SETHU INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

VIRUDHUNAGAR

Estd : 1995

Approved by AICTE, New Delhi
Affiliated to Anna University

DEPARTMENT OF MECHANICAL ENGINEERING

REGULATION 2019

CURRICULA AND SYLLABI

SETHU INSTITUTE OF TECHNOLOGY
(An Autonomous Institution)

Pulloor, Kariapatti, Virudhunagar (Dist.) -Pin: 626 115.

Department of Mechanical Engineering

(Accredited by NBA, New Delhi and NAAC with 'A' Grade)

(Approved Research Centre by Anna University, Chennai)

REGULATION 2019

Choice Based Credit System

CURRICULUM AND SYLLABUS

(Ist Semester To VIIIth Semester)

After Academic Council Meeting – 14.05.2022

CHAIRPERSON

BOARD OF STUDIES

Chairperson
Board of Studies
Mechanical Engineering
Sethu Institute of Technology
Kariapatti - 626 115

CHAIRMAN

ACADEMIC COUNCIL

SETHU INSTITUTE OF TECHNOLOGY
(An Autonomous Institution)

Pulloor, Kariapatti, Virudhunagar (Dist.) -Pin: 626 115.

Department of Mechanical Engineering

(Accredited by NBA, New Delhi and NAAC with 'A' Grade)

(Approved Research Centre by Anna University, Chennai)

Department Vision statement

- To promote excellence in education and research in mechanical engineering for the benefits of industry and society.

Department Mission Statement

1. To provide quality technical educational experience to enable the graduates to become leaders in their chosen profession.
2. To educate through modern teaching tools and experiential learning to produce proficient engineer.
3. To develop skills in recent technological trends and design software and to facilitate various co-curricular activities to enhance employability and entrepreneurship.
4. To establish collaboration with industries for transfer of technical knowledge.
5. To promote research activities among faculty members and students.
6. To offer beneficial services to the society.

Program Educational Objectives (PEOs)

After few years of graduation our Mechanical Engineering graduates are expected to:	
PEO I (Core Competency)	Develop technical competency to become professionals with expertise in core areas of mechanical engineering.
PEO II (Life Long Learning)	Practice Life Long Learning to solve real time problems and for career development.
PEO III (Professional and Ethical Skills)	Develop professional skills to meet the global standards with ethical and social responsibility.

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

PROGRAM SPECIFIC OUTCOMES (PSO's)	
PSO 1	Design, model and analyse mechanical systems and components using computer aided technologies.
PSO 2	Formulate, analyze and provide the solution to thermal engineering related problems with regards to environment and society.
PSO 3	Acquire the profession in industries through the intellectual knowledge of mechanical engineering and team work.

SETHU INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Pulloor, Kariapatti

Department of Mechanical Engineering

REGULATION 2019

Choice Based Credit System

Sl.No	Category	Credits	R2019 % of Credit Distribution
1.	Humanities and social science	9.5	5.3
2.	Basic Sciences	24.5	13.7
3.	Engineering Science	28.5	15.9
4.	Professional Core	71.5	40.0
5.	Project	15	8.4
6.	Professional Electives	18	10.0
7.	Open Electives	12	6.7
Total		**179**	**100**

S.No	Semester	Credits
1.	Semester – I	23
2.	Semester – II	20.5
3.	Semester – III	24
4.	Semester – IV	23
5.	Semester – V	25
6.	Semester – VI	28.5
7.	Semester – VII	21
8.	Semester – VIII	14
Total Credits		**179**

Semester – I

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1	MC	19UGM131	Induction Programme	0	3	0	P/F	45
2	HS	19UEN101	English for Technical Communication	2	0	0	2	30
3	BS	19UMA102	Engineering Mathematics-I	3	1	0	4	60
4	BS	19UPH103	Engineering Physics	3	0	0	3	45
5	BS	19UCY104	Engineering Chemistry(Mechanical &Chemical Engineering)	3	0	0	3	45
6	ES	19UCS108	Problem Solving and Python Programming	3	0	0	3	45
7	ES	19UME109	Engineering Graphics	3	1	0	4	60
PRACTICAL								
8	ES	19UCS110	Problem Solving and Python Programming Laboratory	0	0	3	1.5	45
9	ES	19UME111	Engineering Practice Laboratory (common to Mech, EEE, Civil,Agri, Chem)	0	0	3	1.5	45
10	BS	19UGS113	Basic Science Laboratory (Mechanical &Chemical Engineering)	0	0	2	1	30
Total Credits : 23				**17**	**5**	**8**	**23**	

