a) Joining of plates by horizontal, vertical and overhead welding (arc welding)
b) Joining of plates and pipes using gas metal arc welding/ arc welding /submerged arc welding
c) Preparation of green sand moulds for various patterns
d) Manufacturing of simple sheet metal components using shearing and bending operations.
e) Manufacturing of sheet metal components using metal spinning on a lathe.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate the safety precautions exercised in the mechanical workshop.
CO2 Make the work piece as per given dimensions and calculate machining time for different operations in lathe.
CO3 Join two metals using arc welding
CO4 Use sheet metal fabrication tools and make simple tray and funnel
CO5 Use different moulding tools, patterns and prepare sand moulds

HS1310 PROFESSIONAL SKILLS LABORATORY L T P C 0 0 2 1

OBJECTIVES

- Enhance the employability and career skills of students
- Orient the students towards grooming as a professional
- Make them employable graduates
- Develop their confidence and help them attend interviews successfully.

UNIT - I

Introduction to Soft Skills - Hard skills & soft skills - employability and career Skills - Grooming as a professional with values - Making an Oral Presentation-Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language- General awareness of Current Affairs.

UNIT – II

Introduction to Group Discussion - Participating in group discussions - understanding group dynamics - brainstorming the topic - questioning and clarifying -GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc.

UNIT – III

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette - dress code - body language - attending job interviews - telephone/skype interview -one to one interview & panel interview - Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.

UNIT – IV

Self-Introduction - organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice - Making a Power Point Presentation - Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation - Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language.

UNIT – V

Recognizing differences between groups and teams- managing time-managing stress - networking professionally - respecting social protocols-understanding career management - developing a long-term career plan - making career changes.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Make effective presentations

CO2 Participate confidently in group discussions

CO3 Attend job interviews and be successful in them

CO4 Develop adequate soft skills required for the workplace

CO5 Develop their speaking skills to enable them speak fluently in real contexts

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. Orient Balck Swan: Hyderabad, 2016.
3. E.Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S.Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010.

MA1401 STATISTICS AND NUMERICAL METHODS L T P C 4 0 0 4

OBJECTIVES

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquire the knowledge of testing hypotheses 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 Interpolation operators and numerical techniques of interpolation in various intervals, numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS **12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit CO1

UNIT - II DESIGN OF EXPERIMENTS **12**

One way and two-way classifications - Completely randomized design - Randomized block design - Latin square design - 2^2 factorial design. CO2

UNIT – III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **12**

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Pivoting - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method. CO3

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

Interpolation operators (Forward, Backward, shifting operators and its Properties) -- Newton's forward and backward difference interpolation for equal intervals - Lagrange's and Newton's divided difference interpolation for unequal intervals - Approximation of derivatives using interpolation polynomials - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules CO4

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

.Finite difference methods for solving second order two - point linear boundary value problems 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. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Students will gain knowledge on large samples and small samples. These concepts are very useful in biological, electric power management, social experiments and also in all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.

CO2 ANOVA's statistical significance result is independent of constant bias and scaling of errors. It is used in testing the difference between several treatments in the design of experiments. It checks the impact of one or more factors in any experiment in Engineering.

CO3 Students will learn nonlinear (algebraic or transcendental) equations and linear equations. Students learn to solve the eigen value problem of a matrix numerically when analytical methods tend to fail to give solution and apply all these in the fields like vibrating systems, fluid dynamics.

CO4 Students will learn to construct approximate polynomials that can be used in data representation using interpolation techniques to find the intermediate values. In particular, interpolation methods are extensively applied in the models of the different phenomena where experimental data must be used in computer studies where expressions of those data are required. The learners are introduced to numerical differentiation and integration techniques. The techniques are useful when the function in the analytical form is complicated.

CO5 Students get an insight on ordinary differential equations which will be useful in solving engineering problems. Students learn about the different methods for solving first order and second order differential equations. It will be useful in attempting to solve any engineering problems. ODE is applied in specific mathematical fields like electrical, geometry, analytical mechanics, celestial mechanics and weather modelling.

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, 8th Edition, 2015.

REFERENCE BOOKS:

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. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists" 8th edition, Pearson Education, Asia, 2007

CE1401	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external ·loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- 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. CO1

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. CO2

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. CO3

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. CO4

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. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2 Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO3 Apply basic equation of simple torsion in designing of shafts and helical spring.

CO4 Calculate the slope and deflection in beams using different methods.

CO5 Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

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

REFERENCE BOOKS:

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.

ME1401 THERMAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems
  (Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

UNIT I GAS POWER CYCLES **9**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Comparison of cycles. CO1

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. Performance calculation. CO2

UNIT - III STEAM NOZZLES AND TURBINES **9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations -Governors. CO3

UNIT - IV AIR COMPRESSOR **9**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling - work of multistage air compressor CO4

UNIT - V REFRIGERATION AND AIR CONDITIONING **9**

Refrigerants - Vapour compression refrigeration cycle- superheat, sub cooling - 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- Cooling Load calculations. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand and analyse the gas power cycles (Otto, Diesel, Dual and Brayton cycle)

CO2 Understand the working principle of IC engines, its components and compute its performance.

CO3 Design and analyse the steam nozzle & turbines

CO4 Understand the various types of compressor and compute its performance.

CO5 Understand the basic concepts of different types of refrigeration and air conditioning systems, and to compute cooling load calculations

TEXT BOOKS:

1. R.K. Rajput, "Thermal Engineering" Lakshmi Publishers, 2017
2. Kothandaraman C.P., Domkundwar. S, Domkundwar A.V., "A Course in Thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2002

REFERENCE BOOKS:

1. Sarkar, B.K, "Thermal Engineering" Tata McGraw-Hill Publishers, 2007
2. C.P. Arora, "Refrigeration and Air Conditioning", 3rd Edition, Tata McGraw-Hill Publishers 2017
3. V. Ganesan "Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2012
4. R. Rudramoorthy, "Thermal Engineering", Tata McGraw-Hill, New Delhi,2003
5. K. K. Ramalingam, "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2011.

ME1402 KINEMATICS OF MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basic components and layout of linkages in the assembly of a system machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS **9**

Classification of mechanisms - Basic kinematic concepts and definitions - Degree of freedom, Mobility - Kutzbach criterion, Gruebler's criterion - Grashof's Law - Kinematic inversions of four-bar chain and slider crank chains - Limit positions - Mechanical advantage - Transmission Angle - Description of some common mechanisms - Quick return mechanisms, Straight line generators, Universal Joint - rocker mechanisms. CO1

UNIT - II KINEMATICS OF LINKAGE MECHANISMS **9**

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method- Velocity and acceleration polygons - Velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms - Coincident points - Coriolis component of Acceleration - Introduction to linkage synthesis problem. CO2

UNIT – III KINEMATICS OF CAM MECHANISMS **9**

Classification of cams and followers - Terminology and definitions - Displacement diagrams - Uniform velocity, parabolic, simple harmonic and cycloidal motions - Derivatives of follower motions - Layout of plate cam profiles - Specified contour cams - Circular arc and tangent cams - Pressure angle and undercutting - sizing of cams. CO3

UNIT – IV GEARS AND GEAR TRAINS **9**

Law of toothed gearing - Involutes and cycloidal tooth profiles -Spur Gear terminology and definitions - Gear tooth action - contact ratio - Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains - Speed ratio, train value - Parallel axis gear trains - Epicyclic Gear Trains. CO4

UNIT – V 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 - Friction in brakes - Band and block brakes. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the basics of mechanism

CO2 Calculate velocity and acceleration in simple mechanisms

CO3 Develop CAM profiles

CO4 Solve problems on gears and gear trains

CO5 Examine friction in machine elements

TEXT BOOKS:

1. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
2. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2017.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2008.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
5. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
6. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005.

ME1403 ENGINEERING METALLURGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT I ALLOYS AND PHASE DIAGRAMS **9**

Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron - carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application. CO1

UNIT - II HEAT TREATMENT **9**

Definition - Full annealing, stress relief, recrystallisation and spheroidising - normalising, hardening and Tempering of steel. Isothermal transformation diagrams - cooling curves superimposed I.T. diagram CCR - Hardenability, Jominy end quench test - Austempering, martempering - case hardening, carburizing, Nitriding, cyaniding, carbonitriding - Flame and Induction hardening - Vacuum and Plasma hardening. CO2

UNIT - III FERROUS AND NON-FERROUS METALS **9**

Effect of alloying additions on steel- α and β stabilisers- stainless and tool steels - HSLA, Maraging steels - Cast Iron - Grey, white, malleable, spheroidal - alloy cast irons, Copper and copper alloys Brass, Bronze and Cupronickel - Aluminium and Al-Cu - precipitation strengthening treatment - Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys. CO3

UNIT - IV NON-METALLIC MATERIALS **9**

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers - Urea and Phenol formaldehydes)- Engineering Ceramics - Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON -Composites- Classifications- Metal Matrix and FRP - Applications of Composites. CO4

UNIT - V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS **9**

Mechanisms of plastic deformation, slip and twinning - Types of fracture - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test- izod and charpy, fatigue and creep failure mechanisms. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Identify the material constituents from phase diagrams and to understand the classification of steels and cast iron.

CO2 Understand the classification of various heat treatment processes.

CO3 Understand the effects of alloying elements and Engineering applications of ferrous and non-ferrous metals

CO4 Understand the engineering applications of non-metallic materials.

CO5 Understand the various deformation mechanisms and testing of various mechanical properties of materials

TEXT BOOKS:

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Education; 2nd edition July 2017.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition2014.

REFERENCE BOOKS:

1. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd.,2015.
2. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley,2012
3. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited,2010.
4. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

ME1404 METAL CUTTING AND MACHINE TOOLS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping, milling, drilling, grinding, broaching and allied machines.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.

UNIT I THEORY OF METAL CUTTING **9**

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools- nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability. CO1

UNIT - II TURNING MACHINES **9**

Centre lathe, constructional features, specification, operations - taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Semi automatic lathe- Capstan and turret lathes- tool layout - automatic lathes: - single spindle : Swiss type, screw type - multi spindle automatic lathe- types. CO2

UNIT - III SHAPER, MILLING AND GEAR CUTTING MACHINES **9**

Shaper - Types of operations. Drilling ,reaming, boring, Tapping. Milling operations-types of milling cutter Gear Manufacturing - forming and generation principle - construction of gear milling ,hobbing and gear shaping processes -finishing of gears. CO3

UNIT - IV ABRASIVE PROCESS AND BROACHING **9**

Abrasive processes: grinding wheel - specifications and selection, types of grinding process - cylindrical grinding, surface grinding, centreless grinding and internal grinding - Typical applications - concepts of surface integrity, broaching machines: broach construction - push, pull, surface and continuous broaching machines. CO4

UNIT - V CNC MACHINING **9**

Numerical Control (NC) machine tools - CNC types, constructional details, special features, machining centre, part programming fundamentals CNC - manual part programming - micromachining - wafer machining. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the mechanism of material removal processes, cutting fluids, cutting tool materials, Machinability.

CO2 Describe the constructional and operational features of centre lathe and other special purpose lathes.

CO3 Describe the constructional and operational features of shaper, milling, drilling, Gear forming and generating process.

CO4 Explain the types of grinding, broaching and other super finishing processes.

CO5 Summarize NC, CNC machine tools and write a part program.

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. II., Media Promoters, 2014.
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCE BOOKS:

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White "Machine Tool Practices", Prentice Hall of India, 1998
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984
3. HMT, "Production Technology", Tata McGraw Hill, 1998.
4. Roy. A. Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.

CS1302	DATA STRUCTURES	L	T	P	C
	Common to CSE, IT, AI-DS, AI-ML, MECHATRONICS- Semester III , ECE, MECHANICAL, Semester IV	**3**	**1**	**0**	**3**

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT - I LINEAR DATA STRUCTURES – LIST **9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation - singly linked lists- circularly linked lists- doubly-linked lists – applications of lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal). **CO1**

UNIT – II LINEAR DATA STRUCTURES – STACKS, QUEUES **9**

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues. **CO2**

UNIT - III NON-LINEAR DATA STRUCTURES – TREES **9**

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap. **CO3**

UNIT - IV NON-LINEAR DATA STRUCTURES – GRAPHS **9**

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph. **CO4**

UNIT – V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. ReemaThareja, Data Structures Using C‖, Second Edition , Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Implement abstract data types for linear data structures.

CO2 Apply the different linear data structures to problem solutions.

CO3 Implement abstract data types for non-linear data structures.

CO4 Apply Graph data structure for the real world problems.

CO5 Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

CE1409	STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS LABORATORY

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
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    i. Unhardened specimen
    ii. Quenched Specimen and
    iii. Quenched and tempered specimen.
11. Microscopic Examination of
    i. Hardened samples and
    ii. Hardened and tempered samples.

FLUID MECHANICS AND MACHINES LABORATORY

1. Determination of the coefficient of discharge of a given orifice meter.
2. Determination of the coefficient of discharge of a given venturi meter.
3. Calculation of the rate of flow using rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of submergible pump.
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of gear pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel turbine.
10. Conducting experiments and drawing the characteristics curves of Francis turbine.
11. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Perform tension, torsion, hardness, compression, and deformation test on solid materials.

CO2 Use the measurement equipments for flow measurement.

CO3 Perform test on different fluid machineries.

CO4 To study the properties of mild steel specimen in hardened condition.

CO5 Ability to study the micro structural behaviour different of ferrous and nonferrous material.

ME1407 INTERNAL COMBUSTION ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study valve timing diagram for a 4 stroke diesel engine and port timing diagram for a 2 stroke petrol engine
- To study performance and heat balance test on of IC Engines
- To study the characteristics of fuels/lubricates used in IC Engines

LIST OF EXPERIMENTS

1. Valve timing diagram for a 4 stroke diesel engine.
2. Port timing diagram for a 2 stroke petrol engine
3. Actual p-V diagrams of IC engines.
4. Performance test on 4 - stroke petrol engine.
5. Performance test on 4 - stroke diesel engine.
6. Heat balance test on 4 - stroke diesel engine.
7. Morse test on multi-cylinder petrol engine.
8. Retardation test on a diesel engine.
9. Determination of flash point and fire point of various fuels / lubricants.
10. Determination viscosity of various fuels / lubricants

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Draw valve timing of a 4-stroke engine and port timing diagram of a 2-stroke engine.

CO2 Conduct experiments on an engine to establish performance characteristics.

CO3 Conduct experiments on an engine to draw heat balance sheet.

CO4 Conduct Morse test and retardation test in internal combustion engines.

CO5 Study the fuel and lubricant characteristics.

ME1408 MACHINE TOOLS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry.

LIST OF EXPERIMENTS

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical gear cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine

6. Square head shaping
7. Plain surface grinding
8. Cylindrical grinding
9. Centreless grinding
10. Tool angle grinding with tool and cutter grinder
11. Measurement of cutting forces in milling / turning Process
12. CNC part programming

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Use different milling machine tools.

CO2 Use different machine tools to manufacture gears.

CO3 Use different machine tools for finishing operations

CO4 Manufacture tools using cutter grinder

CO5 Develop CNC part programming

ME1501	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of manufacturing viz., design, proper planning, manufacturing cost, layout & material handling system.

UNIT - I INTRODUCTION **9**

Product cycle - Design process- sequential and concurrent engineering - Computer aided design - CAD system architecture- Computer graphics - coordinate systems - 2D and 3D transformations- homogeneous coordinates - Line drawing – Clipping - viewing transformation - Brief introduction to CAD and CAM - Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM -CAD/CAM concepts - Types of production - Manufacturing models and Metrics - Mathematical models of Production Performance CO1

UNIT - II GEOMETRIC MODELING **9**

Representation of curves - Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling - surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep **CO2**

UNIT - III CAD STANDARDS **9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards. CO3

UNIT - IV FUNDAMENTAL OF CNC AND PART PROGRAMING **9**

Introduction to NC systems and CNC - Machine axis and Coordinate system - CNC machine tools- Principle of operation CNC - Construction features including structure - Drives and CNC controllers - 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes - Cutting Cycles, Loops, Sub program and Macros - Introduction of CAM package. CO4

UNIT - V **CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)** **9**

Group Technology (GT), Part Families - Parts Classification and coding - Simple Problems in Opitz Part Coding system - Production flow Analysis - Cellular Manufacturing - Composite part concept - Types of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning and Control - Quantitative analysis in FMS. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.

CO2 Explain the fundamentals of parametric curves, surfaces and Solids.

CO3 Summarize the different types of Standard systems used in CAD.

CO4 Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines.

CO5 Summarize the different types of techniques used in Cellular Manufacturing and FMS.

TEXT BOOKS:

1. Radhakrishnan P, SubramanyanS.and Raju V., "CAD/CAM/CIM", New Age International (P) Ltd, New Delhi,2015.
2. Ibrahim Zeid, Sivasubramanian R., "CAD/CAM: Theory and Practice"McGraw Hill Education; 2nd edition, 2009.
3. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
4. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007.

REFERENCE BOOKS:

1. R.S. Prasad "Computer Aided Design", Satya Prakashan, Tech India Publications, New Delhi, 2021.
2. Subash L. Gadhave, Kashinath H. Munde, "Computer Aided Manufacturing", Technical publications, 2021.
3. Bi, Zhuming, Wang, Xiaoqin "Computer Aided Design and Manufacturing" First Edition, Wiley - ASME Press Series; John Wiley & Sons, 2020.
4. Ken Evans "Programming of CNC Machines", Fourth Edition, Industrial Press Inc., 2016.
5. Foley, Wan Dam, Feiner and Hughes - "Computer Graphics Principles & Practice" Pearson Education, 2009.
6. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing Management " Fifth Edition, Pearson Education, 2008.

ME1502 DESIGN OF MACHINE ELEMENTS

L	T	P	C
3	1	0	4

OBJECTIVES

- To familiarize the various steps involved in the design process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

(Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS **15**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances - Direct, Bending and torsional stress equations - Impact and shock loading - calculation of principle stresses for various load combinations, eccentric loading - curved beams - crane hook and 'C' frame- Factor of safety - theories of failure - Design based on strength and stiffness - stress concentration - Design for variable loading. CO1

UNIT - II SHAFTS AND COUPLINGS **9**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Keys, keyways and splines - Couplings- Rigid and flexible couplings. CO2

UNIT - III TEMPORARY AND PERMANENT JOINTS **12**

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints - Welded joints, riveted joints for structures - theory of bonded joints. CO3

UNIT - IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS **15**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods , Crank shafts and Piston CO4

UNIT - V BEARINGS **9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfield Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand and analyze stresses and strains in machine elements.

CO2 Analyze and design the components for power transmission.

CO3 Analyze the various stresses developed in temporary and permanent joints.

CO4 Design the energy storing elements, like springs & flywheel and engine components.

CO5 Design and implement the various types of standard bearings.

TEXT BOOKS:

1. Bhandari .V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, Latest Edition.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", Latest Edition, Tata McGraw-Hill.

REFERENCE BOOKS:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo. (Schaum's Outline), 2010.
2. Ansel Ugural, "Mechanical Design Co, -An Integral Approach", 1st Edition, Tata McGraw-Hill Book, 2003.
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.
6. R.S.Khurmi and Guptha, " Machine Design", Latest Edition

ME1503	METROLOGY AND MEASUREMENTS (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES

- To provide knowledge on various metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- To familiar with different metrological equipment's and use of this in industry for quality inspection.