Semester – II

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	HS	19UEN201	Communication Skills for Professionals	1	1	0	1.5	45
2.	BS	19UMA202	Calculus, Fourier Series and Numerical Methods	3	1	0	4	60
3.	BS	19UPH203	Material Physics (common to Mech & Chemical)	3	0	0	3	45
4.	HS	19UCY204	Environmental Science (common to All branches)	3	0	0	3	45
5.	ES	19UME205	Introduction to Mechanical Engineering	3	0	0	3	45
6.	ES	19UEE226	Basic Electrical and Electronics Engineering (common to MECH, Civil, Chemical &Agri)	3	0	0	3	45
PRACTICAL								
7.	BS	19UGS210	Energy and Environmental Science Laboratory	0	0	2	1.5	45
8.	ES	19UME211	Computer Aided Drafting and Modeling Laboratory	0	0	3	1.5	45
Total Credits : 20.5				**16**	**2**	**6**	**20.5**	

Course offered to EEE Department

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
1.	ES	19UME226	Basic Civil and Mechanical Engineering (forEEE)	3	0	0	3	45

Semester –III

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	BS	19UMA321	Probability, Statistics and Partial Differential Equations	3	1	0	4	60
2.	PC	19UME302	Fundamentals of Manufacturing Processes **(INTEGRATED)**	3	0	2	4	75
3.	PC	19UME303	Engineering Thermodynamics	3	1	0	4	60
4.	PC	19UME304	Fluid Mechanics and Machinery **(INTEGRATED)**	3	0	2	4	75
5.	ES	19UME305	Engineering Mechanics	3	1	0	4	60
6.	ES	19UME306	Materials Engineering	3	0	0	3	45
7.	P	19UME307	Seminar	0	0	2	1	30
Total Credits : 24				**18**	**3**	**6**	**24**	

Semester –IV

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME401	Theory of Machines	3	1	0	4	60
2.	PC	19UME402	Applied Thermal Engineering	3	1	0	4	60
3.	PC	19UME403	Manufacturing Technology **(INTEGRATED)**	3	0	2	4	75
4.	PC	19UME404	Mechanics of Materials	3	1	0	4	60
5.	PC	19UME405	Automobile Engineering	3	0	0	3	45
6.	BS	19UGS431	Reasoning and Quantitative Aptitude	1	0	0	1	15
7.	MC	19UGM431	Gender Equality	1	0	0	P/F	15
8.	MC	19UGM432	Basics of Biology for Engineers	2	0	0	P/F	30
PRACTICAL								
9.	PC	19UME407	Thermal Engineering Laboratory - I	0	0	3	1.5	45
10.	PC	19UME408	Design Laboratory	0	0	3	1.5	45
Total Credits : 23				**19**	**3**	**8**	**23**	

Semester – V

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME501	Heat and Mass Transfer	3	0	0	3	45
2.	PC	19UME502	Design of Machine Elements	3	1	0	4	60
3.	ES	19UME503	Object Oriented Python programming **(INTEGRATED)**	3	0	2	4	75
4.	PC	19UME504	Measurements and Instrumentation **(INTEGRATED)**	3	0	2	4	75
5.	PE	E1	Professional Elective – I	3	0	0	3	45
6.	OE	OE 1	Open Elective – I	3	0	0	3	45
7.	HS	19UGS533	Interpersonal Skills Laboratory	0	0	3	1.5	45
PRACTICAL								
8.	P	19UME507	Creative Thinking & Innovations	0	0	2	1	30
9.	PC	19UME508	Thermal Engineering Laboratory - II	0	0	3	1.5	45
Total Credits : 25				**18**	**1**	**12**	**25**	

Semester – VI

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME601	Design of Transmission Systems	3	0	0	3	45
2.	PC	19UME602	Smart Manufacturing	3	0	0	3	45
3.	PC	19UME603	Operations Research	3	1	0	4	60
4.	PC	19UME604	Mechatronics	3	0	0	3	45
5.	PE	E 2	Professional Elective – II	3	0	0	3	45
6.	OE	OE 2	Open Elective - II	3	0	0	3	45
7.	MC	19UGM631	Indian Constitution	1	0	0	P/F	15
PRACTICAL								
8.	P	19UME607	Product Development Project	0	0	8	4	120
9.	PC	19UME608	CAD/ CAM Laboratory	1	0	2	2	60
10.	PC	19UME609	Smart Manufacturing & Mechatronics Laboratory	0	0	4	2	60
11.	HS	19UGS532	Soft Skill and Communications Laboratory	0	0	3	1.5	45
Total Credits : 28.5				**20**	**1**	**17**	**28.5**	