UNIT - I BASICS OF METROLOGY **9**

Introduction to Metrology - Need - Elements - Work piece, Instruments - Persons - Environment - their effect on Precision and Accuracy - Errors - Errors in Measurements - Types - Control - Types of standards. CO1

UNIT – II LINEAR AND ANGULAR MEASUREMENTS **9**

Linear Measuring Instruments - Evolution - Types - Classification - Limit gauges - gauge design - terminology - procedure - concepts of interchange ability and selective assembly - Angular measuring instruments - Types - Bevel protractor clinometers angle gauges, spirit levels sine bar - Angle alignment telescope - Autocollimator - Applications. CO2

UNIT – III ADVANCES IN METROLOGY **9**

Basic concept of lasers Advantages of lasers - laser Interferometers - types - DC and AC Lasers interferometer - Applications - Straightness - Alignment. Basic concept of CMM - Types of CMM- Constructional features - Probes - Accessories - Software - Applications - Basic concepts of Machine Vision System - Element - Applications. CO3

UNIT – IV FORM MEASUREMENT **9**

Principles and Methods of straightness - Flatness measurement - Thread measurement, gear measurement, surface finish measurement, Roundness measurement - Applications. CO4

UNIT – V MEASUREMENT OF POWER, FLOW AND TEMPERATURE **9**

Force, torque, power, speed - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube - Temperature: bimetallic strip, thermocouples, electrical resistance thermometer, Non Contact Temperature Measurement - Reliability and Calibration - Readability and Reliability. CO5

PRACTICAL COURSE **15**

1. Calibration and use of measuring instruments - Vernier caliper, micrometer, Vernier height gauge - using gauge blocks
2. Calibration and use of measuring instruments - bore gauge, telescopic gauge
3. Measurement of linear dimensions using comparators
4. Measurement of angles using bevel protractor and sine bar
5. Measurement of screw thread parameters -Two wire method '(floating carriage micrometer)
6. Measurement of gear parameters - disc micrometers, gear tooth vernier caliper
7. Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
8. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
9. Non-contact (optical) measurement using Toolmaker's microscope, Profile projector and Video measurement system.
10. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.
11. Machine tool metrology - Level tests using precision level; Testing of straightness of a machine tool guide way using autocollimator, spindle tests.
12. Measurement of displacement, force, torque and temperature

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Describe the concepts of measurements to apply in various metrological instruments

CO2 Outline the principles of linear and angular measurement tools used for industrial Applications

CO3 Explain the procedure for conducting computer aided inspection

CO4 Demonstrate the techniques of form measurement used for industrial components

CO5 Discuss various measuring techniques of mechanical properties in industrial applications

TEXT BOOKS:

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCE BOOKS:

1. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th Edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

ME1504 DYNAMICS OF MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism
- To understand the effect of Dynamics of undesirable vibrations
  To understand the principles in mechanisms used for speed control and stability control

UNIT I FORCE ANALYSIS

Dynamic force analysis - Inertia force and Inertia torque- D Alembert's principle -Dynamic Analysis in reciprocating engines - Gas forces - Inertia effect of connecting rod- Bearing loads - Crank shaft torque - Turning moment diagrams -Fly Wheels - Flywheels of punching presses- Dynamics of Cam- follower mechanism — CO1

UNIT - II

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder engine - Balancing of Multi-cylinder inline, V-engines - Partial balancing in engines - Balancing of linkages - Balancing machines-Field balancing of discs and rotors — CO2

UNIT - III FREE VIBRATION

Basic features of vibratory systems - Degrees of freedom - single degree of freedom - Free vibration- Equations of motion - Natural frequency - Types of Damping - Damped vibration- Torsional vibration of shaft - Critical speeds of shafts - Torsional vibration - Two and three rotor torsional systems — **CO3**

UNIT - IV FORCED VIBRATION

Response of one degree freedom systems to periodic forcing - Harmonic disturbances - Disturbance caused by unbalance - Support motion -transmissibility - Vibration isolation vibration measurement — CO4

UNIT - V MECHANISM FOR CONTROL

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Characteristics - Effect of friction - Controlling force curves. Gyroscopes -Gyroscopic forces and torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Calculate static and dynamic forces of mechanisms

CO2 Calculate the balancing masses and their locations of reciprocating and rotating masses

CO3 Compute the frequency of free vibration

CO4 Compute the frequency of forced vibration and damping coefficient

CO5 Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes

TEXT BOOKS:

1. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2011
2. Rattan, S.S, "Theory of Machines", 4 Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014

REFERENCE BOOKS:

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006
3. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005
4. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002

ME1506 COMPUTER AIDED MACHINE DRAWING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems

UNIT I DRAWING STANDARDS FITS AND TOLERANCES 9

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 and tolerancing CO1

UNIT - II INTRODUCTION TO 2D DRAFTING 9

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailed Drawing- Bearings - Bush bearing, Plummer block, Valves - Safety and non-return valves CO2

UNIT - III 3D GEOMETRIC MODELING AND ASSEMBLY 27

Sketcher - Datum planes - Protrusion - Holes - Part modeling - Extrusion - Revolve - Sweep - Loft - Blend - Fillet - Pattern - Chamfer - Round - Mirror - Section - Assembly OF Couplings - Flange, Universal, Oldham's, Muff, Gear couplings- Joints - Knuckle, Gib& cotter, strap, sleeve & cotter joints -Engine parts - Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch- Miscellaneous machine components - Screw jack, machine vice, tail stock, chuck, vane and gear pump CO3 CO4 CO5

Note:

25% of assembly drawings must be done manually and the remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the engineering drawing standards and tolerances

CO2 Develop skills to generate 2D sketching of mechanical elements

CO3 Develop skills to generate 3D modeling of mechanical elements

CO4 Develop skills to make functional assemblies and generate 2D drafting

CO5 Apply design and assembly evaluation techniques using commercial software

TEXT BOOKS:

1. Gopalakrishnan K.R, Machine Drawing", 23nd Edition, Subhas Stores Book Corner, Bangalore, Karnataka, India

REFERENCE BOOKS:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 50th Edition, Charotar Publishers, 2016.
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2007
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", 10th Edition, published by Tata Mcgraw Hill,2017.

S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 20082

ME1507 KINEMATICS AND DYNAMICS LABORATORY L T P C 0 0 4 2

OBJECTIVES

- To supplement the principles learnt in kinematics and dynamics of machinery
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. Study of gear parameters.
2. Experimental study of velocity ratios of simple, compound, epicyclic and differential gear trains.
3. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker, oscillating cylinder mechanisms.
4. Kinematics of single and double universal joints.
5. Determination of mass moment of inertia of Fly wheel and Axle system.
6. Determination of mass moment of inertia of axisymmetric bodies using Turn Table apparatus. Determination of mass moment of inertia using bifilar suspension and compound pendulum.
7. Motorized gyroscope - Study of gyroscopic effect and couple.

8. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
9. Cams - Cam profile drawing, Motion curves and study of jump phenomenon
10. Single degree of freedom Spring Mass System - Determination of natural Frequency and verification of Laws of springs – Damping coefficient
11. determination. b) Multi degree freedom suspension system - Determination of influence coefficient.
12. Determination of torsional natural frequency of single and Double Rotor systems. - Undamped and Damped Natural frequencies.
13. Vibration Absorber - Tuned vibration absorber.
14. Vibration of Equivalent Spring mass system - undamped and damped vibration.
15. Whirling of shafts - Determination of critical speeds of shafts with concentrated loads.
16. Balancing of rotating masses.
17. Balancing of reciprocating masses.
18. Transverse vibration of Free-Free beam - with and without concentrated masses.
19. Forced Vibration of Cantilever beam - Mode shapes and natural frequencies.
20. Determination of transmissibility ratio using vibrating table.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate the principles of kinematics of machinery.

CO2 Demonstrate the principles of dynamics of machinery.

CO3 Use the measuring devices for dynamic testing

CO4 Study the parameters of kinematics of machinery.

CO5 Study the parameters of dynamics of machinery.

ME1601 DESIGN OF TRANSMISSION SYSTEMS L T P C 3 1 0 4

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
- To learn to use standard data and catalogues

(Use of P S G Design Data Book permitted)

UNIT - I DESIGN OF FLEXIBLE ELEMENTS **12**

Design of Flat belts and pulleys - Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets CO1

UNIT - II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS **12**

Speed ratios and number of teeth-Force analysis -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. CO2

UNIT - III BEVEL, WORM AND CROSS HELICAL GEARS **12**

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. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears. CO3

UNIT - IV GEAR BOXES **12**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. - Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications. CO4

UNIT - V CAMS, CLUTCHES AND BRAKES **12**

Cam Design: Types - pressure angle and under cutting base circle determination - forces and surface stresses. Design of plate clutches - axial clutches -cone clutches - internal expanding rim clutches - Electromagnetic clutches. Band and Block brakes - external shoe brakes - Internal expanding shoe brake. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Design flexible drive elements like belt, chain and rope drives.

CO2 Design parallel axis helical gears like spur gears.

CO3 Design bevel, worm and cross helical gears.

CO4 Design multi speed gear box for mechanical applications.

CO5 Design cam, clutches and brakes for automotive and mechanical applications.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008

REFERENCE BOOKS:

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements", 8th 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", 4th Edition, Wiley, 2005.
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

ME1602 FINITE ELEMENT ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the concepts of mathematical modeling of engineering problems.
- To appreciate the use of FEM to a range of engineering problems

UNIT - I INTRODUCTION **9**

Historical Background - Mathematical Modeling of field problems in Engineering - Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems - Weighted Residual Methods - Variational Formulation of Boundary Value Problems - Ritz Technique - Basic concepts of the Finite Element Method. CO1

UNIT - II ONE-DIMENSIONAL PROBLEMS **9**

One Dimensional Second Order Equations - Discretization - Element types - Linear and Higher order Elements - Derivation of Shape functions and Stiffness matrices and force vectors - Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation - Transverse deflections and Natural frequencies of beams. CO2

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

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation - Finite Element formulation - Triangular elements - Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems - Torsion of Non circular shafts - Quadrilateral elements - Higher Order Elements. CO3

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

Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Body forces and temperature effects - Stress calculations - Plate and shell elements. CO4

UNIT - V ISOPARAMETRIC FORMULATION **9**

Natural co-ordinate systems - Isoparametric elements - Shape functions for iso parametric elements - One and two dimensions - Serendipity elements - Numerical integration and application to plane stress problems - Matrix solution techniques - Solutions Techniques to Dynamic problems - Introduction to Analysis Software. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the basic concepts of finite element method.

CO2 Apply the finite element method for one dimensional problems

CO3 Understand the finite element method for two dimensional scalar variable problems

CO4 Understand the finite element method for two dimensional vector variable problems

CO5 Gain the knowledge on isoparametric formulation, numerical integration and dynamic Problems.

TEXT BOOKS:

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCE BOOKS:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)
2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.

ME1603	HEAT AND MASS TRANSFER	L	T	P	C
		3	1	0	4

OBJECTIVES

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer. (Use of Standard HMT data book permitted)

UNIT - I CONDUCTION **12**

General differential equation of heat conduction - Cartesian and polar Coordinates - One dimensional steady state heat conduction - plane and composite systems - Conduction with internal heat generation - Extended surfaces - Unsteady heat conduction - Lumped analysis - Semi infinite and infinite solids - Use of Heisler's charts. CO1

UNIT - II CONVECTION **12**

Free and forced convection - Hydrodynamic and thermal boundary layer. Free and forced convection during external flow over plates and cylinders and internal flow through tubes. CO2

UNIT - III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **12**

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 - Analysis - LMTD method - NTU method CO3

UNIT - IV RADIATION **12**

Black body radiation - Grey body radiation - Shape factor - Electrical analogy - Radiation shields. Radiation through gases. CO4

UNIT - V MASS TRANSFER **12**

Basic concepts - Diffusion mass transfer - Fick's law of diffusion - Steady state molecular diffusion - Convective mass transfer - Momentum, heat and mass transfer analogy - Convective mass transfer correlations. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems

CO2 Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems

CO3 Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems

CO4 Explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems

CO5 Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

TEXT BOOKS:

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
2. Yunus A. Cengel, "Heat Transfer - A Practical Approach", Tata McGraw Hill, 5th Edition 2015

REFERENCE BOOKS:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2010.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2011
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 2010.

ME1607	CAD/CAM LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC machine tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC vertical machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

LIST OF EXPERIMENTS

1. 3D GEOMETRIC MODELLING **30**

1. Introduction of 3D Modelling Software

Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Flange coupling
3. Plummer block
4. Screw jack
5. Lathe tailstock
6. Universal joint
7. Machine vice
8. Stuffing box
9. Crosshead
10. Safety valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

* Students may also be trained in manual drawing of some of the above components

2. Manual Part Programming. **20**

(i) Part Programming - CNC Machining Centre
- (a) Linear Cutting.
- (b) Circular cutting.
- (c) Cutter Radius Compensation.
- (d) Canned Cycle Operations.

(ii) Part Programming - CNC Turning Centre
- (a) Straight, Taper and Radius Turning.
- (b) Thread Cutting.
- (c) Rough and Finish Turning Cycle. d) Drilling and Tapping Cycle.

3. Computer Aided Part Programming **10**

e) CL Data and Post process generation using CAM packages.

f) Application of CAPP in Machining and Turning Centre

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop 2D Part Models using Modeling Software.

CO2 Develop 3D Part Models using Modeling Software.

CO3 Assemble 3D Models using Modeling Software.

CO4 Understand the CNC Control in Modern Manufacturing System.

CO5 Prepare CNC Part Programming and Perform Manufacturing.

ME1608 HEAT TRANSFER AND REFRIGERATION AND AIR-CONDITIONING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study the heat transfer phenomena, predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

HEAT TRANSFER LAB :

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
3. Determination of heat transfer coefficient under forced convection from a tube.
4. Determination of thermal conductivity of composite wall.
5. Heat transfer from pin-fin apparatus (natural & forced convection modes)
6. Determination of Stefan - Boltzmann constant.
7. Determination of emissivity of a grey surface.
8. Effectiveness of parallel / counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING LAB :

1. Determination of COP of a refrigeration system
2. Experiments on psychrometric processes
3. Performance test on a reciprocating air compressor
4. Performance test in a HC refrigeration System
5. Performance test in a fluidized bed cooling tower

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Determine the thermal conductivity, heat transfer coefficient, Stefan Boltzmann constant and emissivity of a grey surface

CO2 Determine the effectiveness of a heat exchanger

CO3 Determine the COP of an AC and refrigeration system

CO4 Conduct experiments on an air compressor and study the performance characteristics.

CO5 Conduct experiments on cooling tower and study the performance characteristics.

ME1609 DESIGN AND FABRICATION PROJECT L T P C
0 0 4 2

OBJECTIVES

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate a sound technical knowledge of their selected project topic.

CO2 Undertake problem identification, formulation and solution.

CO3 Design engineering solutions to complex problems utilising a systems approach and conduct a engineering project.

CO4 Communicate with engineers and the community at large in written an oral forms.

CO5 Demonstrate the knowledge, skills and attitudes of a professional engineer.

ME1701 PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT – I INTRODUCTION TO PROCESS PLANNING 9

Introduction - Methods of process planning - Drawing interpretation - Material evaluation - steps in process selection - Production equipment and tooling selection CO1

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 - Economics of process planning - Case studies. CO2

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 - CNC machine hour rate calculation - Calculation of depreciation cost. CO3

UNIT - IV PRODUCTION COST ESTIMATION 9

Estimation of different types of jobs - Estimation of forging shop, Estimation of welding shop, Estimation of foundry shop CO4

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. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Select the process, equipment and tools for various industrial products.
CO2 Prepare process planning activity charts.
CO3 Explain the concept of cost estimation.
CO4 Compute the job order cost for different types of shop floor.
CO5 Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter Scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.
3. M. Adithan,"Process Planning and the cost Estimation:, New Age International Publishers, 2007.

REFERENCE BOOKS:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F.and Munez J.,"Manufacturing Processes and Systems",9th Edition, JohnWiley, 1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.
6. R.Kesavan, C.Elanchezian, B.VijayRamanth, "Process Planning and Cost Estimation", New Age International Ltd , 2009.

ME1702 MECHATRONICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge about the elements and techniques involved in mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT - I INTRODUCTION **9**

Introduction to mechatronics - Systems - Concepts of mechatronics approach - Need for mechatronics - Emerging areas of mechatronics - Classification of mechatronics. Sensors and Transducers: Static and dynamic characteristics of sensor, Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors. CO1

UNIT - II MICROPROCESSOR AND MICROCONTROLLER **9**

Introduction - Architecture of 8085 - Pin Configuration - Addressing Modes -Instruction set, Timing diagram of 8085 - Concepts of 8051 microcontroller - Block diagram. CO2

UNIT - III PROGRAMMABLE PERIPHERAL INTERFACE **9**

Introduction - Architecture of 8255, Keyboard interfacing, LED display - interfacing, ADC and DAC interface, Temperature control - Stepper motor control - Traffic control interface. CO3

UNIT - IV PROGRAMMABLE LOGIC CONTROLLER **9**

Introduction - Basic structure - Input and output processing - Programming - Mnemonics - Timers, counters and internal relays - Data handling - Selection of PLC. CO4

UNIT - V ACTUATORS AND MECHATRONIC SYSTEM DESIGN **9**

Types of stepper and servo motors - Construction - Working principle - Advantages and disadvantages. Design process - stages of design process - Traditional and mechatronics design concepts - Case studies of mechatronics systems - Pick and place Robot - Engine Management system - Automatic car park barrier. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the interdisciplinary applications of electronics, electrical, mechanical and computer systems for the control of mechanical, electronic systems and sensor technology.

CO2 Discuss the architecture of microprocessor and microcontroller, pin diagram, addressing modes of microprocessor and microcontroller.

CO3 Discuss programmable peripheral interface, Architecture of 8255 PPI, and various device interfacing.

CO4 Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of mechatronics engineering.

CO5 Discuss various actuators and mechatronics systems using the knowledge and skills acquired through the course and also from the given case studies.

TEXT BOOKS:

1. W.Bolton, "Mechatronics", 4th Edition,Prentice Hall, 2013.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. David G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2018.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013.
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007.
4. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
5. A. NagoorKani "Microprocessors and Microcontrollers". McGraw Hill Education,2nd Edition,2017.

ME 1703 POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide an overview of Power Plants using conventional and renewable sources of energy
- To create awareness about the 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. CO1

UNIT - II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS **9**

Otto, diesel, dual & brayton cycle - Analysis & optimisation. Components of diesel and gas turbine power plants. Combined cycle power plants. Integrated gasifier based combined cycle systems. CO2

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. CO3

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. CO4

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. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the layout, construction and working of the components inside a thermal power plant.

CO2 Know about the layout, construction and working of the components inside a diesel, gas and combined cycle power plants

CO3 Understand the layout, construction and working of the components inside nuclear power plants.

CO4 Know about the layout, construction and working of the components inside Renewable energy power plants.

CO5 Gain knowledge about the applications of power plants while extending their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOKS:

1. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", 6th Edition Dhanpat Rai, 2011
2. Nag P.K ,"Power Plant Engineering". 5th edition Tata McGraw- Hill ,2021

REFERENCE BOOKS:

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. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw - Hill, 1998.
4. Dr.P.C.Sharma, Power Plant Engineering," S. K. Kataria & Sons, 2013
5. R.K Rajput, " Power Plant Engineering ", Scitech Publications, 2006
6. G.R.Nagpal , "Power Plant Engineering", Khanna Publishers, 1998
7. G.D.Rai, "Introduction to Power Plant technology" Khanna Publishers, 1995

ME1707 SIMULATION AND ANALYSIS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools

LIST OF EXPERIMENTS

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-functions of one variable and two variables
2. Use of MAT lab to solve simple problems in vibration
3. Mechanism simulation using multi body dynamic software

B. ANALYSIS

1. Force and stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi - symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Get familiar with 1D, 2D Finite Elements(FE), modelling of structural elements with loading and boundary conditions

CO2 Understand the behaviour of structural engineering problems by 1D and 2D Finite Elements

CO3 Understand the thermal behaviour of engineering problems by using 1D and 2D Finite Elements

CO4 Understand the vibration and dynamic behaviour of 1D and 2D engineering problems

CO5 Learn and solve core mechanical engineering problems using MATLAB computational package

ME1708	MECHATRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 - Addition - Subtraction - Multiplication - Division - Sorting - Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using software.
8. Study of PLC and its applications.
9. Study of image processing techniques.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate the functioning of mechatronics system with various pneumaticsystems.

CO2 Demonstrate the functioning of mechatronics system with various hydraulicsystems.

CO3 Demonstrate the functioning of mechatronics systems with various Electrical and Electro-pneumatic systems.

CO4 Demonstrate the functioning of control systems with the help of PLC and microcontrollers.

CO5 Demonstrate the functioning of control systems with the help of microprocessors.

MG1801	INDUSTRIAL ECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT - I INTRODUCTION TO ECONOMICS **9**

Introduction to economics- Flow in an economy, Law of supply and demand, Concept of engineering economics - Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal revenue, Sunk cost, Opportunity cost, Break-even analysis - P-V ratio, Elementary economic Analysis - Material selection for product - Design selection for a product, Process planning. CO1

UNIT - II VALUE ENGINEERING **9**

Make or buy decision, Value engineering - Function, aims, Value engineering procedure. Interest formulae and their applications - Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series Present worth factor - Equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate CO2

UNIT - III CASH FLOW **9**

Capital budgeting - Balance Sheet - Methods of comparison of alternatives - Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Rate of return method - Risk and decision Making - Technological change in global economy - Locating the firm in a global economy - Taxes and decision making. CO3

UNIT - IV REPLACEMENT AND MAINTENANCE ANALYSIS **9**

Replacement and maintenance analysis - Types of maintenance, Types of replacement problem, Determination of economic life of an asset, Replacement of an asset with a new asset - Capital recovery with return and concept of challenger and defender - Exchange rate determination - Marketing - Product life cycle - Marketing research - Branding CO4

UNIT - V DEPRECIATION **9**

Depreciation- Introduction, Straight line method of depreciation, Declining balance method of depreciation - Sum of the years digits method of depreciation, Sinking fund method of depreciation/Annuity method of depreciation, Service output method of depreciation - Evaluation of public alternatives - Introduction, Examples, Inflation adjusted decisions - Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply basic economic concepts in economic analysis

CO2 Learn time value of money and interest rates

CO3 Learn revenue based and cost based cash flow analysis

CO4 Learn replacement and maintenance based on economic life

CO5 Learn depreciation and inflation based on economic life

TEXT BOOKS:

1. Panneerselvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
2. Suma Damodaran, "Managerial economics", Oxford University press 2006.

REFERENCE BOOKS:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.
5. Smith, G.W., "Engineering Economy", Lowa State Press, Iowa, 1973.
6. Truett&Truett, " Managerial economics - Analysis, problems & cases " Wiley India 8th edition 2004.
7. Luke M Froeb / Brian T Mccann, "Managerail Economics - A Problem Solving Approach" Thomson learning 2007.E

ME1807	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS: 300

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate a sound technical knowledge of their selected project topic.

CO2 Undertake problem identification, formulation and solution.

CO3 Design engineering solutions to complex problems utilising a systems approach and conduct an engineering project.

CO4 Communicate with engineers and the community at large in written and oral forms.

CO5 Demonstrate the knowledge, skills and attitudes of a professional engineer.

ME1511	DESIGN OF HEAT EXCHANGERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT - I INTRODUCTION 9

Types of heat exchangers, shell and tube heat exchangers - regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA).

UNIT - II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers - LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT - III STRESS ANALYSIS 9

Stress in tubes - header sheets and pressure vessels - thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT - IV COMPACT AND PLATE HEAT EXCHANGER 9

Types - Merits and Demerits - Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT - V CONDENSERS AND COOLING TOWERS 9

Design of surface and evaporative condensers - Cooling tower - Performance characteristics.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the classification of heat exchanger as per TEMA
CO2 Understand the design process of heat exchangers
CO3 Analyse the stress failures in the heat exchanger components
CO4 Study the performance of compact and plate heat exchanger
CO5 Study the performance of condensers and cooling tower

TEXT BOOKS:

1. Sadik Kakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2007
2. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
3. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001
4. Kuppan. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000
5. Eric M. Smith, "Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients", John Wiley & Sons, 1999

ME1512 ENERGY CONSERVATION AND AUDITING

L	T	P	C
3	0	0	3

OBJECTIVES

- To conduct energy audit and suggest methodologies for energy savings
- To understand and analyse the energy data of industries
- To carryout energy accounting and balancing
- To conduct the available resources in optimal ways

UNIT - I INTRODUCTION OF ENERGY CONSERVATION 9

Energy - Power - Past & Present scenario of world; National energy consumption Data - Environmental aspects associated with energy utilization - Energy auditing: Need, Types, Methodology and Barriers. Role of energy managers. Instruments for energy auditing.

UNIT - II THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters - Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT - III ELECTRICAL SYSTEMS 9

Components of EB billing - HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination - Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT - IV ENERGY CONSERVATION IN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems - Cooling Towers - D.G. sets.

UNIT - V ECONOMICS 9

Energy Economics - Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing - ESCO concept.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Learn the concept of energy scenario, energy consumption and instruments for energy auditing

CO2 Carry out energy accounting and balancing in electrical system

CO3 Carry out energy accounting and balancing in thermal system system

CO4 Suggest methodologies for energy savings in major utilities

CO5 Understand the economics in energy saving

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCE BOOKS:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford,1981
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987

ME1513 EXPERIMENTAL DESIGN AND ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE)
- To demonstrate knowledge and understanding of Taguchi's approach
- To develop skills to design and conduct experiments using DOE and Taguchi's approach
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process

UNIT - I FUNDAMENTALS OF EXPERIMENTAL DESIGNS 9

Basic Principles - Guidelines for Designing Experiments- Hypothesis testing - single mean, two means, dependent/ correlated samples - confidence intervals, Experimentation - need, Simple Comparative Experiments - Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation - choice of sample size - Normal and half-normal probability plot - simple linear and multiple linear regression, testing using Analysis of variance.

UNIT - II SINGLE-FACTOR EXPERIMENTS 9

Basic Definitions - Principles of Factorial Design - The Advantage of Factorial Design - Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design - Latin Square Design- Graeco Latin Square Design - Applications.

UNIT - III FACTORIAL DESIGNS 9

Main and Interaction effects - Two and three-factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT - IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking and Confounding in 2K Designs- blocking in replicated design - 2K Factorial Design in two blocks - Complete and partial confounding- Confounding 2K Design in four blocks - Two level Fractional Factorial Designs - one-half fraction of 2K Design, design resolution, Construction of one - half fraction with highest design resolution, one-quarter fraction of 2K Design.

UNIT - V ANALYSIS OF SINGLE RESPONSE AND MULTI-RESPONSE TECHNIQUES 9

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA - attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design - case studies. Introduction to Response Surface Methodology - The method of steepest ascent - Analysis of a second-order Response Surface - Experimental designs for fitting response surfaces.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the Basic principle of DOEs and ANOVA
CO2 Understand the various single factor experiments
CO3 Learn full and fraction factorial experiment design
CO4 Understand the special experimental design
CO5 Understand the single and multi-response techniques

TEXT BOOKS:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons,10th Edition 2019.
2. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2012.

REFERENCE BOOKS:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery",2nd Edition, Wiley, 2009.
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.Third Reprint 2008.

ME1514 GAS DYNAMICS AND JET PROPULSION

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basic difference between incompressible and compressible flow
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
  (Use of Standard Gas Tables permitted)

UNIT - I BASIC CONCEPTS AND ISENTROPIC FLOWS **6**

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable ducts - Nozzle and Diffusers.

UNIT - II FLOW THROUGH DUCTS **9**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties.

UNIT - III NORMAL AND OBLIQUE SHOCKS **10**

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl - Meyer relations - Applications.

UNIT - IV JET PROPULSION **10**

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT - V SPACE PROPULSION **10**

Types of rocket engines - Propellants-feeding systems - Ignition and combustion - Theory of rocket propulsion - Performance study - Staging - Terminal and characteristic velocity - Applications - space flights.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of compressible fluid flow in variable area ducts that follows isentropic process
CO2 Study the effects of friction and heat transfer on compressible fluid flow in constant area ducts
CO3 Acquire the knowledge of normal shock and oblique shock waves and its effects on compressible fluid properties in constant area and variable area ducts
CO4 Understand working principle and cycle analysis of jet propulsion engines
CO5 Understand theory of rocket engines and study its performance

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", 4th Edition, McGraw Hill, 2020.
2. Yahya, S.M. "Fundamentals of Compressible Flow" 6th Edition, New Age International (P) Limited, New Delhi, 2018.

REFERENCE BOOKS:

1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison - Wesley Publishing company, 2009.
2. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley, 2013.
3. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 2013.
4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2016
5. Shapiro. A.H., " Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1984
6. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2011
7. Somasundaram. PR.S.L., "Gas Dynamics and Jet Propulsions", New Age International Publishers, 1996
8. Babu. V., "Fundamentals of Gas Dynamics", ANE Books India, 2020
9. Cohen. H., G.E.C. Rogers and Saravana mutto, "Gas Turbine Theory", Longman Group Ltd., 2017

ME1515 REFRIGERATION AND AIRCONDITIONING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components
- To provide knowledge on design aspects of Refrigeration & Air conditioning system

UNIT - I INTRODUCTION TO REFRIGERATION 6

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 10

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle - subcooling and superheating- 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 SYSTEMS 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 10

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 10

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 PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the basic concepts of refrigeration

CO2 Explain the vapor compression refrigeration systems and to solve problems

CO3 Discuss the various types of refrigeration systems

CO4 Calculate the psychrometric properties and its use in psychrometric processes

CO5 Explain the concepts of air conditioning and to solve problems

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
2. Khurmi, R.S., "Textbook of Refrigeration and Air Conditioning" 5th edition, S Chand and Company Ltd, 2020.

REFERENCE BOOKS:

1. ASHRAE Hand book, Fundamentals, 2017.
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2020.
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009
4. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 2012

ME1516 TURBOMACHINES

L	T	P	C
3	0	0	3

OBJECTIVES

- 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
- Analyzing flow behavior 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 Turbomachines - 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 Turbomachines.

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 PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the energy transfer in rotor and stator parts of the turbo machines
CO2 Explain the function of various elements of centrifugal fans and blowers
CO3 Evaluate the working and performance of centrifugal compressor
CO4 Analyze flow behavior and flow losses in axial flow compressor
CO5 Explain the types and working of axial and radial flow turbines

TEXT BOOKS:

1. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011.
2. Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2018.

REFERENCE BOOKS:

1. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, Butterworth-Heinemann, 2014.
2. Gopalakrishnan .G and Prithvi Raj .D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996
4. Saravanamutto, Rogers, Cohen, Straznicky., "Gas Turbine Theory" 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.

ME1517 BIOENERGY CONVERSION TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES

- To elucidate on biomass, types, availability, and characteristics
- To study 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 CO1

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. CO2

UNIT – III BIOMASS COMBUSTION **9**

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion CO3

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 CO4

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 CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Estimate the surplus biomass availability of any given area.

CO2 Design a biogas plant for a variety of biofuels.

CO3 Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.

CO4 Analyse the influence of process governing parameters in thermochemical conversion of biomass.

CO5 Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS:

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar , Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).

REFERENCE BOOKS:

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester,1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981

ME1518 ENERGY EFFICIENT BUILDINGS L T P C 3 0 0 3

OBJECTIVES

- To learn the climate and buildings, building efficiency rating and standards
- Developing energy efficiency in building envelopes through alternate methods
- To study the thermal comfort, passive heating and cooling techniques
- To apply various energy saving concepts in buildings.
- To incorporate Renewable energy systems in buildings

UNIT – I INTRODUCTION **9**

Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ, NBC and ECBC Standards CO1

UNIT – II LANDSCAPE AND BUILDING ENVELOPES **9**

Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools CO2

UNIT – III THERMAL COMFORT, PASSIVE HEATING AND COOLING **9**

Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort – Passive heating and cooling systems - HVAC Systems for built environment – Cooling Load Calculations, Heat Pumps, Evaporative Cooling and Radiant Cooling. CO3

UNIT – IV ENERGY CONSERVATION IN BUILDING UTILITIES **9**

Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors , Pumps, Compressors, Illumination Systems, Electrical distribution systems, Cooling Towers, Refrigeration and Air Conditioning Systems, Cogeneration Systems, Water and Waste heat recovery systems CO4

UNIT – V RENEWABLE ENERGY IN BUILDINGS **9**

Introduction of Renewable sources in buildings, Stand-alone PV systems, BIPV, Solar water heating, Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Familiar with climate responsive building design and basic concepts

CO2 Explain the basic terminologies related to buildings

CO3 Discuss the energy efficient air conditioning techniques

CO4 Evaluate the performance of buildings

CO5 Gets acquainted with Renewable energy systems in buildings

TEXT BOOKS:

1. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018),ISBN-10 : 3319814869
2. Thermal Comfort and Energy-Efficient Cooling of Nonresidential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10 : 9783319045818.

REFERENCE BOOKS:

1. ASHRAE Handbook – Fundamentals / Equipment's/ Applications – ASHRAE 2021,2020, 2019 Editions
2. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998
3. Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994
4. J A Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006.
5. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.

ME1519	ENERGY STORAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the various types of energy storage devices and technologies and them comparison.
- To learn 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. CO1

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. CO2

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. CO3

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 CO4

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 – Biogas Storage. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the need and identify the suitable energy storage devices for applications.

CO2 Explain the working of various energy storage devices and their importance.

CO3 Explain the basic characteristics of batteries for mobile and hybrid systems.

CO4 Discuss the storage of renewable energies and management systems.

CO5 Explain the need for other energy devices and their scope for applications.

TEXT BOOKS:

1. Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2 nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, “Understanding Batteries”, Royal Society of Chemistry, 2001 .

REFERENCE BOOKS:
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", John Wiley & amp; Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. AuliceScibioh M. and Viswanathan B, "Fuel Cells – principles and applications', University Press(India), 2006
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

ME1520 RENEWABLE POWERED OFF HIGHWAY VEHICLES AND EMISSION CONTROL TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES
- To study the low and zero carbon fuels suitability and methods of use in off-road vehicles.
- To learn and understand the green energy production methodologies and its use in off-road vehicle categories.
- To learn various fuel cell types and its suitability in off-highway vehicles applications
- To illustrate the impact of in-cylinder technologies on engine out emissions control.
- To study the existing after-treatment technologies used in off-highway vehicle applications.

UNIT - I LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY VEHICLES **9**

Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles. CO1

UNIT - II GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES **9**

Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles. CO2

UNIT - III FUEL CELL POWERED OFF-HIGHWAY VEHICLES **9**

Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications. CO3

UNIT - IV IN-CYLINDER TREATMENT TECHNOLOGIES **9**

Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed- Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies. CO4

UNIT - V AFTER TREATMENT TECHNOLOGIES **9**

Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO2 absorption techniques, Waste Heat Recovery and Organic Rankine Cycle. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment.

CO2 Gain the knowledge on various green energy production methods and its impact on meeting energy demand of off-road vehicle applications.

CO3 Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications.

CO4 Gain the knowledge on various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions.

CO5 Develop the working of various existing aftertreatment systems in controlling the engine out emissions.

TEXT BOOKS:

1. John Twidell, and Tony Weir. Renewable Energy Sources – 3rd Edition 2015,
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines.

REFERENCE BOOKS:

1. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering,
2. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control.
3. Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill | 1 June 2011
4. Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. | 7 April 2022
5. The Political Economy of Low Carbon Transformation: Breaking the habits of capitalism (Routledge Studies in Low Carbon Development) by Harold Wilhite | 21 December 2017

ME1621 APPLIED HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide student with knowledge on the application of 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 PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to fluid power - Advantages and applications - Fluid power systems - Types of fluids - Properties of fluids and selection - Basics of hydraulics - Pascal's law - Principles of flow - Friction loss - Work, Power and Torque Problems, Sources of hydraulic power : Pumping theory - Pump classification - Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of linear and rotary - Fixed and variable displacement pumps - Problems.

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 - Problems.

UNIT - III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits - Regenerative, Pump unloading, Double-Pump, Pressure intensifier, Air-over oil, Sequence, reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

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, Design of pneumatic circuit - Cascade method - Electro pneumatic system - Elements - Ladder diagram - Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT - V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble shooting and Remedies in hydraulic and pneumatic systems, 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 PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, 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	Explain the different types of hydraulic circuits and systems
CO4	Explain the working of different pneumatic circuits and systems
CO5	Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education, 9th Edition, 2017.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2017

REFERENCE BOOKS:

1. Shanmugasundaram. K, "Hydraulic and Pneumatic controls", Chand & Co, 2014.
2. R. Srinivasan, "Hydraulic and Pneumatic controls", Tata McGraw-Hill, 2012.
3. Majumdar S.R., "Pneumatic Systems- Principles and Maintenance", Tata McGraw-Hill, 2017

ME1622 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

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 AND FIXTURES 9

Design and development of jigs and fixtures for given component- Types of jigs - Post, turnover, channel, latch, box, pot, angular post jigs - Indexing jigs - General principles of milling, Lathe, boring, broaching and grinding fixtures - Assembly, Inspection and Welding fixtures - Modular fixturing systems- Quick change fixtures.

UNIT - III 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 - IV 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.

UNIT - V OTHER FORMING TECHNIQUES 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies - recent trends in tool design- computer Aids for sheet metal forming Analysis - basic introduction - tooling for numerically controlled machines- setup reduction for work holding - Single minute exchange of dies - Poka Yoke.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the locating and clamping principles
CO2 Understand the importance of Jigs and Fixture
CO3 Understand the press working terminologies and elements of cutting dies
CO4 Understand the bending and drawing dies
CO5 Understand the other forming techniques

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Third Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H “Press tools - Design and Construction”, Fourth Edition, S.Chand, 2010.

REFERENCE BOOKS:

1. Venkataraman. K., “Design of Jigs Fixtures & Press Tools”,ANE Books India, Second Edition, 2020.
2. Donaldson, Lecain and Goold, “Tool Design”, 4rd Edition, Tata McGraw Hill, 2017.
3. Hoffman, “Jigs and Fixture Design”, Delmar Learning Drafting series, Singapore, 2011.
4. Design Data Hand Book, PSG College of Technology, Coimbatore

ME1623	FLUID POWER AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process
- To train the students in designing the hydraulic and pneumatic circuits using various design procedures

UNIT - I INTRODUCTION **9**

Need for Automation, Hydraulic & Pneumatic Comparison - ISO symbols for fluid power elements, Hydraulic, pneumatics - Selection criteria.

UNIT - II FLUID POWER GENERATING/UTILIZING ELEMENTS **9**

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification - Drive characteristics - Linear actuator - Types, mounting details, cushioning - power packs - construction. Reservoir capacity, heat dissipation, accumulators - standard circuit symbols, circuit (flow) analysis.

UNIT - III CONTROL AND REGULATION ELEMENTS **9**

Direction flow and pressure control valves - Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves - Different types - characteristics and performance.

UNIT - IV CIRCUIT DESIGN **9**

Typical industrial hydraulic circuits - Design methodology - Ladder diagram-cascade, method - truth table - Karnaugh map method - sequencing circuits-combinational and logic circuit.

UNIT - V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS **9**

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of hydraulics and pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the basics of hydraulics, Pneumatics and different fluid power symbols

CO2 Familiarize the different power generating elements with types and working

CO3 Acquire the knowledge pressure control and direction control element

CO4 Have a complete idea to design various circuits that suit today's industrial circuit applications

CO5 Enhance the knowledge of electro pneumatic circuits

TEXT BOOKS:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988.

REFERENCE BOOKS:

1. Dudbey. A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967
2. E.C.Fitch and J.D.Suryaatmadja. Introduction to fluid logic, McGraw Hill, 1978
3. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
4. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994
5. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
6. Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003

ME1624	LOW COST AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give basic knowledge about automation
- To understand the basic hydraulics and pneumatics systems for automation
- To understand the assembly automation

UNIT - I AUTOMATION OF ASSEMBLY LINES 9

Concept of automation - mechanization and automation - concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - transfer line-monitoring system (TLMS) using Line Status - line efficiency - Buffer stock Simulation in assembly line.

UNIT - II AUTOMATION USING HYDRAULIC SYSTEMS 9

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT - III AUTOMATION USING PNEUMATIC SYSTEMS 9

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations - application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

UNIT - IV AUTOMATION USING ELECTRONIC SYSTEMS 9

Introduction - various sensors - transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers.

UNIT - V ASSEMBLY AUTOMATION 9

Types and configurations - parts delivery at workstations - various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - product design for automated assembly.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Know the concept of automation and its assembly lines
CO2 Gain knowledge in usage of hydraulic components in automation
CO3 Use different methods of pneumatic circuits in the automation industry
CO4 Study various sensors and programming of control systems
CO5 Study the types of assembly automation and part delivery systems

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with applications”, Prentice Hall international, 2009.
2. Mikell P Groover, “Automation, Production System and Computer Integrated Manufacturing”, Prentice Hall Publications, 2007

REFERENCE BOOKS:

1. Kuo .B.C, “Automatic control systems”, Prentice Hall India, New Delhi, 2007
2. Peter Rohner, “Industrial hydraulic control”, Wiley Edition, 1995
3. Mujumdar.S.R, “Pneumatic System”, Tata McGraw Hill 2006

ME1625	PRODUCT DESIGN ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- The course aims at providing the basic concepts of innovative and evolutionary product design strategies so that students can have a basic knowledge in new product development methods and development of innovative products and processes for commercially driven markets

UNIT - I NEW PRODUCT DEVELOPMENT 9

New Product development – NPD - Design by Evolution-Design by Innovation - Product development Strategy - Integration of functional skills - Competitor and Customer - Lean Strategy. Understanding customers needs - role of customers in product development and managing requirements - Product Management Strategy - Process management and improvement -Establish product specifications-Engineering and non-engineering.

UNIT - II CONCEPT IDEALIZATION AND SELECTION 9

Goal Oriented Design - Structured approaches - Customer centric approach - Process centric approach - House of Quality - Search externally and internally - explore systematically for feasibility analysis-reflect on the outcomes – solutions - concept selection - methodology - benefits.

UNIT - III SYSTEM LEVEL PRODUCT DESIGN 9

Implications - Conceptual framework for system level design - Design standardization - product performance - manufacturability - product development strategy - product architecture - clustering - geometric layout development - fundamental and incidental interactions - procedure-pattern - framework – related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-interactive system design.

UNIT - IV INDUSTRIAL DESIGN STRATEGIES 9

Integrated product and process design - Cost management - Robust design strategy - Integrating CAE, CAD, CAM tools - Simulation based product performance and manufacturing processes - Need for industrial design - investigation for industrial design - investigation of customer needs - conceptualization - refinement - engineering change management-technology and user driven products -Qualitative index for an industrial design.

UNIT - V DESIGN FOR MANUFACTURING AND PROJECT EXECUTION 9

Definition - Product costing - Manufacturing cost - Types of manufacturing cost - Cost Minimization -Design for light weight materials - Product complexity - Prototype basics - principles of prototyping - planning for prototypes - Project plan and capital expenditure - baseline project planning - accelerating the project - project metrics and evaluation strategies.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the integrated product and process development
CO2 Develop product concepts and selection methodologies
CO3 Develop product architecture and product detailing and prototyping
CO4 Develop product development Integrated with CAD/CAM/CAE
CO5 Develop DFXs concepts with emphasis on economic decision making

TEXT BOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 7th Edition, 2020.

REFERENCE BOOKS:

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4
3. Staurt Pugh, "Tool Design -Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY. Digitized 2010

ME1626 VIBRATION AND NOISE CONTROL TECHNIQUES FOR MACHINES AND AUTOMOBILES

L T P C

3 0 0 3

OBJECTIVES

- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT – I INTRODUCTION TO VIBRATION 9

Introduction, Types of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies , source of vibration in Automobile, source of vibration in Machines.

UNIT - II INTRODUCTION TO NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement of noise in environment, equipment, frequency analysis, tracking analysis, sound quality analysis, measurement of noise in machine tool.

UNIT - III SOURCES OF NOISE IN AUTOMOBILE 9

Noise Characteristics of engines systems, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, overall noise levels of automobile, Noise Characteristics of suspension systems , transmission noise, aerodynamic noise, tire noise, brake noise, measurement of noise in automobile.

UNIT - IV VIBRATION CONTROL TECHNIQUES 9

Vibration isolation in suspension system, Vibration isolation in Machine tools, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT - V NOISE CONTROL TECHNIQUES 9

Methods for control techniques of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the different types of vibrations and basics of Vibration
CO2 Study the different types of noise and basics of Noise
CO3 Understand and analyze the various sources of automotive Noise
CO4 Acquire the knowledge of control techniques for vibration in engine and suspension system
CO5 Aware about the sources and control techniques of automotive noise

TEXT BOOKS:

1. Singiresu S.Rao, "Mechanical Vibrations", 6th Edition, Pearson Education, 2016, Latest Edition.
2. David Bies and Colin Hansen, "Engineering Noise Control - Theory and Practice",4th E and FN Spon, Taylore & Francise e-Library, 2009.

REFERENCE BOOKS:

1. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007
3. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", Second Edition, SAE International, 1999
4. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 2009

ME1627 DESIGN THINKING

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart the importance of design in today's context of global competition.

UNIT - I DESIGN THINKING FOR NEED IDENTIFICATION **9**

Introduction to New Product Development (NPD) & Design Thinking – A Framework of Design Thinking– Nine Criteria of an Inspirational Design Brief– Customer Experience Mapping– The Visualize, Empathize, and Ideate Method–Design Heuristics–Prototypes in Design Thinking – Integrating Design into the Fuzzy Front End (FFE) – Four Pillars of Innovation for Enabling Design Thinking. CO1

UNIT - II PRODUCT DEVELOPMENT PROCESS **9**

The six phases of generic development–Concept Development–Opportunity Identification Process – Five step process of product planning – Process of Identifying Customer Needs – Process of Product Specifications–Concept generation method–Methods of Concept Selection & Concept Testing. CO2

UNIT - III PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN FOR ENVIRONMENT **9**

Modular Architecture–Types of Modularity–Implications of the Architecture –Establishing the Architecture – Delayed Differentiation – Platform Planning: Differentiation Plan, Commonality Plan– The Industrial Design Process–Assessing the Quality of Industrial Design– Environmental Impacts –The Design for Environment Process. CO3

UNIT - IV ROBUST DESIGN FOR MANUFACTURING AND SUPPLY CHAIN **9**

Robust design through the design of experiments (DOE)–Design for X (DFX)–Iteration of DFM method–Failure Mode and Effect Analysis (FMEA)–Quality Function Deployment (QFD)–Partial disassembly, folding, or compression– Delayed final packaging. CO4

UNIT - V DESIGN THINKING IN COST-CUTTING AND INTELLECTUAL PROPERTY **9**

Fundamentals of Cost Calculations–Methods for Estimating Costs–Target Costing–Life Cycle costs–"Design" in Intellectual Property–Utility Patents–Design Patents–Copyrightable Designs – Trademark Rights–Legal Overlap, Trade-Offs, and Strategic Considerations. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply design concepts for manufacturing, assembly and environment.

CO2 Make economically sound decisions.

CO3 Design methodologies on industrial ecology.

CO4 Analyze the design for its manufacturability using modern quality control concepts and Approaches.

CO5 Learn the value of design and how it impacts society, industry, and the environment.

TEXT BOOKS:

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", ISBN: 978-1-118-97180-2, November 2015, Wiley-Blackwell Publishers.
2. Karl Ulrich, Steven Eppinger, Maria C. Yang, "Product Design and Development", ISBN:9789390113231, Seventh Edition, McGraw Hill Publishers.
3. Gerhard Pahl, Wolfgang Beitz, Jörg Feldhusen, Karl-Heinrich Grote, "Engineering Design: A Systematic Approach", ISBN: 978-1-84628-319- 2, 2007, Springer Publishers.

REFERENCE BOOKS:

1. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", ISBN: 978-1-118-62012-0, August 2013,Wiley Publishers.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", ISBN: 978-1-118-08346-8, October 2012,Wiley Publishers.
3. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", ISBN: 9780062856623, March 2019, Harper Collins Publishers.

ME1628 NEW PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT - I FUNDAMENTALS OF NPD **9**

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD. CO1

UNIT - II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS **9**

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis. CO2

UNIT - III ESSENTIALS OF NPD **9**

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents. CO3

UNIT - IV CRITERIONS OF NPD **9**

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD. CO4

UNIT - V REPORTING & FORWARD-THINKING OF NPD **9**

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.) CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss fundamental concepts and customer specific requirements of the new product development

CO2 Discuss the material specification standards, analysis and fabrication, manufacturing process.

CO3 Develop feasibility studies & reporting of new product development

CO4 Analyzing the new product qualification and market survey on similar products of new product development

CO5 Develop reverse engineering, generate cloud points, convert cloud data to 3D model

TEXT BOOKS:

4. Product Development – Sten Jonsson
5. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCE BOOKS:

4. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
5. Change by Design
6. Toyota Product Development System – James Morgan & Jeffrey K. Liker
7. Winning at New Products – Robert Brands 3rd Edition
8. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

ME1629	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study about the history, concepts and terminology in PLM
- To learn the functions and features of PLM/PDM
- To develop different modules offered in commercial PLM/PDM tools
- To demonstrate PLM/PDM approaches for industrial applications
- To use PLM/PDM with legacy data bases, Coax & ERP systems

UNIT – I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM **9**

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications CO1

UNIT – II PLM/PDM FUNCTIONS AND FEATURES **9**

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration CO2

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE **9**

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed CO3

UNIT – IV ROLE OF PLM IN INDUSTRIES **9**

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance-process compliance and process automation CO4

UNIT – V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE **9**

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Summarize the history, concepts and terminology of PLM

CO2 Develop the functions and features of PLM/PDM

CO3 Discuss different modules offered in commercial PLM/PDM tools.

CO4 Interpret the implement PLM/PDM approaches for industrial applications.

CO5 Integrate PLM/PDM with legacy data bases, CAx& ERP systems

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016),ISBN-10 : 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989)ISBN-10 : 0899303196

REFERENCE BOOKS:

1. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2008 (3rd Edition)
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.
3. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007 \
4. John Stark, "Product Life cycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

ME1631 ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.

UNIT - I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing Technology - Principle - AM Process Chain- Classification - Rapid Prototyping - Rapid Tooling - Rapid Manufacturing – Applications - Benefits - Case studies.

UNIT - II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation - Part orientation and support structure generation - Model slicing -Tool path generation- Design for Additive Manufacturing: Concepts and Objectives - AM unique capabilities - DFAM for part quality improvement- Customised design and fabrication for medical applications.

UNIT - III PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA-Photo curable materials - Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description - powder fusion mechanism - Process Parameters- Typical Materials and Application. Electron Beam Melting.

UNIT - IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction - Basic Principle - Materials - Applications and Limitations - Bioextrusion. Sheet Lamination Process:LOM- Gluing or Adhesive bonding - Thermal bonding.

UNIT - V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies - Continuous mode - Drop on Demand mode - Three Dimensional Printing - Advantages - Bioplotter - Beam Deposition Process: LENS- Process description - Material delivery - Process parameters - Materials - Benefits - Applications.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Know the overview of additive manufacturing
CO2 Understand the design concept of additive manufacturing
CO3 Understand the working principle of additive manufacturing processes
CO4 Learn about the construction of additive Manufacturing technologies
CO5 Understand about modern techniques and mass production in additive manufacturing process

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.
2. Ian Gibson, David W.Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" second edition, Springer , 2015.

REFERENCE BOOKS:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006
3. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications :A tool box for prototype development", CRC Press, 2007
4. Tom Page "Design for Additive Manufacturing" LAP Lambert Academic Publishing, 2012

ME1632 NON DESTRUCTIVE TESTING AND EVALUATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT - I OVERVIEW OF NDT 9

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection - Unaided and aided.

UNIT - II SURFACE NDE METHODS 9

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT - III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 9

Thermography - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT - IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 9

Ultrasonic Testing - Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultra sound, Time of Flight Diffraction. Acoustic Emission Technique - Principle, AE parameters, Applications.

UNIT - V RADIOGRAPHY (RT) 9

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy - Xero-Radiography, Computed Radiography, Computed Tomography.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the fundamental concepts of NDT
CO2 Gain knowledge of the different methods of NDE
CO3 Explain the concept of thermography and eddy current testing
CO4 Explain the concept of ultrasonic testing and acoustic emission
CO5 Explain the concept of radiography

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCE BOOKS:

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing
3. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

ME1633 POLYMERS AND COMPOSITES

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn fundamentals of polymer composites.
- To learn the manufacturing methods of polymer composites
- To impart knowledge on testing on composite materials
- To study the need processing of ceramic matrix composites

UNIT - I INTRODUCTION TO POLYMER COMPOSITES 9

Fundamentals of composites, characteristics, applications of composites, Reinforcements - glass fibers, boron fibers, carbon fibers, organic fibers, aramid fibers, ceramic fibers, oxide and non-oxide fibers, Forms of reinforcements - Roving, Woven fabrics, Non-woven, random mats, whiskers, Rule of mixtures, Matrix materials - Polymers - Thermosetting resins, thermoplastic resins.

UNIT - II MANUFACTURING METHODS OF POLYMER COMPOSITES 9

Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fiber/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fiber/epoxy, glass fiber/polyester, etc.

UNIT - III TESTING OF COMPOSITES 9

Mechanical testing of polymer composites- tensile testing, compressive testing, intra-laminar shear testing, Impact, Flexural testing, Dynamic testing-DMA-Low velocity impact test, vibrational analysis, Thermal analysis.

UNIT - IV CERAMIC MATRIX COMPOSITES 9

Need for CMCs, Processing of CMCs - cold pressing and sintering, hot pressing, infiltration, chemical vapor deposition and chemical vapor impregnation, sol-gel and polymer pyrolysis, high temperature synthesis properties and applications of CMC.

UNIT - V METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC limitations of MMC Processing of MMC, liquid metal infiltration, squeeze casting, stir casting, compo casting, solid state route and diffusion bonding, powder metallurgy route slip casting.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Identify suitable reinforcement and matrix materials for different applications
CO2 Study the various manufacturing processes of Polymer Matrix Composite
CO3 Gain knowledge in testing of composites
CO4 Understand the procedure processing of CMC
CO5 Understand the procedure for processing of metal matrix composites

TEXT BOOKS:

1. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, John Wiley and Sons, New York, 2000.
2. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012.
3. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.

REFERENCE BOOKS:

1. Sharma S.C., Composite materials, Narosa Publications, 2000
2. Sanjay.K.Majumdar, Composites Manufacturing, Kindle edition, CRC press, 2001
3. F.L.Matthews & R.D.Rawlings, Composite Materials, Engineering & Sciences, Chapman & Hall, London, 2001.
4. Graeme W.Milton , The Theory of Composites, CUP, London,2004.
5. Issac M. Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University Press-2006, First Indian Edition - 2007.

ME1634 TESTING AND CHARACTERIZATION OF MATERIALS

L T P C

3 0 0 3

OBJECTIVES

- To understand the various destructive and non-destructive testing methods of materials and its industrial application.

UNIT - I INTRODUCTION TO MATERIALS & TESTING STANDARDS 9

Overview of materials, properties and application of advanced materials, Purpose of testing, Selection of material, Development of testing, Classification of material testing, Result Analysis, Advantages of testing, Testing organizations and its committee, Testing standards.

UNIT - II MECHANICAL TESTING FOR VARIOUS MATERIALS 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy), Drop Weight Impact test - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend (Flexural) test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT - III NON DESTRUCTIVE TESTING FOR VARIOUS MATERIALS 9

Visual inspection, Liquid Penetrate Test, Magnetic particle test, Thermography test - Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT - IV MATERIAL CHARACTERIZATION & SURFACE TOPOLOGY 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques (XRD), Spectroscopic Techniques (FTIR), Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT - V OTHER TESTING 9

Thermal Testing: Differential Scanning Calorimetry, Differential Thermal Analysis. Thermo-mechanical/Thermo Gravimetric Analysis and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma- Mass Spectrometry.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Study the basics of various materials, different types of material testing, material testing standards and organizations, characterization and techniques
CO2	Study the various mechanical testing and its procedure with application
CO3	Study the various non-destructive testing techniques
CO4	Study and analyze the surface and elemental behavior of various materials using different material characterization techniques
CO5	Study and analyze the thermal, chemical behavior of various materials by special testing techniques

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2019.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

REFERENCE BOOKS:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

ME1635 UNCONVENTIONAL MACHINING PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

UNIT - I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES **9**

Unconventional machining Process - Need - classification - merits, demerits and applications. Abrasive Jet Machining - Water Jet Machining - Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles - equipment used - Process parameters – MRR - Applications. CO1

UNIT - II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES **9**

Electric Discharge Machining (EDM) - Wire cut EDM - Working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool - Power and control Circuits-Tool Wear - Dielectric - Flushing -- Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles - Equipment - Types - Beam control techniques - Applications. CO2

UNIT - III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES **9**

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants - Maskant - techniques of applying maskants - Process Parameters - Surface finish and MRR - Applications. Principles of ECM- equipment-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications. CO3

UNIT - IV ADVANCED NANO FINISHING PROCESSES **9**

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, their working principles, equipment, effect of process parameters, applications, advantages and limitations. CO4

UNIT - V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES **9**

Recent developments in non-traditional machining processes, their working principles, equipment, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the need for unconventional machining processes and its classification
CO2 Compare various thermal energy and electrical energy based unconventional machining processes
CO3 Summarize various chemical and electro-chemical energy based unconventional machining processes
CO4 Explain various nano abrasives based on unconventional machining processes
CO5 Distinguish various recent trends based unconventional machining processes

TEXT BOOKS:

1. Anup Goel, Dr.A.Jacob Moses, "Unconventional Machining Processes", Technical Publications 1st Edition,2020.
2. Vijay.K.Jain, "Advanced Machining Processes",Allied Publishers Pvt.Ltd.,New Delhi, 2007.
3. Pandey P.C.and Shan H.S, "Modern Machining Processes", Tata Mc Graw-Hill, New Delhi, 2007.

REFERENCE BOOKS:

1. Kapil Gupta, Neelesh K. Jain, R. F. Laubscher, "Hybrid Machining Processes: Perspectives on Machining and Finishing", Springer International Publishing,2016
2. Paul De Garmo, J.T.Black, and Ronald. A. Kohser, "Materials And Processes in Manufacturing" Prentice Hall India Pvt.Ltd.,8th Edition, New Delhi, 2001
3. Benedict.G.F., "Non-traditional Manufacturing Processes",Marcel Dekker Inc., NewYork, 1987.
4. McGeough, "Advanced Methods of Machining",Chapman and Hall, London,1998.

ME1636 WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basics of welding and to know about the various types of welding processes.

UNIT - I GAS AND ARC WELDING PROCESSES **9**

Fundamental principles - Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications. CO1

UNIT - II RESISTANCE WELDING PROCESSES **9**

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications. CO2

UNIT - III SOLID STATE WELDING PROCESSES **9**

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications. CO3

UNIT - IV OTHER WELDING PROCESSES **9**

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Underwater welding, Welding automation in aerospace, nuclear and surface transport vehicles. CO4

UNIT - V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS **9**

Various weld joint designs - Welding defects - causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the construction and working principles of the gas and arc welding process
CO2 Understand the construction and working principles of the resistance welding process
CO3 Understand the construction and working principles of various solid state welding processes
CO4 Understand the construction and working principles of various special welding processes
CO5 Understand the concepts on weld joint design, weldability and testing of weldments

TEXT BOOKS:

1. Little R.L.,"Welding and welding Technology",Tata McGraw Hill Publishing Co.,Ltd., McGraw Hill Education July 2017
2. Parmer R.S.,"Welding Engineering and Technology ",1st Edition, Khanna Publishers, 2013
3. O.P.Khanna.,"Text Book Of Welding Technology", Dhanpat Rai Publications; 2011.

REFERENCE BOOKS:

1. AWS - Welding Hand HandBook.8th Edition. Vol-2. "Welding Process".
2. Christopher Davis. "LaserWelding-Practical Guide".Jaico Publishing House
3. Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers,1st Edition, 2005.
4. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993
5. Tylecote R.F., "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London.

ME1637 GREEN MANUFACTURING DESIGN AND PRACTICES

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the concept of environmental design and industrial ecology.
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.
- To enlighten the students with knowledge about water pollution and its effects on the environment.
- To introduce the concept of green co-rating and its need.

UNIT - I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT **9**

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle. CO1

UNIT - II AIR POLLUTION SAMPLING AND MEASUREMENT **9**

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone. CO2

UNIT - III NOISE POLLUTION AND CONTROL **9**

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects. CO3

UNIT - IV WATER DEMAND AND WATER QUALITY **9**

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues. CO4

UNIT - V GREEN CO-RATING **9**

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage - Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies Of Green Co- Rating CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the environmental design and selection of eco-friendly materials.

CO2 Analyse manufacturing processes towards minimization or prevention of air pollution.

CO3 Analyse manufacturing processes towards minimization or prevention of noise pollution.

CO4 Analyse manufacturing processes towards minimization or prevention of water pollution.

CO5 Evaluate green co-rating and its benefits.

TEXT BOOKS:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

REFERENCE BOOKS:

1. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
2. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
3. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
4. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006
5. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

ME1638	GREEN SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiar the various standards and legislation of modern electronic manufacturing.
- To know the conventional electronic processing and lead-free electronic manufacturing techniques.
- To recognize the steps involved in assembly process and understand the need of recycle the electronics
- To implement reliability and product life cycle estimation tools in green electronic manufacturing.
- To demonstrate the green electronic manufacturing procedure in applications.

UNIT - I INTRODUCTION TO GREEN ELECTRONICS **9**

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH). CO1

UNIT - II GREEN ELECTRONICS MATERIALS AND PRODUCTS **9**

Basics of IC manufacturing and its process – Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products. CO2

UNIT – III GREEN ELECTRONICS ASSEMBLY AND RECYCLING **9**

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology. CO3

UNIT – IV PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN **9**

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry. CO4

UNIT – V CASE STUDIES **9**

Reliability of green electronics systems , Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.

CO2 Explain the conventional electronic processing and lead free electronic manufacturing techniques.

CO3 Realize the assembly process and the need of recycle of electronics

CO4 Use reliability and product life cycle estimation tools for electronic manufacturing.

CO5 Validate the green electronic manufacturing procedures in applications.

TEXT BOOKS:

1. Green Supply Chain Management, by CharisiosAchillas , Dionysis D. Bochtis , Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 : 1138644617
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

REFERENCE BOOKS:

1. David Austen, Green Electronic Morning, Ingleby Gallery, 2006.
2. John Hu. Mohammed Ismail, CMOS High Efficiency on – Chip Power Management, Springer Publications 4th edition, 2011.
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

ME1639 INDUSTRY 4.0 FOR MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

(Common for all Branches of B.E. / B. Tech Programmes)

OBJECTIVES

- To introduce revolutions in the manufacturing industry
- To introduce technological advancement in modern manufacturing industries
- To introduce concepts of smart manufacturing, emphasizing Industry 4.0 in manufacturing industries

UNIT – I INTRODUCTION TO INDUSTRY 4.0 **9**

Introduction to Industry 4.0 -Need for Industry 4.0 - Framework for Industry 4.0 -Technological pillars in Industrial 4.0 -Applications, challenges and scope for Industry 4.0 - Dissemination of Industry 4.0 and the disciplines contributing to its development, Artificial intelligence, Industrial Internet of Things, Additive manufacturing, Robotization, and automation. Difference between conventional automation and Industry 4.0. CO1

UNIT – II TECHNOLOGICAL DEVELOPMENTS IN INDUSTRY 4.0 **9**

Introduction to Smart Manufacturing - Big Data, Cyber-Physical Systems, Value chains in manufacturing companies - Customization of products -Internet of Things (IoT) - Industrial Internet of Things (IIoT) -Digital Twins - Cloud Computing / Cloud Manufacturing -Artificial Intelligence and Machine Learning - Security issues within Industry 4.0 networks **CO2**

UNIT – III CYBER-PHYSICAL SYSTEMS **9**

Components of I4.0- Cyber-Physical System –Cyber world and Physical world- Concepts of embedded systems, Wireless sensor networks - Mobile networks - Satellite networks - RFID & IoT Enabled Cyber Security Systems. CO3

UNIT – IV SMART MANUFACTURING SYSTEMS **9**

Introduction to Manufacturing Processes and Systems - Industrial revolutions, Background and concept of smart manufacturing- Elements of the Smart Manufacturing Process; Sensing Elements and IoT Technologies; Data-driven models - Precision Manufacturing, Flexible Manufacturing, and Agile Manufacturing - Concept of edge, fog, and cloud computing in Manufacturing - VR, and MR (Mixed Reality) in Manufacturing - Case Studies. CO4

UNIT – V ECOSYSTEM FOR INDUSTRY 4.0 **9**

Economic aspects, opportunities, and skills required for Industry 4.0 - Effects of 4-M-Man, Machine, Material, and Method in Industry 4.0 - The Current State of Industry 4.0 in India. The Strategic Framework for Successful Implementation of Industry 4.0 and beyond. CO5

TOTAL PERIODS: 45

TEXT BOOKS

1. Leong W., (2020), Nine pillars of technologies for Industry 4.0, IET publishers.
2. Klaus Schwab, "The Fourth Industrial Revolution".
3. Wang L, and Vincent W X, (2019), Cloud Based Cyber-Physical Systems in Manufacturing, Springer

REFERENCE BOOKS

1. V.K. Jain, Data Sciences and Analytics, Khanna Publishing House, New Delhi, 2019. 4.
2. R. Chopra, Machine Learning, Khanna Publishing House, New Delhi, 2020.
3. Jeschke S, Brecher C, Song H, and Rawat D B, (2017), Industrial Internet of Things – Cyber Manufacturing Systems, Springer
4. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things 1st ed. Edition, Kindle Edition, 2018
5. Tao F, Zhang M, and Nee A Y C, (2019), Digital Twin Driven Smart Manufacturing, Academic Press.
6. Wang L, and Vincent W X, (2019), Cloud Based Cyber-Physical Systems in Manufacturing, Springer.
7. MIT Online Course on Smart Manufacturing: https://professional.mit.edu/course catalog/smart-manufacturing-moving-static-dynamic-manufacturing-operations/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Correlate the recent manufacturing trends and technological pillars of Industry 4.0.
CO2 Understand the importance of Cloud Computing, AI, Big data,and IoT in modern industry
CO3 Understand different components of Cyber-Physical systems and their benefits
CO4 Appreciate concepts and basic framework necessary for smart manufacturing
CO5 Compare the ecosystem of the current manufacturing industry and Industry 4.0

ME1640	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

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

UNIT – I 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. CO1

UNIT – II INTRODUCTION TO 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. CO2

UNIT – III DEEPER UNDERSTADING 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. CO3

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. CO4

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. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the basics of 6 SIGMA
CO2 Elaborate the lean manufacturing tools.
CO3 Illustrate about the deeper understanding methodologies of Lean manufacturing.
CO4 Discuss lean concepts and its elements.
CO5 Describe the implementation and challenges of lean manufacturing.

TEXT BOOKS:

1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
3. The Toyota Way: 14 Management Principles
4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai

REFERENCE BOOKS:

1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).
4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

MG1003	APPLIED OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Computer Applications.
- To understand , develop and solve mathematical model of linear programming problems
- To understand , develop and solve mathematical model of Transport and assignment problems
- To Understand network modeling for planning and scheduling the project activities

UNIT - I LINEAR PROGRAMMING MODELS **12**

Mathematical Formulation - Graphical Solution of linear programming models - Simplex method - Artificial variable techniques. CO1

UNIT - II TRANSPORTATION AND ASSIGNMENT MODELS **8**

Mathematical formulation of transportation problem - Methods for finding initial basic feasible solution - optimum solution - degeneracy -Mathematical formulation of assignment models - Hungarian Algorithm. CO2

UNIT - III INVENTORY MODELS **8**

Inventory Models - Economic order Quantity Models- Quantity Discount Models- Stochastic Inventory Models- Multi Product Model- Inventory Control Models in Practice. CO3

UNIT - IV SCHEDULING FOR PROJECT ACTI VITIES **7**

Network Construction - Critical Path Method - Project Evaluation and Review Technique - Resource Analysis in Network Scheduling. CO4

UNIT - V QUEUEING MODELS **10**

Characteristics of Queuing Models - Single and multi server models
Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), CO5
(M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Analyze the problems in engineering, management or business environment, focusing on important details.
CO2 Understand the transportation and assignment in logistics and job allocation scenarios.
CO3 Understand the inventory management in manufacturing context.
CO4 Understand the concept of network and project planning
CO5 Understand the applications of queuing theory in real world

TEXT BOOKS:

1. Hillier and Libeberman, “Operations Research”, Holden Day, 2005
2. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOKS:

1. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley,2009
2. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990
3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern,1994
5. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

ME1741 COMPUTER INTEGRATED MANUFACTURING SYSTEMS AND AUTOMATION

L T P C

3 0 0 3

OBJECTIVES

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT - I INTRODUCTION **9**

Brief introduction to CAD and CAM - Manufacturing planning, Manufacturing control-Introduction to CAD/CAM - Concurrent engineering-CIM concepts - Computerised elements of CIM system - Types of production - Manufacturing models and metrics - Mathematical models of production performance - Simple problems - Manufacturing control - Simple problems - Lean production and Just-In-Time Production. CO1

UNIT - II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING **9**

Process planning - Computer Aided Process Planning (CAPP) - Logical steps in Computer Aided Process Planning - Aggregate Production Planning and the Master Production Schedule - Material Requirement planning - Capacity planning- Control Systems-Shop floor control-Inventory control-Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) , Computer Integrated Additive Manufacturing(CIAM) - Simple problems. CO2

UNIT - III CELLULAR MANUFACTURING **9**

Group Technology (GT), Part Families - Parts classification and coding - Simple Problems in Opitz part coding system - Production flow analysis - Cellular manufacturing - Composite part concept - Machine cell design and layout - Quantitative analysis in Cellular manufacturing - Rank order clustering method - Arranging machines in a GT cell - Hollier method - Simple problems. CO3

UNIT - IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) **9**

Types of Flexibility - FMS - FMS Components - FMS application & benefits - FMS planning and control - Quantitative analysis in FMS - Simple problems. Smart manufacturing - IoT, Automated Guided Vehicle System (AGVS) - AGV's application - Vehicle guidance technology - Vehicle management & safety. CO4

UNIT - V INDUSTRIAL AUTOMATION **9**

Basic Elements of an Automated System - Advanced Automation Functions Levels of Automation - Automation and Artificial Intelligence. Industrial Control Systems: Process Industries versus Discrete Manufacturing Industries - Continuous versus Discrete Control - Computer Process Control -Industry 4.0. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems
CO2 Summarize the production planning and control and computerized process planning
CO3 Differentiate the different coding systems used in group technology
CO4 Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system
CO5 Understand the basics of automation and control systems

TEXT BOOKS:

1. Mikell.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2016
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2008.

REFERENCE BOOKS:

1. Gideon Halevi and Roland Weill, "Principles of Process Planning - A Logical Approach" Chapman & Hall, London,2012
2. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.1995
3. Rao. P, N Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

ME1742 MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like preventive maintenance, condition monitoring and repair of machine elements
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT - I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING **9**

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound Maintenance systems - Reliability and machine availability - MTBF, MTTR and MWT - Factors of availability - Maintenance organization - Maintenance economics. CO1

UNIT - II MAINTENANCE POLICIES - PREVENTIVE MAINTENANCE **9**

Maintenance categories - Comparative merits of each category - Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication - TPM. CO2

UNIT - III CONDITION MONITORING **9**

Condition Monitoring - Cost comparison with and without CM - On-load testing and offload testing - Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers - wear-debris analysis. CO3

UNIT - IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS **9**

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings - Failure analysis - Failures and their development - Logical fault location methods - Sequential fault location. CO4

UNIT - V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT **9**

Repair methods for Material handling equipment - Equipment records -Job order systems -Use of computers in maintenance. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the principles and practices of maintenance planning
CO2 Explain the maintenance policies and strategies to preventive maintenance
CO3 Summarize the different principles of condition monitoring
CO4 Summarize the repair methods for basic machine elements
CO5 Summarize the repair methods for material handling equipment

TEXT BOOKS:

1. Amiya R Mohanty, "Machinery Condition Monitoring: Principles and Practices", CRC Press, 2015
2. Terry Wireman, "Benchmarking Best Practices for Maintenance, Reliability and Asset Management", 3rd Edition, Industrial Press Inc. 2014.
3. Venkataraman .K "Maintenance Engineering and Management", PHI Learning, Pvt. Ltd., 2007.
4. Heinz P. Bloch and Fred K. Geitner, "Machinery Component Maintenance and Repair", 3rd Edition, Elsevier, 2005

REFERENCE BOOKS:

1. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 2010
2. Keith Mobley, Lindley Higgins, Darrin Wikoff, "Maintenance Engineering Handbook", Seventh Edition, Mc-Graw Hill Professional, 2008.

EC1008 MEMS AND NEMS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of microsystems
- To know the design concepts of micro sensors and micro actuators.
- To introduce the concepts of quantum mechanics and nano systems

UNIT - I INTRODUCTION TO MEMS AND NEMS **9**

New trends in Engineering and Science: Micro and Nano scale systems. Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals. CO1

UNIT - II MEMS FABRICATION TECHNOLOGIES **9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PECVD, Sputtering, Etching techniques: Dry and wet etching, electrochemical etching, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA. CO2

UNIT - III MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester. CO3

UNIT - IV MICRO ACTUATORS **9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch. CO4

UNIT - V NANO DEVICES **9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nano rods based NEMS device: Gas sensor. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the fundamentals and working principles of microsystems and microelectronics
CO2 Understand the both micro fabrication and manufacturing techniques
CO3 Acquire knowledge about micro system design and its various applications
CO4 Study about the basic concepts of nano electronics with various devices and also discusses with its applications
CO5 Realize the various application of NEMS and architecture of MEMS

TEXT BOOKS:

1. Marc Madou, Fundamentals of Microfabrication, CRC press 1997
2. Stephen D. Senturia, Micro system Design , Kluwer Academic Publishers,2001.

REFERENCE BOOKS:

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcraw Hill, 2002.
2. Chang Liu, Foundations of MEMS, Pearson education India limited, 2006.
3. Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures‖ CRC Press, 2002.

ME1743 SAFETY ENGINEERING AND DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety
- Collaborate and modify processes / procedures for safety

UNIT - I INTRODUCTION **9**

Evolution of modern safety concepts - Fire prevention - Mechanical hazards - Boilers, Pressure vessels, Electrical Exposure. CO1

UNIT - II CHEMICAL HAZARDS **9**

Chemical exposure - Toxic materials - Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene - Industrial Toxicology. CO2

UNIT - III ENVIRONMENTAL CONTROL **9**

Industrial Health Hazards - Environmental Control - Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection. CO3

UNIT - IV HAZARD ANALYSIS **9**

System Safety Analysis -Techniques - Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment. CO4

UNIT - V SAFETY REGULATIONS AND DISASTER MANAGEMENT **9**

Explosions - Disaster management - catastrophe control, hazard control, Factories Act, Safety regulations Product safety - case studies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Identify and prevent chemical, environmental mechanical, fire hazard

CO2 Collect, analyze and interpret the accidents data based on various safety techniques. CO3: Apply proper safety techniques on safety engineering and management

CO3 Apply proper safety techniques on safety engineering and management

CO4 Perform hazard analysis

CO5 Design the system with environmental consciousness by implementing safety regulation

TEXT BOOKS:

1. John V.Grimaldi, "Safety Management", AITB S Publishers, 2003

REFERENCE BOOKS:

1. David L.Goetsch, "Occupational Safety and Health for Technologists", Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, "Industrial Safety Management", Tata McGraw-Hill Publishing Company Ltd.,2005.
3. Safety Manual, "EDEL Engineering Consultancy", 2000.

ME1744 TOTAL QUALITY MANAGEMENT AND RELIABILITY ENGINEERING

L T P C

3 0 0 3

OBJECTIVES

- To facilitate the understanding of quality management principles and process.
- Impart knowledge in reliability concepts

UNIT - I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Supplier partnership - Partnering, Supplier selection, Supplier Rating. CO1

UNIT - II TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils, Quality Circles - Employee involvement Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - TPM - Concepts. CO2

UNIT - III TQM TOOLS AND TECHNIQUES **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, Applications to manufacturing industry - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types, Performance measures, Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function. CO3

UNIT - IV RELIABILITY CONCEPTS **9**

Reliability definition - Quality and Reliability- Reliability mathematics - Reliability functions - Hazard rate - Measures of Reliability - Design life -A priori and posteriori probabilities - Mortality of a component - Mortality curve - Useful life. CO4

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. CO5

ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of quality management

CO2 Apply the principles of quality management to manufacturing and services processes

CO3 Apply the traditional tools and techniques of quality management to manufacturing and services processes

CO4 Understand the basic concepts of reliability engineering

CO5 Understand the quality management and environmental management system in manufacturing and services processes

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.
5. ISO 9001-2015 standards

ME1745 DESIGN FOR MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- To learn design consideration principles of forming in the design of extruded, stamped, and forged products.
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- To learn design consideration principles of welding in the design of welded products.
- To learn design consideration principles of assembly in the design of assembled products.

UNIT - I INTRODUCTION AND CASTING **9**

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts. CO1

UNIT - II FORMING **9**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts. CO2

UNIT - III MACHINING **9**

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts. CO3

UNIT - IV WELDING **9**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment CO4

UNIT - V ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.

CO2 Explain design consideration principles of forming in the design of extruded, stamped, and forged products.

CO3 Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

CO4 Explain design consideration principles of welding in the design of welded products.

CO5 Explain design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill, 1986.
2. O. M olloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCE BOOKS:

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Henry Peck, "Designing for Manufacture", Sir Isaac Pitman & Sons Ltd., 1973.
5. Matousek, "Engineering Design", Blackie & Sons, 1956.

ME1746 DIGITAL MANUFACTURING AND IoT

L	T	P	C
3	0	0	3

OBJECTIVES

- To study the various aspects of digital manufacturing.
- To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
- To formulate of smart manufacturing systems in the digital work environment.
- To interpret IoT to support the digital manufacturing.
- To elaborate the significance of digital twin.

UNIT - I INTRODUCTION **9**

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing. CO1

UNIT - II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT **9**

Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM CO2

UNIT - III SMART FACTORY **9**

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity CO3

UNIT - IV INDUSTRY 4.0 **9**

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies. CO4

UNIT - V STUDY OF DIGITAL TWIN **9**

Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Impart knowledge to use various elements in the digital manufacturing.

CO2 Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.

CO3 Select the proper procedure of validating practical work through digital validation in Factories.

CO4 Implementation the concepts of IoT and its role in digital manufacturing.

CO5 Analyse and optimize various practical manufacturing process through digital twin.

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.

REFERENCE BOOKS:

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.

ME1747	PRECISION MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the need, significance and progress of precision manufacturing and the different levels of manufacturing.
- To study the principle and working of different methods of precision machining.
- To study the special construction requirements of precision machine tools.
- To study the errors involved in precision machine tools and calculate the error budgets for a given situation.
- To study the Selecting a suitable measurement solution to measure and characterize precision machined features.

UNIT - I PRECISION ENGINEERING **9**

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology. CO1

UNIT - II PRECISION MACHINING **9**

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro-milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc. CO2

UNIT - III MACHINE DESIGN FOR PRECISION MANUFACTURING **9**

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings. CO3

UNIT - IV MECHANICAL AND THERMAL ERRORS **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. CO4

UNIT - V MEASUREMENT AND CHARACTERISATION **9**

Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nano features.

CO5

Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.

CO2 Explain the principle and working of different methods of precision machining.

CO3 Explain the special construction requirements of precision machine tools.

CO4 Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.

CO5 Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS:

1. Jain , V.K., Introduction to micromachining, Narosa publishers, 2018
2. Venktesh V.C., SudinIzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007.

REFERENCE BOOKS:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.
2. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
3. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
4. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
5. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

ME1748 SURFACE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To study the fundamentals of surface features and different types of friction associated with metals and non-metals
- To study the different types of wear mechanism and its standard measurement.
- To study the different types of corrosion and its preventive measures
- To study the different types of surface properties and surface modification techniques
- To study the various types of materials used in the friction and wear applications

UNIT - I SURFACES AND FRICTION **9**

Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction-Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact. CO1

UNIT - II WEAR **9**

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements CO2

UNIT - III CORROSION **9**

Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors CO3

UNIT - IV SURFACE TREATMENTS **9**

Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy – Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings CO4

UNIT - V ENGINEERING MATERIALS **9**

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Describe the fundamentals of surface features and different types of friction associated with metals and non-metals

CO2 Analyze the different types of wear mechanism and its standard measurement.

CO3 Analyze the different types of corrosion and its preventive measures

CO4 Analyze the different types of surface properties and surface modification techniques

CO5 Analyze the various types of materials used in the friction and wear applications.

TEXT BOOKS:

1. G.W .Stachowiak and A.W.Batchelor, "Engineering Tribology", Butterworth-Heinemann, 2005.
2. S.K. Basu, S.N.Sengupta and B.B.Ahuja ,"Fundamentals of Tribology", Prentice Hall of India, 2005.

REFERENCE BOOKS:

1. Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
2. Halling, J. (Editor), "Principles of Tribology ", MacMillian, 1984.
3. Rabinowicz.E., "Friction and Wear of materials", John Willey &Sons,1995.
4. Williams J.A., "Engineering Tribology", Oxford University Press, 1994.
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

ME1751 ADVANCED INTERNAL COMBUSTION ENGINES

L T P C

3 0 0 3

OBJECTIVES

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc

UNIT - I SPARK IGNITION ENGINES **9**

Mixture requirements - Fuel injection systems - Mono point, Multipoint & Direct injection - Stages of combustion - Normal and Abnormal combustion - Knock - Factors affecting knock - Combustion chambers. CO1

UNIT - II COMPRESSION IGNITION ENGINES **9**

Diesel Fuel Injection Systems - Stages of combustion - Knocking - Factors affecting knock - Direct and Indirect injection systems - Combustion chambers - Fuel Spray behavior - Spray structure and spray penetration - Air motion - Introduction to Turbo-charging. CO2

UNIT - III POLLUTANT FORMATION AND CONTROL **9**

Pollutant - Sources - Formation of Carbon Monoxide, Un burnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter - Methods of controlling Emissions - Catalytic converters, Selective Catalytic Reduction and Particulate Traps - Methods of measurement - Emission norms and Driving cycles. CO3

UNIT - IV ALTERNATIVE FUELS **9**

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications. CO4

UNIT - V RECENT TRENDS **9**

Air assisted Combustion, Homogeneous charge compression ignition engines - Variable Geometry turbochargers - Common Rail Direct Injection Systems - Hybrid Electric Vehicles - NOx Adsorbers - Onboard Diagnostics. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the performance & characteristics a S.I Engine

CO2 Understand about various injection systems, Fuel spray behavior, Stages of combustion, Turbo charging, Combustion chambers and Knocking in C.I Engine

CO3 Understand various pollutants and its formations, method of controlling Emissions, Methods of measurement, Emission norms and Driving cycles

CO4 Understand various alternative fuels, their suitability and corresponding Engine Modifications

CO5 Understand about the recent trends in I.C. Engine's Injection Systems, Combustion, ignition, Hybrid Vehicles and Onboard Diagnostics

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.
3. John Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill Education, 2017

REFERENCE BOOKS:

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

ME1752 AUTOMOBILE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT - I AUTOMOTIVE ENGINE AUXILIARY SYSTEMS **9**

Automotive engines - External combustion engines -Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines - four stroke engines - construction and working principles - IC engine components - functions and materials - valve timing - port timing diagram- Injection system -Common Rail Direct injection system - Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines - CI engines-Ignition system - Electronic ignition system - Distributor less ignition system - Transistorized ignition system, capacitive discharge ignition system. CO1

UNIT - II VEHICLE STRUCTURE AND STEERING SYSTEM 9

Vehicle construction and different Chassis layouts -classifications of chassis- types of frames - frameless chassis construction -articulated vehicles - vehicle body - Vehicle aerodynamics - various resistances and its effects - steering system - conventional - sophisticated vehicle- and types of steering gear box-Power Steering - Steering geometry-condition for true rolling motion-Ackermann's - types of stub axle - Types of rear axles. CO2

UNIT - III TRANSMISSION SYSTEMS 9

Clutch - types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints - Hotchkiss Drive and Torque Tube Drive - rear axle - Differential-wheels and tyres. CO3

UNIT - IV SUSPENSION AND BRAKES SYSTEMS 9

Suspension Systems - conventional Suspension Systems - independent Suspension Systems - leaf spring - shock absorber - coil spring - taper - lite - eligo,s spring Types of brakes - Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface. CO4

UNIT - V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles - Engine modifications required - Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers - Engine emission control by three way catalytic converter system. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the construction and working of an IC Engine and its auxiliary systems as fuel injection and ignition systems

CO2 Understand the construction and working principle of various parts of an automobile. Especially about the frame structure, layout and about the steering mechanism and components

CO3 Know about the power train, the transmission right from the flywheel, clutch and knowing further about the gear box and till the propeller shaft till the differentials and wheels

CO4 Impart knowledge on the suspension system and vehicle control systems as brake and the recent advancements in the field, the application of electronic control unit in brake and traction control

CO5 Have idea about the alternate energy sources to propel the automobile: such as natural gas, LPG, electric and also to know about hybrid vehicles and the modification needed in the existing vehicles to suit the changes. Also about the treatment on emission. Also to have practice for assembling and dismantling of engine parts and transmission system

TEXT BOOKS:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw Hill, 2012.
2. Jain K. K. and Asthana. R. B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 2020

REFERENCE BOOKS:

1. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East- West Press, 2004.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart -Will Cox Company Inc, USA, 2007.
4. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 2001

ME1753	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce Governing Equations of viscous fluid flows.
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers

UNIT - I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **9**

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, Momentum and Energy equations - Chemical species transport - Physical boundary conditions - Time-averaged equations for Turbulent Flow - Turbulent-Kinetic Energy Equations - Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations. CO1

UNIT - II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION **9**

Derivation of finite difference equations - Simple Methods - General Methods for first and second order accuracy - Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems -Parabolic equations - Explicit and Implicit schemes - Example problems on elliptic and parabolic equations - Use of Finite Difference and Finite Volume methods. CO2

UNIT - III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION **9**

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes properties of discretization schemes - Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes. CO3

UNIT - IV FLOW FIELD ANALYSIS **9**

Finite volume methods -Representation of the pressure gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants - PISO Algorithms. CO4

UNIT - V TURBULENCE MODELS AND MESH GENERATION **9**

Turbulence models, mixing length model, Two equation (k-Ɛ) models - High and low Reynolds number models - Structured Grid generation - Unstructured Grid generation - Mesh refinement - Adaptive mesh - Software tools. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Summarize the Governing equations of fluid dynamics

CO2 Create numerical modeling in finite difference and finite volume methods for diffusion and its role in the field of fluid flow and heat transfer

CO3 Create numerical modeling in finite difference and finite volume methods for convection diffusion and its role in the field of fluid flow and heat transfer

CO4 Understand the flow field in finite volume methods

CO5 Use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCE BOOKS:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005.
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. Prodip Niyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press,2005

GE1004 FUNDAMENTALS OF NANOSCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn about basis of nano material science, preparation method, types and application.

UNIT - I INTRODUCTION — 9

Nano scale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nano structured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only). CO1

UNIT - II GENERAL METHODS OF PREPARATION — 9

Bottom-up Synthesis - Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE. CO2

UNIT - III NANOMATERIALS — 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications. CO3

UNIT - IV CHARACTERIZATION TECHNIQUES — 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS - Nano indentation. CO4

UNIT - V APPLICATIONS — 9

Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS) - Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2 Acquire knowledge in general methods of preparation of nano materials.
CO3 Understand the Nano forms of Carbon and methods of synthesis
CO4 Acquire knowledge in characteristic nanomaterial on various technique.
CO5 Gain knowledge on various application of nano materials.

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

ME1754 MECHANICS OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the fundamentals of composite material strength and its mechanical behaviour.
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber
- Thermo-mechanical behaviour and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips

UNIT - I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING — 9

Definition - Need - General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions - Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina - Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina - Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding - Pultrusion - Filament Winding - Other Manufacturing Processes. CO1

UNIT - II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS — 9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations - Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates. CO2

UNIT - III LAMINA STRENGTH ANALYSIS — 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure. CO3

UNIT - IV THERMAL ANALYSIS **9**

Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations - Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi- Isotropic Laminates. CO4

UNIT - V ANALYSIS OF LAMINATED FLAT PLATES **9**

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations - Natural Frequencies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Identify the various matrices, reinforcements and their combinations in composite materials
CO2 Understanding the analysis of fiber reinforced Laminate to derive Flat plate Laminate equations
CO3 Analyze Lamina strength of individual plies on the global and local axial, bending and twisting deformation of laminate
CO4 Analyze Thermo-mechanical behaviour and study of residual stresses in Laminates during processing
CO5 Implementation of Classical Laminate Theory (CLT) to analyse Laminate flat plates

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", Fourth Edition, McGraw-Hill, CRC press, 2016.
2. Hyer, M.W., "Stress Analysis of Fiber - Reinforced Composite Materials", Destech Pubns Inc, 2008.

REFERENCE BOOKS:

1. Hyer, M.W., "Stress Analysis of Fiber - Reinforced Composite Materials", Destech Pubns Inc, 2008.
2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1992.
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007.
4. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", CRC Press, 2007.

MG1001 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To enable the students to study the evolution of management.
- To study the functions and principles of management
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication
- To gain the knowledge of tools and techniques for an effective managerial skill

UNIT - I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers - managerial roles and skills - Evolution of Management - Scientific, human relations , system and contingency approaches - Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management. CO1

UNIT - II PLANNING **9**

Nature and purpose of planning - planning process - types of planning - objectives - setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process. CO2

UNIT - III ORGANISING **9**

Nature and purpose - Formal and informal organization - organization chart - organization structure - types - Line and staff authority - departmentalization - delegation of authority - centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management. CO3

UNIT - IV DIRECTING **9**

Foundations of individual and group behavior - motivation - motivation theories - motivational techniques - job satisfaction - job enrichment - leadership - types and theories of leadership - communication - process of communication - barrier in communication - effective communication -communication and IT. CO4

UNIT - V CONTROLLING **9**

System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance - direct and preventive control - reporting. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the various terms and definitions related to management and organization

CO2 Acquire the skill of planning and various strategies of management in an organization

CO3 Understand the various hierarchies of management and also get an insight into an HR values in an organization management

CO4 Acquire the skills of leadership and understand the importance of communication to run an organization effectively

CO5 Analyse the risk related to budget and methods to handle the risk with help of technology to manage an organization

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India), Pvt. Ltd., 15th Edition, 2020.

REFERENCE BOOKS:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 6th Edition 2017.

ME1755	CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- 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 — CO1

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 — CO2

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 — CO3

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. — CO4

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 — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the climate change and carbon footprint
CO2 Discuss the principle of product life cycle and Green House Gas emissions accounting
CO3 Explain the Methodology for Carbon Footprint Calculation
CO4 Discuss emission mitigation and carbon sink
CO5 Explain the case study of carbon footprint.

TEXT BOOKS:

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10 : 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742

REFERENCE BOOKS:

1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press
2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers
3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard
4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.
5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.

ME1756 INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

OBJECTIVES

- To study the fundamental concept and principles of industrial safety
- To study the principles of maintenance engineering.
- To Analyzing the wear and its reduction.
- To study the faults in various tools, equipments and machines.
- To study the periodic maintenance procedures in preventive maintenance.

UNIT - I INDUSTRIAL SAFETY **9**

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. CO1

UNIT - II MAINTENANCE ENGINEERING **9**

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. CO2

UNIT - III WEAR AND CORROSION AND THEIR PREVENTION **9**

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. CO3

UNIT - IV FAULT TRACING **9**

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. CO4

UNIT - V PERIODIC AND PREVENTIVE MAINTENANCE **9**

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. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the fundamental concept and principles of industrial safety

CO2 Apply the principles of maintenance engineering.

CO3 Analyze the wear and its reduction.

CO4 Evaluate faults in various tools, equipments and machines

CO5 Apply periodic maintenance procedures in preventive maintenance.

TEXT BOOKS:

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.

REFERENCE BOOKS:

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

ME1757	THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the working principle of Li-ion batteries and battery packs.
- To learn the thermal management system in battery modules.
- To develop the different case studies in battery thermal management system.
- To learn the working principle of fuel cells cooling methods.
- To learn the inside components of thermal management systems in various famous electric and fuel cell electric vehicles.

UNIT - I ADVANCED BATTERIES **9**

Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Supercapacitors Vs batteries. Diamond battery concepts. CO1

UNIT - II THERMAL MANAGEMENT IN BATTERIES **9**

Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Tesla Model-S Battery Module- bonding techniques, thermal management. CO2

UNIT - III BATTERY THERMAL MANAGEMENT CASE STUDIES **9**

EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Modelling Liquid Cooling of a Li-Ion Battery Pack with COMSOL Multiphysics- simulation concepts. CO3

UNIT - IV THERMAL MANAGEMENT IN FUEL CELLS **9**

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions. CO4

UNIT - V CASE STUDIES ON FUEL CELL AND BATTERIES **9**

Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations and case studies - Battery EVs Vs Fuel Cell EVs. FCV- Operating principle, High pressure hydrogen tank, Boost convertor, Hydrogen refuelling, Advanced Battery Case Studies - NiMH Battery. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the different Li-ion batteries and fuel cell performances.

CO2 Design a battery pack with appropriate PCM.

CO3 Apply cooling models using Simulation

CO4 Estimate fuel economy.

CO5 Utilize different thermal management system approaches during real world usage.

TEXT BOOKS:

1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems’’, Wiley, 2017.
2. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles’’, Wiley, 2015.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals, Theory, and Design’’, CRC Press, 2005.
4. John G. Hayes and G. Abas Goodarzi, “Electric Powertrain”, Wiley, 2018
5. Davide Andrea, “Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECH House, 2010.

REFERENCE BOOKS:

1. Nag.P.K, “Engineering Thermodynamics”, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. “Vehicle thermal Management Systems Conference Proceedings”, 1st Edition; 2013, Coventry Techno centre, UK
3. Younes Shabany,” Heat Transfer: Thermal Management of Electronics Hardcover” 2010, CRC Press.
4. T. Yomi Obidi, “Thermal Management in Automotive applications”, 2015, SAE International.
5. Jerry Sergent, Al Krum, “Thermal Management Handbook: For Electronic Assemblies Hardcover”, 1998, Mc Graw- Hill.

ME1758	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the value engineering process and able to identify its functions within the process.
- To determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes.
- To learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle.
- To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing.
- To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT - I VALUE ENGINEERING BASICS **9**

Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis. CO1

UNIT - II VALUE ENGINEERING JOB PLAN AND PROCESS **9**

Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering. CO2

UNIT - III VALUE ENGINEERING TECHNIQUES **9**

Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC) CO3

UNIT - IV WORKSHEETS AND GUIDELINES **9**

Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion. CO4

UNIT - V VERSATILITY OF VALUE ENGINEERING **9**

Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.

CO2 Discuss the product and articulate it in various phases of value engineering

CO3 Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training

CO4 Apply querying theory and FAST to prefect a value engineering project implementation.

CO5 Develop various case studies related to value engineering project implementation.

TEXT BOOKS:

1. Iyer. S.S., "Value Engineering", New Age International (P) Limited, 9th Edition, 2009 3Ed", 2009.
2. Anil Kumar. and Mukhopadhyaya., "Value Engineering: Concepts Techniques and applications", SAGE Publications, 1st Edition, 2003.

REFERENCE BOOKS:

1. Del L. Younker., "Value Engineering: analysis and methodology", CRC Press, 2003.
2. Richard Park., "Value Engineering A Plan for Invention", CRC Press, 1998.
3. Arthur E. Mudge., "Value Engineering :A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'Isola., "Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations", R.S. Means Company, 1997.
5. Lawrence D. Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

ME1861 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT - I ENTREPRENEURSHIP **9**

Entrepreneur-Meaning and Importance - Types of Entrepreneurs - Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. CO1

UNIT - II MOTIVATION **9**

Major Motives Influencing an Entrepreneur - Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test - Stress Management, Entrepreneurship Development Programs - Need, Objectives. CO2

UNIT - III BUSINESS **9**

Small Enterprises - Definition, Classification - Characteristics, Ownership Structures - Project Formulation - Steps involved in setting up a Business - identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies. CO3

UNIT - IV FINANCING AND ACCOUNTING **9**

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation - Income Tax, Excise Duty - Sales Tax. CO4

UNIT - V SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business - Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators - Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion, Diversification, Joint Venture, Merger and Sub Contracting. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Know about the importance of entrepreneurship
CO2 Know about the problems faced and to get motivated
CO3 Know about the types of business and feasibility of the business
CO4 Know about the financial need and all about the income tax and excise duty
CO5 Know about the government policies

TEXT BOOKS:

1. Donald F Kuratko, "Entrepreneurship - Theory, Process and Practice", 9 th Edition, Cengage Learning, 2014.
2. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

REFERENCE BOOKS:

1. EDII "Faulty and External Experts - A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, "Entrepreneurship" 8 th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2 nd Edition, Oxford University Press, 2011.

ME1862 INDUSTRIAL TRIBOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To gain knowledge of topography of various engineering material surfaces in the aspect of friction.
- To understand the various types of wear mechanism, lubrication methods and its theory.
- To gain knowledge on surface engineering theory and bearing materials

UNIT - I SURFACES AND FRICTION **9**

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding friction - Adhesion- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction - Stick slip motion - Measurement of Friction. CO1

UNIT - II WEAR **9**

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements. CO2

UNIT - III LUBRICANTS AND LUBRICATION TYPES **9**

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication. CO3

UNIT - IV FILM LUBRICATION THEORY **9**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram. CO4

UNIT - V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS **9**

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the topography of various engineering material surfaces in the aspect of friction
CO2	Understand the various types of wear mechanism and its measurements for various engineering material
CO3	Understand the lubricants, lubrication types and it testing methods
CO4	Understand the fluid film lubrication theory
CO5	Understand the surface engineering theory and materials used for bearings

TEXT BOOKS:

1. A.Harnoy, " Bearing Design in Machinery "Marcel Dekker Inc, NewYork,2003.

REFERENCE BOOKS:

1. M.M.Khonsari & E.R.Booser, "Applied Tribology", John Willey & Sons, New York, 2001.
2. E.P.Bowden and Tabor.D., "Friction and Lubrication", Heinemann EducationalBooks Ltd., 1974.
3. A.Cameron, "Basic Lubrication theory", Longman, U.K.., 1981.
4. M.J.Neale (Editor), "Tribology Handbook", Newnes. Butter worth, Heinemann, U.K., 1995.

GE1001 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on design, geographical indication (GI), plant variety and layout design protection and their registration aspects
- To aware about enforcement in IPR and government steps in fostering IPR

UNIT - I INTRODUCTION **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad - Genesis and Development - the way from WTO to WIPO - TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations - Important examples of IPR. CO1

UNIT - II REGISTRATION OF IPRs **9**

Meaning and practical aspects of registration of Copyrights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad. CO2

UNIT - III AGREEMENTS AND LEGISLATIONS **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act. CO3

UNIT - IV DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets - IP Laws, Cyber Law and Digital Content Protection - Unfair Competition - Meaning and Relationship between Unfair Competition and IP Laws - Case Studies. CO4

UNIT - V ENFORCEMENT OF IPRs **9**

Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Get an adequate knowledge on patent and copyright for their innovative research works

CO2 Get an idea about the registration process of IPR

CO3 Study various agreements and Acts regarding IPR

CO4 Inculcate the knowledge on innovations, developments and IP laws

CO5 Gain the knowledge on enforcement and current issues

TEXT BOOKS:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2003.
3. Ahuja, V K, Law relating to Intellectual Property Rights. India, Lexis Nexis, 2017

REFERENCE BOOKS:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition,2017.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education,2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

ME1863 LEAN SIX SIGMA

L	T	P	C
3	0	0	3

OBJECTIVES

- To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT - I LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS **9**

Historical Overview - Definition of quality - What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance - Six sigma and cultural changes - six sigma capability - six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing - assessment questions. CO1

UNIT - II THE SCOPE OF TOOLS AND TECHNIQUES **9**

Tools for definition - IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter - Tools for measurement - Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis - Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving - Tools for improvement - Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis - Tools for control - Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management. CO2

UNIT - III SIX SIGMA METHODOLOGIES **9**

Design For Six Sigma (DFSS), Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership - Change Acceleration Process (CAP) - Developing communication plan - Stakeholder. CO3

UNIT - IV SIX SIGMA IMPLEMENTATION AND CHALLENGES **9**

Tools for implementation - Supplier Input Process Output Customer (SIPOC) - Quality Function Deployment or House of Quality (QFD) - alternative approach - implementation - leadership training, close communication system, project selection - project management and team - champion training - customer quality index - challenges - program failure, CPQ vs six sigma, structure the deployment of six sigma - cultural challenge - customer/internal metrics. CO4

UNIT - V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS **9**

Evaluation strategy - the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates - continuous improvement - lean manufacturing - value, customer focus, Perfection, focus on waste, overproduction - waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people - Kaizen - 5S. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of lean and six sigma

CO2 Apply the tools and techniques of process improvement for manufacturing and services processes

CO3 Understand methodologies of six sigma

CO4 Understand and steps of implementing six sigma

CO5 Understand the method of evaluation and improvement process of manufacturing

TEXT BOOKS:

1. Best Practices in Lean Six Sigma Process Improvement Richard Schonberger John Wiley & Sons, Inc. 2008.
2. Lean Six Sigma Statistics Alastair K. Muir, Ph.D. McGraw-Hill 2006.

REFERENCE BOOKS:

1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw - Hill 2003.
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000.
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, Author House, 2004.
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma: A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 20

ME1864 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
- To know the logistics and supply chain management

UNIT - I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control - Types of production - job - batch and continuous - Product development and design - Marketing aspect - Functional aspects - Operational aspect - Durability and dependability aspect aesthetic aspect. Profit consideration - Standardization, Simplification & specialization - Break even analysis-Economics of a new design. CO1

UNIT - II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards. CO2

UNIT - III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning - Extending the original product information-Value analysis - Problems in lack of product planning - Process planning and routing- Prerequisite 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. CO3

UNIT - IV PRODUCTION SCHEDULING **9**

Production Control Systems - Loading and scheduling-Master Scheduling-Scheduling rules - Gantt charts - Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling- Batch production scheduling - Product sequencing - Production Control systems - Periodic batch control-Material requirement planning Kanban - Two bin system Dispatching - Progress reporting and expediting- Manufacturing lead time - Techniques for aligning completion times and due dates. CO4

UNIT - V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory Control - Purpose of holding stock-Effect of demand on inventories - Ordering procedures. Ordering cycle system - Determination of Economic order uantity and economic lot size - ABC analysis - Fundamentals of MRP II and ERP. Definition of Logistics and SCM: Evolution, Scope, Importance - Supply chain stages and decision phases process view of a supply chain - Supply chain flows. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand production systems and their characteristics
CO2 Evaluate MRP and JIT systems against traditional inventory control systems
CO3 Understand basics of variability and its role in the performance of a production system
CO4 Analyze aggregate planning strategies
CO5 Apply forecasting and scheduling techniques to production systems

TEXT BOOKS:

1. James. B.Dilworth, "Operations management -Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2018.
3. Sunil Chopra, Peter Meindl, "Supply Chain Management: Strategy, Planning, and operation", 5th Edition, Pearson Education Limited 2013.

REFERENCE BOOKS:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2017.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007
5. Melynk, Denzler, " Operations management - A value driven approach" Irwin Mcgraw hill
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and Operations Management - Text and cases" 1st Edition, Excel books 2019
9. Martin Christopher "Logistics & Supply Chain Management: Logistics & Supply Chain Management" FT Publishing International, 5th Edition, 2016
10. Heizer, Render & Munson "Principles of Operations Management: Sustainability and Supply Chain Management", 11th Edition Pearson 2020

GE1003 PROFESSIONAL ETHICS IN ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To create awareness on professional ethics and human values.
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

UNIT - I HUMAN VALUES **9**

Morals, values and Ethics - Integrity - Work ethic - Service learning - Civic virtue - Respect for others - Living peacefully - Caring - Sharing - Honesty - Courage - Valuing time - Cooperation - Commitment - Empathy - Self confidence - Character - Spirituality - Introduction to Yoga and meditation for professional excellence and stress management. CO1

UNIT - II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Models of professional roles - Theories about right action - Self-interest - Customs and Religion - Uses of Ethical Theories. CO2

UNIT - III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law. CO3

UNIT - IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination. CO4

UNIT - V GLOBAL ISSUES **9**

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership -Code of Conduct - Corporate Social Responsibility. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Define the dimensions or senses of engineering ethics and describe the various theories of moral development

CO2 Describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies

CO3 Understand significance of safety and risk assessment when developing engineering products

CO4 Understand the social responsibilities and intellectual property rights of engineers

CO5 Understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 4th edition 2017.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 12th edition, 2011.

REFERENCE BOOKS:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 3rd edition, 2008.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Cengage Learning, 6th edition, 2019.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013
6. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011

ME1865 ADVANCED VEHICLE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- 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 VEHICLES **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. CO1

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. CO2

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, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System. CO3

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. CO4

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, Introduction to Cyber-physical system. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Acquire an overview of electric vehicles and their importance in automotive.

CO2 Discuss the characteristics and the selection of traction motor.

CO3 Comprehend the vehicle-to-vehicle and autonomous technology.

CO4 Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.

CO5 Be familiar with on-board diagnostics systems.

TEXT BOOKS:

1. John G Hayes and G AbaasGoodarzi, Electric Powertrain -, 1st Edition, John Wiley & Sons Ltd., 2018
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities,CRC Press, 1st Edition, 2020.

REFERENCE BOOKS:

1. Dominique Paret, Multiplexed Networks for Embedded Systems, John Wiley & Sons Ltd., 2007.
2. Hong Cheng, ―Autonomous Intelligent Vehicles: Theory, Algorithms & Implementation‖, Springer, 2011
3. Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science, Engineering and Technology: Congressional Policies, Practices and Procedures)by Andrew M Wright and Harrison R Scott | 5 September 2012
4. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002
5. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey | 1 September 2011

ME1866	DESIGN CODES AND STANDARDS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the Codes and Standards and Need for them in the Industry
- To know the different sources and the bodies that publish Codes and Standards
- To familiarize the Government Regulations and its applicability
- To familiarize with different codes used in Different Industry
- To familiarize the Codes and Standards used in Process Industry

UNIT - I INTRODUCTION **9**

Introduction to Codes and Standards. What is code? What is Standard? Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices. CO1

UNIT - II CODES **9**

Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes CO2

UNIT - III STANDARDS **9**

Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes. CO3

UNIT - IV REGULATIONS **9**

Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers CO4

UNIT - V DESIGN CODES **9**

Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the need for codes and Standards in Industry.

CO2 Discuss the different codes and standards used in different industry.

CO3 Discuss the sources of different codes and standards and the societies that publish them and how these are evolved

CO4 Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International

CO5 Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry.

TEXT BOOKS:

1. Mechanical Engg. Handbook. ASME. ASTM.API
2. Perrys Chemical Engg Handbook

REFERENCE BOOKS:

1. ASME
2. API
3. ISO, IBR, OISD
4. AWS
5. ISHRAE

ME1867 DESIGN OF PRESSURE VESSELS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the Mathematical knowledge to design pressure vessels and piping
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.
- To learn piping layout and flow diagram.

UNIT - I INTRODUCTION **9**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications CO1

UNIT - II STRESSES IN PRESSURE VESSELS **9**

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels. CO2

UNIT - III DESIGN OF VESSELS **9**

Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design. CO3

UNIT - IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS **9**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading. CO4

UNIT - V PIPING **9**

Introduction – Flow diagram – piping layout and piping stress Analysis. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications

CO2 Analyse stress in pressure vessels

CO3 Design and analysis of pressure vessels.

CO4 Analysis of buckling and fracture analysis in vessels

CO5 Design and analysis piping layout and piping.

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001

REFERENCE BOOKS:

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. | 1 January 2001

ME1868 POWER GENERATION EQUIPMENT DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the power generation equipments types layouts working cycles.
- To learn the fuels, combustion and burning methods of combustion system.
- To study the various boilers and its boilers parts of steam power plant.
- To study the basics of nuclear fuels and reactor classification.
- To study of techno economics and operating cost and safety of power plant.

UNIT - I INTRODUCTION **9**

Introduction to types, layouts and working cycles - Layouts of diesel-electric, hydro-electric, nuclear, gas turbine, steam, cogeneration, MHD and other power plants - Site selection - Reheat and regenerative steam cycles - Binary vapour cycle - Combined cycle - Topping cycle - Power plant instrumentation and control - air flow, furnace pressure, steam temperature control system - Governing system - Steam turbine. CO1

UNIT - II COMBUSTION SYSTEM **9**

Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system - FSSS - Ash handling system. CO2

UNIT - III STEAM POWER PLANT **9**

Steam generators - fire tube, water tube, forced circulation, once through, super charged, super critical, Lamont, Loeffler, Schmide, Hortmen and Velox boilers, Fluidised Bed & Circulated Fluidised Bed boilers - Natural, artificial, balanced and steam jet drafts - Simple problems - Functions of super heaters, economisers, air-heaters, deaerators, feed heaters, air ejectors - Feed pumps - Injectors - Feed water control- Condensers – Jet and surface type - Simple problems - Cooling towers. CO3

UNIT - IV NUCLEAR POWER PLANT **9**

Nuclear power plant - Basics of nuclear fuels - Fission and chain reaction - Reactor classification - Boiling water, pressurised water, homogeneous, gas cooled breeding and metal cooled CO4

UNIT - V TECHNO ECONOMICS OF POWER PLANT **9**

Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the power generation equipments types layouts working cycles.

CO2 Explain the fuels, combustion and burning methods of combustion system.

CO3 Discuss the various boilers and its boilers parts of steam power plant.

CO4 Explain the basics of nuclear fuels and reactor classification.

CO5 Discuss of techno economics and operating cost and safety of power plant.

TEXT BOOKS:

1. Power Plant Engineering - PK Nag
2. A Textbook of Power Plant Engineering - Rajput

REFERENCE BOOKS:

1. Basics of Boiler and HRSG Design - Brad Buecker
2. Steam Plant Operation-Everett B. Woodruff,Herbert B. Lammers,Thomas F. Lammers
3. Nuclear Power Plant Design and Analysis Codes Development Validation and Application 2020 Edition by Jun Wang, Xin Li, Chris Allison, Judy Hohorst , Elsevier
4. A Techno-Economic Analysis of Solar Thermal Power Plant by Malik Monu and Saini R P | 8 November 2012
5. Power Plant Engineering by Dilip Vairagkar | 1 January 2019

OEC103 BASICS OF EMBEDDED SYSTEMS AND IOT

L	T	P	C
3	0	0	3

OBJECTIVES

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IOT

UNIT - I INTRODUCTION TO EMBEDDED SYSTEM DESIGN **9**

Complex systems and microprocessors- Embedded system design process - Design methodologies- Design flows - Requirement Analysis - Specifications-System analysis and architecture design - Quality Assurance techniques- Distributed embedded systems - MPSoCs and shared memory multiprocessors -Design example: Model train controller. CO1

UNIT - II ARM ARCHITECTURE AND PERIPHERAL INTERFACING **9**

ARM Architecture Versions - ARM Architecture - Instruction Set - Stacks and Subroutines - Features of the LPC 214X Family - Peripherals - The Timer Unit - Pulse Width Modulation Unit - UART - Block Diagram of ARM9 and ARM Cortex M3 MCU CO2

UNIT - III EMBEDDED PROGRAMMING **9**

Components for embedded programs- Models of programs - Assembly, linking and loading - compilation techniques - Program level performance analysis - Software performance optimization - Program level energy and power analysis and optimization - Analysis and optimization of program size - Program validation and testing CO3

UNIT - IV INTRODUCTION TO IOT **9**

Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT, Embedded Systems and M2M - Industry 4.0 concepts- Passive and active sensors - Different applications of sensors - Multi-sensors - Pre-processing - IoT front-end hardware Case Studies - Smart Parking, Air Pollution Monitoring. CO4

UNIT - V COMMUNICATION PROTOCOLS FOR EMBEDDED AND IOT **9**

Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C). IoT Infrastructure - 6LowPAN - IPv6 - URIs, Communication/ Transport - Wi-Fi, Bluetooth, ZigBee, LPWAN. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the embedded system design process
CO2 Describe the architecture and programming of ARM processor
CO3 Outline the concepts of embedded system programming
CO4 Explain the basic concepts of IOT
CO5 Model Networked systems with basic protocols

TEXT BOOKS:

1. Marilyn Wolf, Computers as Components - Principles of Embedded Computing System Design‖, Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, IV)
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things, A Hands-on-Approach", 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons", Inc, USA, 2013

REFERENCE BOOKS:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley & Sons Ltd, UK, 2014
2. Peter Waher, "Learning Internet of Things", 1st Edition, Packt Publishing Ltd, UK, 2015.
3. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi", 1st Edition, Apress Publishers, USA, 2013.
4. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017.

OCS102 PROGRAMMING AND DATA STRUCTURES

L	T	P	C
3	0	2	4

OBJECTIVES

- To learn the basics of C programming
- To learn the advanced features of C programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table

UNIT - I C PROGRAMMING BASICS **9**

Structure of C program - Data Types - Storage classes – Variables - Constants - Keywords - Operators - Input/Output statements, Assignment statements - Decision making statements - Switch statement - Looping statements - Introduction to Arrays: Declaration, Initialization - One dimensional array - Two dimensional arrays. CO1

UNIT - II FUNCTIONS, POINTERS AND STRUCTURES **9**

Introduction to functions: Function prototype, function definition, function call, Recursion - Pointers - Pointer operators - Pointer arithmetic - Array of pointers - Parameter passing: Pass by value, Pass by reference. Structure - Nested structures - Pointer and Structures - Array of structures - Self-referential structures - Dynamic memory allocation. CO2

UNIT - III LINEAR DATA STRUCTURES **9**

List - Singly Linked lists - Application of List - Polynomial addition - Linked list implementation of Stacks - Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues - Application of Queue. CO3

UNIT - IV NON-LINEAR DATA STRUCTURES **9**

Trees - Binary Trees - Binary tree representation and traversals - Binary Search Trees - Applications of trees. Graph and its representations - Graph Traversals - Topological Sort - Applications of graphs. CO4

UNIT - V SEARCHING, SORTING AND HASH TABLE **9**

Linear Search - Binary Search. Bubble Sort - Insertion sort - Merge sort - Quick sort - Hashing functions - Hash tables - Introduction to Overflow handling. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Implement basics of C.
CO2 Implement advanced features of C.
CO3 Apply the different linear data structures to problem solutions.
CO4 Implement Tree and Graph data structure.
CO5 Analyse the various sorting, searching algorithms and hash table.

TEXT BOOKS:

1. Reema Thareja, Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

OEE104 ELECTRIC VEHICLE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiarize about the significance of EV than conventional vehicles.
- To understand the concept of hybrid electric vehicles and its types with their performance.
- To understand the EV transmission and electric propulsion using various drives.
- To understand the various converter topologies for EV vehicle.
- To understand the different strategies related to battery technology and energy storage systems.

UNIT - I INTRODUCTION TO CONVENTIONAL AND ELECTRIC VEHICLES **9**

Conventional Vehicles: Internal combustion Engines-working principle, Engine Operation Characteristics, Emission Control. EV vehicles: EV system -configurations of EVs -Components of EV - Recent EVs and HEVs - EVs advantages - EVs market - Environmental Impact. CO1

UNIT - II HYBRID ELECTRIC VEHICLES **9**

Concept of Hybrid Electric drive, Types of Hybrid, Architectures of Hybrid Electric Drive Trains, Design of HEV, Plug-in Hybrid Electric Vehicles (PHEVs), Fuel Cell Electric Vehicles (FCEVs), Comparison of Different Vehicle Specifications CO2

UNIT - III ELECTRIC TRAINS AND PROPULSION 9

EV Transmission configurations, Transmission components, Ideal Gearbox: Steady State Model, EV Motor Sizing. Electric Propulsion: DC motor drives, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives. CO3

UNIT - IV POWER ELECTRONIC CONVERTER TOPOLOGIES FOR EV/PHEV CHARGING 9

Power converter topology, Grid and Photovoltaic (PV) System for EV/PHEV Charging, Design of DC/DC Converters and DC/AC Inverters for Grid/PV, Integrated converter, With and without Transformer Based Isolated Charger topology. CO4

UNIT - V POWER SOURCES AND ENERGY STORAGE 9

Battery Technologies - Analysis: Lead-Acid Battery, Nickel-Based Batteries, Lithium-Based Batteries - Battery parameters, Fuel cell - types and characteristics, Ultra capacitors based energy storage and its analysis, Ultra-High-Speed Flywheels based energy storage and its analysis, Hybridization of energy storage devices. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the significance of electric vehicle compared to conventional vehicles.
CO2 Understand the concept of hybrid electric vehicles architecture with their performance.
CO3 Acquire the knowledge in EV transmission and electric propulsion using various drives train.
CO4 Design the various converter topologies for EV vehicle.
CO5 Analyse different strategies related to battery technology and energy storage systems.

TEXT BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. Iqbal Husain, "Electric and Hybrid vehicles:Design fundamentals", CRC PRESS, Boca Raton London, New York Washington, D.C,2005.

REFERENCE BOOKS:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.
5. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
6. Gregory L.Plett, "Battery Management systems", ARTECH House,London,2016.

OCE103	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on Environmental management and Environmental Impact Assessment.

UNIT - I INTRODUCTION **9**

Impact of development projects - EIA Notifications - Urbanization – Meaning - Activities involved - Effects on environment-Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS). CO1

UNIT - II METHODOLOGIES **9**

Methods of EIA – Checklists - Matrices-Networks - Cost-benefit analysis - Analysis of alternatives - Uncertainty in EIA. CO2

UNIT - III PREDICTION AND ASSESSMENT **9**

Assessment of Impact on land, water, air, social & cultural activities and on flora& Fauna - Mathematical models - Public participation - SIA Judgment authorities - Rapid EIA. CO3

UNIT - IV ENVIRONMENTAL MANAGEMENT PLAN **9**

Plan for mitigation of adverse impact on environment - Options for mitigation of impact on water, air, land and on flora & fauna - Addressing the issues related to the Project Affected People CO4

UNIT - V CASE STUDIES **9**

EIA for infrastructure projects – Dams - Highways- Multi-storey Buildings - Water Supply and Drainage Projects - Waste water treatment plants, STP. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Carry out scoping and screening of developmental projects for environmental and social assessments

CO2 Explain different methodologies for environmental impact prediction and assessment

CO3 Plan environmental impact assessments and environmental management plans

CO4 Evaluate environmental impact assessment reports

CO5 Understand the Membrane Applications.

TEXT BOOKS:

1. Canter,R.L., “Environmental Impact Assessment”, McGraw-Hill Inc., New Delhi,1996.
2. Richard K. Morgan., “Environmental Impact Assessment”, Kluwer Academic Publications, London, 2002.

REFERENCE BOOKS:

1. John G. Rauand David C Hooten (Ed).,“Environmental Impact Analysis Handbook”, McGraw-Hill BookCompany,1990.
2. “Environmental Assessment Sourcebook”, Vol. I, II & III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I & II”, Blackwell Science, 1999.

OCH101	FUNDAMENTALS OF COMBUSTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the student understand the fundamentals of combustion
- To teach them combustion in different regions like basic flame to gas turbine engines to rocket engines and finally how it is done in supersonic speed

UNIT - I INTRODUCTION TO COMBUSTION **9**

Thermo-chemical equations - Heat of formation - Activation energy - Multi-step reactions - Heat of reaction - first order, second order and third order reactions - Calculation of adiabatic flame temperature CO1

UNIT - II BASICS OF CHEMICAL KINETICS AND FLAMES **9**

Premixed flames - Diffusion flames -measurement of burning velocity - various methods - Effect of various parameters on burning velocity - flame stability - Deflagration - Detonation – Rankine - Hugoniot curve - Radiation by flames. CO2

UNIT - III COMBUSTION IN GAS TURBINE ENGINES **9**

Combustion in gas turbine combustion chambers - Recirculation - combustion efficiency, Factors affecting combustion efficiency - Fuels used for gas turbine combustion chambers - combustion stability - Flame holder types. CO3

UNIT - IV COMBUSTION IN ROCKETS **9**

Solid propellant grain types - types of solid propellant burning in rocket combustion chambers - basic mechanism of composite propellant combustion - solid propellant burn rate laws - criterion for stable combustion - combustion in liquid rocket engines - single fuel droplet combustion model - combustion in hybrid rockets. CO4

UNIT - V SUPERSONIC COMBUSTION (Qualitative Treatment only) **9**

Introduction - supersonic combustion controlled by diffusion, mixing and heat convection - Analysis of reactions and mixing processes - supersonic burning with detonation shocks . CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the detailed mechanism of combustion process

CO2 Analyse and impart the chemical kinetics and flames in combustion processes.

CO3 Understand the detailed mechanism of Aerospace Vehicles and Aircraft Engines

CO4 Analyse and impart the combustion processes that occur in Aircraft Engines and Rocket Vehicles.

CO5 Understand the supersonic combustion

TEXT BOOKS:

1. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. D.P. Mishra, Fundamentals of Combustion, Prentice Hall of India, New Delhi, 2008.
3. Kuo K.K., “Principles of Combustion” John Wiley and Sons, 2005.
4. Strehlow R A., “Fundamentals of combustion”, McGraw Hill Book Company, 1984.

REFERENCE BOOKS:

1. Beer, J.M., and Chiierar, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
2. Chowdhury, R., Applied Engineering Thermodynamics, Khanna Publishers, New Delhi, 1986.
3. Loh, W.H.T., “Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design, Springer Verlag, New York, 1982.
4. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.
5. Sutton,G.P., Rocket Propulsion Elements, John Wiley, 1993.

OEE108	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- At the end of the course, the students are expected to identify new methodologies / technologies for effective utilization of renewable energy sources.

UNIT - I ENERGY SCENARIO AND OCEAN ENERGY **9**

Conventional and non-conventional energy resources - Introduction, availability, classification, relative merits and demerits - Role of energy in economic development and social transformation: Energy &GDP, GNP and its dynamics - Energy Sources and Overall Energy demand and Availability - Energy Consumption in various sectors and its changing pattern. CO1

OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT - II BIO-ENERGY **9**

Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas Plants - applications - alcohol production from biomass - bio diesel production - Urban waste to energy conversion - Biomass energy programme in India. CO2

UNIT - III GEOTHERMAL ENERGY AND MHD **9**

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. Thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance, and limitations. Cells: Principle of working of various types of fuel cells and their working, performance, and limitations. CO3

UNIT - IV SOLAR AND WIND ENERGY **9**

Solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant - Net metering concept

Wind energy conversion devices - classification, characteristics, applications - offshore wind energy - Hybrid systems - safety and environmental aspects - wind energy potential and installation in India, horizontal and vertical axis windmills, performance characteristics, Betz criteria. CO4

UNIT - V ENERGY FORECASTING MODEL **9**

Forecasting Techniques - Regression Analysis - Double Moving Average - Double Experimental Smoothing - Triple Exponential Smoothing - ARIMA model - Validation techniques - Qualitative forecasting - Delphi technique - Concept of Neural Net Works. Applications of IoT, AI and Machine learning for energy resources assessment. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the energy scenario and ocean energy.

CO2 Acquire knowledge of biomass energy conversion techniques.

CO3 Understand geothermal energy recovery and principles of MHD, fuel cell.

CO4 Acquire knowledge of solar and wind energy conversion systems.

CO5 Carry out forecasting to predict energy demand

TEXT BOOKS:

1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011.
2. Twidell& Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011.

REFERENCE BOOKS:

1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2011.
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2010.
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2010.
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.

OCS105 DATA ANALYTICS WITH R PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT - I INTRODUCTION TO DATA ANALYSIS **9**

Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics — CO1

UNIT - II R PROGRAMMING BASICS **9**

Overview of R programming, Environment setup with R Studio, R Commands,Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages — CO2

UNIT - III DATA VISUALIZATION USING R **9**

Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.
Working with R Charts and Graphs: Histograms, Box plots, Bar Charts, Line Graphs, Scatter plots, Pie Charts — CO3

UNIT - IV STATISTICS WITH R **9**

Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression — CO4

UNIT - V PRESCRIPTIVE ANALYTICS **9**

Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the basics of data analytics

CO2 Understand and apply the R-Programming concepts

CO3 Apply R-Programming for data visualization

CO4 Implement various classification techniques using R

CO5 Apply R programming to perform perspective analytics on data

TEXT BOOKS:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W.N.Venables, D.M.Smith and the R Development Core Team.
2. URL:https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS:

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R. L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No.1. NewYork: Springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley & Sons, 2010
7. Joseph F Hair,William C Black et al, "Multivariate Data Analysis", Pearson Education,7 th edition, 2013.
8. Mark Gardener,"Beginning R- The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013

OEI104 INTERNET OF THINGS

L	T	P	C
3	0	0	3

OBJECTIVES

- To Understand general concepts of Internet of Things (IoT) (Understand)
- To Recognize various devices, sensors and applications (Knowledge)
- Analyze and Apply design concept to IoT solutions (Apply)
- Evaluate design issues in IoT applications (Evaluate)
- Create IoT solutions using sensors, actuators and Devices (Create)

UNIT - I INTRODUCTION TO IoT **9**

Internet of Things – Physical Design – Logical Design – IoT Enabling Technologies - IoT Levels & Deployment Templates – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF-YANG - IoT Platforms Design Methodology CO1

UNIT - II IoT ARCHITECTURE **9**

M2M high-level ETSI architecture – IETF architecture for IoT- OGC architecture - IoT reference model – Domain model – information model – functional model - Communication model – IoT reference architecture CO2

UNIT - III IoT PROTOCOLS **9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4– BAC Net Protocol – Modbus – Zigbee Architecture – Network layer – 6 Low PAN –CoAP – Security CO3

UNIT - IV BUILDING IoT WITH RASPBERRY PI & ARDUINO **9**

Building IOT with RASPERRY PI – IoT Systems – Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device - Building blocks - Raspberry Pi -Board - Linux on Raspberry Pi – Raspberry Pi Interfaces – Programming Raspberry Pi with Python - Other IoT Platforms - Arduino. CO4

UNIT - V CASESTUDIES AND REAL WORLD APPLICATIONS **9**

Real world design constraints – Applications – Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs–Cloud for IoT – Amazon Web Services for IoT. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Analyze various protocols for IoT

CO2 Develop web services to access/control IoT devices.

CO3 Design a portable IoT using Rasperry Pi

CO4 Deploy an IoT application and connect to the cloud.

CO5 Analyze applications of IoT in real time scenario statistics

TEXT BOOKS:

1. Arshdeep Bahga,Vijay Madisetti,―Internet of Things – A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds),―Architecting the Internet of Things, Springer, 2011.

REFERENCE BOOKS:

1. Honbo Zhou,―The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
2. Jan Höller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi,―The Internet of Things – Key applications and Protocols, Wiley, 2012.

OCS108 INTRODUCTION TO PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the fundamentals of python programming.
- To learn control structures in python.
- To decompose programs in Python into functions and use Strings.
- To construct programs in Collection classes.
- To develop python programs using files and exception handling.

UNIT – I INTRODUCTION TO PYTHON PROGRAMMING **9**

Introduction to Python, Demo of Interactive and script mode, Tokens in Python – Variables, Keywords, Comments, Literals, Data types, Indentation, Operators and its precedence, Expressions, Input and Print functions, Type Casting. CO1

UNIT – II CONTROL STRUCTURES **9**

Control Structures: Selective statements – if, if-else, nested if, if – elif ladder statements; Iterative statements - while, for, range functions, nested loops, else in loops, break, continue and pass statements. CO2

UNIT – III FUNCTIONS AND STRINGS **9**

Functions: function definition, function call, flow of execution, parameters and arguments, return values, local and global scope, recursion and Lambda functions. CO3
Strings: string slices, immutability, string functions and methods, string module. Regular expression: Matching the patterns, Search and replace.

UNIT – IV COLLECTIONS **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, nested lists, list comprehension; Tuples: tuple assignment, tuple as return value, tuple operations. Dictionary: Create, add, and replace values, operations on dictionaries. Sets: Create and operations on set. CO4

UNIT – V FILES AND EXCEPTION HANDLING **9**

Files: Open, Read, Write, Append and Close. Tell and seek methods. Illustrative programs: word count, copy file. CO5
Command line arguments, Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, Exception Chaining, User-defined Exceptions, Defining Clean-Up actions.

TOTAL PERIODS: 45

TEXT BOOKS

1. Allen B. Downey, –Think Python: How to Think Like a Computer Scientist , 2nd Edition, Updated for Python 3, Shroff/O Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr,—An Introduction to Python –Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, **I**ntroduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem – Solving Focus,Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction.

COURSEOUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple console application in python.

CO2 Develop and execute simple Python programs using conditionals and loops for solving problems.

CO3 Express proficiency in the handling of strings and functions

CO4 Represent compound data using python lists, tuples and dictionaries.

CO5 Read and write data from/to files in Python.

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on the principle and design of particulate/gaseous air pollutant and its emerging trends.
- To acquaint the students with the basics of selection of control equipment.
- To learn about indoor air quality control.

UNIT - I AIR QUALITY MONITORING **9**

Structure and composition of Atmosphere - Definition, Scope and Scales of Air Pollution - Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility - Ambient Air Quality and Emission standards - Composition of Particulate and Gaseous Pollutants. CO1

UNIT - II EFFECT OF ATMOSPHERIC DISPERSION **9**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns - Atmospheric Diffusion Theories - Dispersion models, Plume rise CO2

UNIT - III PARTICULATE CONTAMINANTS **9**

Gas Particle Interaction - Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators - Operational Considerations - Factors affecting Selection of Control Equipment. CO3

UNIT - IV GASEOUS CONTAMINANTS **9**

Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters - Process control and Monitoring - Operational Considerations - Factors affecting Selection of Control Equipment -CO2 capturing. CO4

UNIT - V INDOOR AIR QUALITY MONITORING **9**

Sources, types and control of indoor air pollutants, sick building syndrome types - Sources and Effects of Noise Pollution- Standards - Control and Preventive measures. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the chemistry of the atmosphere, characterize the air pollutants, know the effects of air pollution, identify the criteria air pollutants, and know about NAAQS

CO2 Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and the Gaussian plume dispersion model

CO3 Select a suitable method and design the particulate pollutant control equipment

CO4 Select appropriate method for control of gaseous pollutant by due consideration of sources of emission

CO5 Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
3. Anjaneyulu. Y, “Air Pollution and Control Technologies”, Allied Publishers (P) Ltd., India 2002.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C.Stern, "Air Pollution (Vol.I - Vol. VIII)" , Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc., 2000.

OCS104 FUNDAMENTALS OF DATABASE DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of transaction processing and concurrency
- To have an basic knowledge about the storage implementation and query processing
- To understand database security concepts and database programming

UNIT - I INTRODUCTION **10**

Purpose of Database System - Views of data - Data Models - Database System Architecture - Introduction to relational databases - Relational Model - Keys - Relational Algebra - SQL fundamentals - DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL – Static Vs Dynamic SQL — CO1

UNIT - II DATABASE DESIGN **10**

Entity-Relationship model - E-R Diagrams - Enhanced-ER Model - ER-to-Relational Mapping - Functional Dependencies - Non-loss Decomposition - First, Second, Third Normal Forms, Dependency Preservation - Boyce/Codd Normal Form - Multi-valued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form — CO2

UNIT - III TRANSACTION CONCEPTS AND CONCURRENCY CONTROL **7**

Introduction-Properties of Transaction - Serializability- Concurrency Control - Locking Mechanisms- Two Phase Locking - Two Phase Commit Protocol - Dead lock - SQL Facilities for Concurrency and Recovery — CO3

UNIT - IV IMPLEMENTATION TECHNIQUES **9**

RAID - File Organization - Organization of Records in Files - Indexing and Hashing -Ordered Indices - B+ tree Index Files - B tree Index Files - Static Hashing - Dynamic Hashing - Query Processing Overview - Query optimization using Heuristics and Cost Estimation. — CO4

UNIT - V ADVANCED TOPICS AND DATABASE PROGRAMMING **9**

security issues - Discretionary access control - role based access - Encryption and public key infrastructures - challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL/Oracle. ODBC/JDBC connectivity with front end tools — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand relational data model, evolve conceptual model of a given problem and SQL

CO2 Understand relational model and normalization to perform database design effectively

CO3 Apply and relate the concept of transaction, concurrency control and recovery in database

CO4 Understand the implementation technique and query processing

CO5 Understand the concepts of database security and database programming

TEXT BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications.

OCS103 INTRODUCTION TO CLOUD COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
- To have knowledge on the various virtualization techniques that serve in computation. and storage services on the cloud.
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT - I INTRODUCTION **9**

Introduction to Cloud Computing - Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing - Challenges and Risks of Cloud Computing — CO1

UNIT - II VIRTUALIZATION **9**

Introduction to Virtualization Technology - Load Balancing and Virtualization - Understanding Hypervisor and its types, Types of Virtualizations - Hardware, OS, Memory, Application Virtualization, Levels of Virtualization — CO2

UNIT - III CLOUD ARCHITECTURE, SERVICES AND STORAGE **9**

NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges - Deployment models of cloud, Services of cloud - Cloud Storage. — CO3

UNIT - IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD **9**

Inter Cloud Resource Management - Resource Provisioning Methods - Security Overview - Cloud Security Architecture-Cloud Security Challenges - Data Security - Application Security - Virtual Machine Security. — CO4

UNIT - V CASE STUDIES **9**

Google App Engine (GAE) - GAE Architecture - Functional Modules of GAE - Amazon Web Services (AWS) - GAE Applications - Cloud Software Environments - Bio-data Platform & Bio Cloud — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

CO2 Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing

CO3 Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

CO4 Enlighten the core issues of cloud computing such as security, privacy, and interoperability.

CO5 Be familiarization with areas of cloud technologies and working experience in several of them

TEXT BOOKS:

3. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
4. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.

REFERENCE BOOKS:

6. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
7. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata Mcgraw Hill, 2009.
8. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

OEI102 ROBOTICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the functions of the basic components of a Robot
- To study the use of various drive systems and types of End Effectors
- To gain knowledge on the types of sensors and machine vision
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics

UNIT - I FUNDAMENTALS OF ROBOT **9**

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Payload - Robot Parts and their Functions - Need for Robots - Different Applications CO1

UNIT - II ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives - D.C. Servo Motors, Stepper Motors, A.C. Servo Motors - Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Selection and Design Considerations CO2

UNIT - III SENSORS AND MACHINE VISION **9**

Requirements of a sensor, Principles and Applications of the following types of sensors - Position sensors - Piezoelectric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, CO3

Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data - Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis - Data Reduction, Segmentation, Feature Extraction, Object recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

UNIT - IV ROBOT KINEMATICS AND ROBOT PROGRAMMING **9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End Effector commands and simple Programs. CO4

UNIT - V IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the functions of the basic components of a Robot.

CO2 Study the different types of drive system and various types of End Effectors

CO3 Understand the working of sensors and machine vision system

CO4 Familiarize with the kinematics motions of robots and to develop robotic programs for different tasks.

CO5 Examine the implementation of robots in various industrial sectors and economic analysis of Robots

TEXT BOOKS:

1. Groover M.P., Industrial Robotics -Technology, Programming and Applications‖, McGraw Hill Education, 2017.
2. Klafter R.D., Chmielewski T.A and Negin M., Robotic Engineering - An Integrated Approach‖, Prentice Hall, 2003.

REFERENCE BOOKS:

1. Deb S.R., Robotics Technology and Flexible Automation‖ Tata McGraw Hill Book Co., 2013.
2. Ray Asfahl. C., Robots and Manufacturing Automation‖, John Wiley & Sons Inc., 1985.
3. Janakiraman P.A., Robotics and Image Processing‖, Tata McGraw Hill, 1995.

OEI101 SENSORS AND TRANSDUCERS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

UNIT - I INTRODUCTION TO SENSOR-BASED MEASUREMENT SYSTEMS 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 Output Signal Types CO1

UNIT - II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors - Potentiometers, Resolver, Encoders - Optical, Magnetic, Inductive, Capacitive, LVDT - RVDT - Synchro - Microsyn, Accelerometer - GPS, Bluetooth, Range Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). CO2

UNIT - III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage, Load Cell, Magnetic Sensors - types, principle, requirement and advantages: Magneto resistive - Hall Effect - Current sensor Heading Sensors - Compass, Gyroscope, Inclinometers. CO3

UNIT - IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR - Fiber optic sensors - Pressure - Diaphragm, Bellows, Piezoelectric - Tactile sensors, Temperature - IC Sensor, Thermistor, RTD, Thermocouple. Acoustic Sensors - flow and level measurement, Radiation Sensors - Introduction to Smart Sensors - Film (Thin and thick film) sensor, MEMS & Nano mechanical Sensors, LASER sensors, Environmental (Air and water quality) monitoring sensors. CO4

UNIT - V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification - Filtering - Sample and Hold circuits - Data Acquisition: Single channel and multi channel data acquisition - Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Structural health monitoring CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Expertise in various calibration techniques and signal types for sensors.

CO2 Apply the proximity and ranging sensors in the automotive and mechatronics applications.

CO3 Understand the principles of various magnetic and heading sensors.

CO4 Understand the functioning of optical, pressure, temperature and smart sensors.

CO5 Implement the DAQ systems with different sensors for real time applications.

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems - Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawhney A K and Puneet Sawhney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

OEE107	SOLAR AND WIND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand types and applications of various form of energy sources and its environmental impacts
- To attain a broad comprehension of solar photovoltaic systems used for various applications.
- To understand and estimate performance of wind turbine

UNIT - I INTRODUCTION OF SOLAR ENERGY **9**

Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors - solar thermal applications - heating, cooling, desalination, drying, cooking, etc - solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells — CO1

UNIT - II SOLAR PHOTOVOLTAIC TECHNOLOGY **9**

Photovoltaic basics - structure and working of solar cells - types, electrical properties and behaviour of solar cells - cell properties and design, stand alone PV systems - schematics, components, batteries, charge conditioners, grid connected PV systems - schematics, components, charge conditioners, interface components, hybrid systems - solar, biomass, wind, diesel hybrid systems, design of PV systems - radiation and load data, simple case studies. — CO2

UNIT - III PHOTOVOLTAIC APPLICATIONS **9**

Battery charger, domestic lighting, street lighting, water pumping etc - Solar PV power plant - Net metering concept. National / International PV Power Programmes - Photovoltaic Power Systems - System Integration - Energy Storage - Power Electronics - Stand-Alone Systems - Grid-Connected Systems - Concentrating Photovoltaics (CPV) - Electrical Performance. Applications of IoT and Machine learning for SPV applications. — CO3

UNIT - IV WIND ENERGY **9**

Nature of the wind - power in the wind - factors influencing wind - wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications - offshore wind energy - Hybrid systems - safety and environmental aspects - wind energy potential and installation in India - Repowering concept. — CO4

UNIT - V AERODYNAMICS AND PERFORMANCE OF WIND TURBINE **9**

Horizontal Axis Wind Turbine (HAWT) & Vertical Axis Wind Turbine (VAWT), Power Developed, Maximum power coefficient (Betz Limit), Thrust, Efficiency, Rotor selection Rotor design considerations, Diameter of the Rotor. Aerodynamic design principles, Blade Profile, Blade Element Theory, Choice of the number of blades, Choice of the Pitch angle, Tip speed ratio, Power speed characteristics, Torque speed characteristics, Solidity. Applications of IoT and Machine learning for wind turbines performance assessment. — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the basics of solar energy and its measurements applications

CO2 Understand the fundamentals of solar photovoltaic technology and design different SPV systems

CO3 Understand the application of solar photovoltaic technologies

CO4 Understand the wind resource assessment and conversion systems

CO5 Analyse wind turbine performance with regard to aerodynamics

TEXT BOOKS:

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984
2. Twidell& Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011 G.D. , "Non-Conventional Energy Sources",

REFERENCE BOOKS:

1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2011
3. Ramesh R & Kumar K.U , "Renewable Energy Technologies", Narosa Publishing House, 2010
4. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2010
5. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.

OEE102 DRONE TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT - I INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability — CO1

UNIT - II DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection. — CO2

UNIT - III DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications — CO3

UNIT - IV DRONE COMMERCIAL APPLICATIONS **9**

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing — CO4

UNIT - V FUTURE DRONES AND SAFETY **9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Know about a various type of drone technology, drone fabrication and programming.

CO2 Execute the suitable operating procedures for functioning a drone

CO3 Select appropriate sensors and actuators for Drones

CO4 Develop a drone mechanism for specific applications

CO5 Create the programs for various drones

TEXT BOOKS:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCE BOOKS:

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

OCS107	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and 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. CO1

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. CO2

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 CO3

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 CO4

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 CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand basic machine learning techniques such as regression, classification

CO2 Understand about clustering and segmentation

CO3 Model a fuzzy logic system with fuzzification and defuzzification

CO4 Understand the concepts of neural networks and neuro fuzzy networks.

CO5 Gain knowledge on Reinforcement learning.

TEXT BOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011

REFERENCE BOOKS:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer
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", 4th Edition, Chichester, 2011, Sussex Wiley.

AD1001 CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT - I INTRODUCTION **9**

History of Making of the Indian Constitution - Drafting Committee - (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features CO1

UNIT - II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies Directive Principles of State Policy - Fundamental Duties CO2

UNIT - III ORGANS OF GOVERNANCE **9**

Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions CO3

UNIT - IV EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency CO4

UNIT - V LOCAL ADMINISTRATION **9**

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 - CEO Zila Pachayat - Position and role-Block leve - lOrganizational Hierarchy (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand history and philosophy of Indian Constitution.

CO2 Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

CO3 Understand powers and functions of Indian government.

CO4 Understand emergency rule.

CO5 Understand structure and functions of local administration.

TEXT BOOKS:

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

AD1002 VALUE EDUCATION

L	T	P	C
2	0	0	0

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

UNIT - I INTRODUCTION TO VALUE EDUCATION **9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgments CO1

UNIT - II IMPORTANCE OF VALUES **9**

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline CO2

UNIT - III INFLUENCE OF VALUE EDUCATION **9**

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth. CO3

UNIT - IV REINCARNATION THROUGH VALUE EDUCATION **9**

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence - Holy books vs Blind faith, Self-management and Good health, Science of reincarnation CO4

UNIT - V VALUE EDUCATION IN SOCIAL EMPOWERMENT **9**

Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Gain knowledge of self-development

CO2 Learn the importance of Human values

CO3 Develop the overall personality through value education

CO4 Overcome the self-destructive habits with value education

CO5 Interpret social empowerment with value education

TEXT BOOKS:

1. Chakroborty , S.K. "Values and Ethics for Organizations Theory and Practice", Oxford University Press, New Delhi

AD1003 PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT - I INTRODUCTION AND METHODOLOGY **9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and searching. CO1

UNIT - II THEMATIC OVERVIEW **9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education. CO2

UNIT - III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **9**

Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies. CO3

UNIT - IV PROFESSIONAL DEVELOPMENT **9**

Professional development: alignment with classroom practices and follow up support - Peersupport - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes CO4

UNIT - V RESEARCH GAPS AND FUTURE DIRECTIONS **9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the methodology of pedagogy

CO2 Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.

CO3 Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

CO4 Know the factors necessary for professional development.

CO5 Identify the Research gaps in pedagogy.

TEXT BOOKS:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD1004 STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT - I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog.(Ashtanga) CO1

UNIT - II YAM **9**

Do`s and Don’ts in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan CO2

UNIT - III NIYAM **9**

Do `s and Don'ts in life. Ahinsa, satya, astheya, bramhacharya and aparigraha CO3

UNIT - IV ASAN **9**

Various yog poses and their benefits for mind & body CO4

UNIT - V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop healthy mind in a healthy body thus improving social health also improve efficiency

CO2 Learn Do's and Don't's in life through Yam

CO3 Learn Do's and Don't's in life through Niyam

CO4 Develop a healthy mind and body through Yog Asans

CO5 Learn breathing techniques through Pranayam

TEXT BOOKS:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

AD1005 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT - I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses - 19,20,21,22 (wisdom) – Verses - 29,31,32 (pride & heroism) – Verses - 26,28,63,65 (virtue) CO1

UNIT - II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY – II **9**

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) CO2

UNIT - III ORGANS OF GOVERNANCE **9**

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48 CO3

UNIT - IV EMERGENCY PROVISIONS **9**

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 CO4

UNIT - V LOCAL ADMINISTRATION **9**

Chapter 2 - Verses 17, Chapter 3 - Verses 36, 37, 42 - Chapter 4 - Verses 18, 38, 39 Chapter18 - Verses 37, 38, 63 CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop basic personality skills holistically

CO2 Develop deep personality skills holistically to achieve happy goals

CO3 Rewrite the responsibilities

CO4 Reframe a person with stable mind, pleasing personality and determination

CO5 Awaken wisdom in students

TEXTBOOKS:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringarvairagya, New Delhi, 2010
2. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN **9**

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. CO1

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT - II RURAL ECONOMY AND LIVELIHOOD **9**

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . CO2

Assignment**:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT - III RURAL INSTITUTIONS **9**

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. CO3

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT - IV RURAL DEVELOPMENT PROGRAMMES **9**

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

CO4

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.

UNIT - V FIELD WORK **9**

Each student selects one programme for field visit Field based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools I mid-day meal centres, study academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation

CO5

- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings, and interview school drop outs
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Able to understand of rural life, culture and social realities

CO2 Able to understand the concept of measurement by comparison or balance of parameters.

CO3 Able to develop a sense of empathy and bonds of mutuality with local community

CO4 Able to appreciate significant contributions of local communities to Indian society and economy

CO5 Learn to value the local knowledge and wisdom of the community

TEXT BOOKS:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS:

1. P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

The course will introduce the students to

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT - I INTRODUCTION TO CULTURE **9**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India — CO1

UNIT - II INDIAN LANGUAGES AND LITERATURE **9**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature — CO2

UNIT - III RELIGION AND PHILOSOPHY **9**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only) — CO3

UNIT - IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) **9**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India — CO4

UNIT - V EDUCATION SYSTEM IN INDIA **9**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Scienceand Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India — CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand philosophy of Indian culture.

CO2 Distinguish the Indian languages and literature.

CO3 Learn the philosophy of ancient, medieval and modern India.

CO4 Acquire the information about the fine arts in India.

CO5 Know the contribution of scientists of different eras.

TEXT BOOKS:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014.

AD1008 SANGA TAMIL LITERATURE APPRECIATION

L	T	P	C
2	0	0	0

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and'Purathinai' in Sanga Tamil Literature.
- 'Attruppadai' in Sanga Tamil Literature.
- 'Puranaanuru' in Sanga Tamil Literature.
- 'Pathitrupaththu' in Sanga Tamil Literature.

UNIT - I SANGA TAMIL LITERATURE – AN INTRODUCTION **9**

Introduction to Tamil Sangam - History of Tamil Three Sangams - Introduction to Tamil Sangam Literature - Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar Tamil Sangam Literature's parables. CO1

UNIT - II 'AGATHINAI'AND'PURATHINAI' **9**

Tholkappiyar's Meaningful Verses - Three literature materials - Agathinai's message - History of culture from Agathinai – Purathinai - Classification - Message to Society from Purathinai. CO2

UNIT - III 'ATTRUPPADAI' **9**

Attruppadai Literature – Attruppadaiin 'Puranaanuru' – Attruppadaiin 'Pathitrupaththu' - Attruppadaiin 'Paththupaattu'. CO3

UNIT - IV 'PURANAANURU' **9**

Puranaanuru on Good Administration, Ruler and Subjects - Emotion & its Effect in Puranaanuru. CO4

UNIT - V 'PATHITRUPATHTHU' **9**

Pathitrupaththuin 'Ettuthogai' - Pathitrupaththu's Parables - Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2 Differentiate 'Agathinai' and 'Purathinai'in their personal and societal life.
CO3 Appreciate and apply the messages in' Attruppadai' in their personal and societal life.
CO4 Appreciate and apply the messages in' Puranaanuru' in their personal and societal life.
CO5 Appreciate and apply the messages in' Pathitrupaththu' in their personal and societal life.

TEXT BOOKS:

1. Sivaraja Pillai, The Chronology of the Early Tamils, Sagwan Press, 2018.
2. Hank Heifetz and George L. Hart, The Purananuru, Penguin Books, 2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. George L. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press, 2015.
5. Xavier S. Thani Nayagam, Landscape and poetry: A Study of Nature in Classical Tamil Poetry, Asia Pub. House, 1967.

MV0001	3D PRINTING	L	T	P	C
		1	0	2	2

OBJECTIVES

- To broaden and deepen the principle methods, capabilities in analytical and experimental research methods in rapid prototyping and its applications.
- To be familiar with characteristics of different materials used in additive manufacturing.

UNIT - I INTRODUCTION 5

Need for the compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems, Materials for Additive Manufacturing Technology, Data Processing for additive manufacturing technology: CAD model preparation – Part orientation and support generation – Model Slicing – Tool path Generation – Software for Additive Manufacturing Technology: MIMICS, MAGICS – Benefits.

UNIT - II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Stereolithography Apparatus, Fused deposition modeling, Laminated object manufacturing: Working principles, details of processes, products, materials, advantages, limitations and applications – Case studies

UNIT - III POWDER BASED RAPID PROTOTYPING SYSTEMS 10

Selective Laser Sintering, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

UNIT - IV RAPID MANUFACTURING PROCESS OPTIMIZATION 10

Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

UNIT - V MEDICAL AND BIO – ADDITIVE MANUFACTURING 10

Customized implants and prosthesis: Design and production, Bio-Additive Manufacturing – Computer Aided Tissue Engineering (CATE) – Case studies.

TOTAL PERIODS: 45

COURSE OUTCOME

Upon completion of the course, students will be able to

Understand the principle methods, area of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies

REFERENCE BOOKS

1. Pham D T and Dimov S S, "Rapid MANUFACTURING", Verlag, 2001.
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, Lioy W. Liou, Frank W. Liou, CRC Press, 2007.
3. Rapid Prototyping: Theory and Practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
4. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.

MV0002 ENTREPRENEURSHIP IN SOLAR PV TECHNOLOGY

L	T	P	C
1	0	2	2

OBJECTIVES

- Understanding the design and installation of solar PV systems for residential, industrial, commercial, and agricultural locations.
- To comprehend the design of on-grid, off-grid, and hybrid solar PV systems
- Government regulations and procedures for startups to comply with the Ministry of Corporate Affairs in the Solar PV sector.

UNIT - I SOLAR PV DESIGN AND INSTALLATION COMPONENTS 9

Renewable and Non-Renewable Energy Sources, Electricity Fundamentals, Overview of Solar Photovoltaic Cells- Building Blocks -Types-Modules- and Array Configuration-Imaging Objects-Tracking Device, Invertors-On Grid- Off Grid-Single Phase-Three Phase and Balance of Components

UNIT - II SOLAR PV SYSTEM DESIGN TECHNIQUES 9

Solar PV system Design Software for Solar system design, Irradiance, PV design and Orientation, Performance, Simulation, Tilting, Tracking, Shadow Effects, Load Calculation and Analysis. TNEB tariff calculation-Introduction to concentrated PV Cell

UNIT - III SOLAR PANEL MOUNTING STRUCTURE 9

Essential of Structures, Structure Materials- Aluminum –MS, GI, SS. Module Mounting Structures and Types for Different Roof, Ground-mounted and Vehicle-mounted PV Systems. Safety Measures, Types of Solar Batteries and Inverters, Grid Tie Connection Procedures in Tamil Nadu.

UNIT - IV APPLICATIONS OF SOLAR PV SYSTEM 9

Design and Development of Charge Controller, DC to AC converter, Solar Study Lamp, Arduino based Sun Tracking PV System, Design of Solar powered Mobile Charger, Solar Water Pumping System, Solar Street Light, Solar PV Plant Design for Industry, Simulation of Solar PV cell.

UNIT - V DESIGN OF SOLAR PV PLANT FOR INDUSTRIAL APPLICATIONS 9

Concept, Functions and Importance, Educational Impact, Entrepreneurship Schemes for Students and Startups, Startup India, How to Start a Company, Funding Schemes, Business Opportunity: Identification, Evaluation and Selection.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Design and development of fundamental solar PV components
- Design techniques for solar PV technology
- Design and development of solar panel mounting structures
- Categorical application of solar PV technology
- Design and development of solar PV technology for industrial applications

TEXT BOOKS

1. Handbook for Solar Photovoltaic (PV) Systems, "Installation, Operation & Maintenance of Solar PV Microgrid Systems", A Handbook for Trainers.
2. Photovoltaic Systems Analysis and Design", A.K. Mukherjee and Nivedita Thakur

REFERENCE BOOKS

1. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers Kindle Edition by Chetan Singh Solanki
2. Design and Installation of a Grid-Connected PV System" John Christer Sivertsen Petter Soyland

MV0003 ELECTRICAL HARNESS AND ROUTING DESIGN FOR ELECTRIC VEHICLES

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OBJECTIVES

- Create and modify aerodynamic surfaces
- Create electrical parts and layout design
- Proficiency in electrical harness installation and flattening.

UNIT - I 3D MODELLING FUNDAMENTAL FOR ELECTRICAL HARNESS DESIGN 9

Sketcher Mode and Orientation, Sketch workbench Tool bars are Profile, Operation, Constraint. Pad, Pocket, Shaft, Groove, Hole, Chamfer, Round, Stiffener, Shell, Mirror, Pattern, Rib, slot, Multi Section Solid, Removed Multi Section Solid, Point, Line and Plane.

UNIT - II ASSEMBLY & DRAFTING FUNDAMENTAL FOR ELEC HARNESS DESIGN 9

Insert Component, Manipulation, Snapping, checking degree of freedom, Fix Constraints, Coincidence, Contact, Offset, Angular, Fix Together, Quick Constraint, Change Constraint, Reuse Pattern, Replace Component, Fast Multi Instant, Define Multi Instant, New Part Creation and New Product Creation, Introduction to Drafting, New Sheet Creation, Sheet Properties, View Creation, Dimension creation, Dimension Properties, Text Creation, Table Creation and Balloon Creation

UNIT - III WIREFRAME AND SURFACE DESIGNFUNDAMENTALS 9

Extrude, Revolve, Sphere, Cylinder, Offset, Multi Section Surface, Sweep, Blend, Join, Healing, Untrim, Disassemble, Split, Trim, Boundary, Extract, Extrapolate, Project, intersect, Circle, and Spline.

UNIT - IV CONVERSION - MECHANICAL PARTS TO ELECTRICAL COMPONENTS 9

Electrical Device Definition Define Mounting equipment, Define Equipment, Define shell, Define Connector, Define Contact, Define Back Shell, Define Filler Plug Define Support Part, and Define protection part. Electrical Device Connection Point Definition Define Cavity, Define Termination, Define Connector Connection Point, Define Bundle Connection Point, Define Connector Connection Point, Define Back Shell Connection Point, Define Shell Connection Point and Define Cavity Connection point, Connect Electrical Device and Disconnect Electrical Device.

UNIT - V ELECTRICAL LAYOUT DESIGN (INSTALLATION & FLATTENING) 9

Geometrical Bundle, Multibranchable Document, Local Slack, and Protective Covering. Management Link, Unlink, Add Support, Remove Support, Add Branch Point, Remove Branch Point, and Delete Special—introduction to electrical harness flattening Flatten Harness Flattening Parameters, Extract and Flatten. Manipulator Arrange Junction Umbrella Like, arrange junction Equal Angle, Rotate, Bend, Quick Roll, Roll, Scale, and Straighten

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Proficiency in 3D modeling design and development for wire harness design
- Proficiency in assembly and drafting modules for wire harness design
- Proficiency in wireframe and surface modeling design for wire harness design
- Assemblage of mechanical and electrical components for wire harness design
- Design and development of electrical layout design for wire harness design

TEXT BOOKS

1. CATIA V5 for Designers by Sham Tickoo
2. Mastering Automotive Wiring Harness in CATIA V5 - Abdellatif M. Sadeq Qatar Naval Academy

REFERENCE BOOKS

1. IBM Product Lifecycle Management, “CATIA V5 Electrical Wire Harness Design and Manufacturing”, https://public.dhe.ibm.com/solutions/plm/doc/content/bin/plm_05-PLM-001610_P2_Electrical_flyer_LR.pdf
2. Wichita State University, “CATIA Electrical Harness Design” ,/Electrical-Harness-Design-R30.pdf