Semester –VII

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME701	Project Management and Finance	3	0	0	3	45
2.	PC	19UME702	Finite Element Analysis	3	0	0	3	45
3.	PE	E 3	Professional Elective III	3	0	0	3	45
4.	PE	E 4	Professional Elective – IV	3	0	0	3	45
5.	PE	E 5	Professional Elective – V	3	0	0	3	45
6.	OE	OE 3	Open Elective III	3	0	0	3	45
7.	MC	19UGM731	Professional Ethics & Human values	2	0	0	P/F	30
PRACTICAL								
8.	P	19UME707	Summer Internship	0	0	2	1	30
9.	PC	19UME708	Computational Analysis Laboratory (ANSYS & CFD)	0	0	3	2	60
Total Credits : 21				**20**	**0**	**5**	**21**	

Semester –VIII

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
1.	P	19UME801	Project Work	0	0	16	8	240
2.	PE	E6	Professional Elective VI	3	0	0	3	45
3.	OE	OE4	Open Elective IV	3	0	0	3	45
Total Credits : 14				**6**	**0**	**16**	**14**	

PROFESSIONAL ELECTIVE:

Sl. No	Course Category	Course Code	Course Name	L	T	P	C
1.	PE	19UME901	Industrial and Quality Management	3	0	0	3
2.	PE	19UME902	Gas Dynamics and Jet Propulsion	3	0	0	3
3.	PE	19UME903	Applied Hydraulics and pneumatics	3	0	0	3
4.	PE	19UME904	Design of Jigs, Fixtures & Press Tools	3	0	0	3
5.	PE	19UME905	Computational Fluid Dynamics	3	0	0	3
6.	PE	19UME906	Quality Control and Reliability Engineering	3	0	0	3
7.	PE	19UME907	Renewable Sources of Energy	3	0	0	3
8.	PE	19UME908	Industrial Tribology	3	0	0	3
9.	PE	19UME909	Power Plant Technology	3	0	0	3
10.	PE	19UME910	Unconventional Machining Processes	3	0	0	3
11.	PE	19UME911	Composite Materials	3	0	0	3
12.	PE	19UME912	Process Planning and Cost Estimation	3	0	0	3
13.	PE	19UME913	Nano Science and Technology	3	0	0	3
14.	PE	19UME914	Vibration and Noise Control	3	0	0	3
15.	PE	19UME915	Refrigeration and Air conditioning	3	0	0	3
16.	PE	19UME916	Nuclear Engineering	3	0	0	3
17.	PE	19UME917	Entrepreneurship Development	3	0	0	3
18.	PE	19UME918	Maintenance Engineering	3	0	0	3
19.	PE	19UME919	Production Planning and Control	3	0	0	3
20.	PE	19UME920	Design of Heat Exchangers	3	0	0	3
21.	PE	19UME921	Advanced I.C. Engines	3	0	0	3
22.	PE	19UME922	Failure Analysis and Design	3	0	0	3
23.	PE	19UME923	Computer Integrated Manufacturing	3	0	0	3
24.	PE	19UME924	Cryogenics	3	0	0	3
25.	PE	19UME925	Industrial Robotics	3	0	0	3
26.	PE	19UME926	Introduction to aircraft industry and aircraft systems	3	0	0	3
27.	PE	19UME927	Design of aircraft structures	3	0	0	3
28.	PE	19UME928	Non Destructive Testing (NDT)	3	0	0	3
29.	PE	19UME929	Statistical Quality Control (SQC)	3	0	0	3
30.	PE	19UME930	Additive Manufacturing	3	0	0	3
31.	PE	19UME931	Thermal Turbo Machines	3	0	0	3
32.	PE	19UME932	Piping Design	3	0	0	3
33.	PE	19UME933	Machine Learning	3	0	0	3

OPEN ELECTIVE (Mechanical Department offering course):

Sl. No	Course Category	Course Code	Course Name	L	T	P	C
1.	OE	19UME971	Industrial Psychology and Work Ethics	3	0	0	3
2.	OE	19UME972	Industrial Safety and Engineering	3	0	0	3
3.	OE	19UME973	Synthesis of Nano Materials	3	0	0	3
4.	OE	19UME974	Principles of Management	3	0	0	3
5.	OE	19UME975	Total Quality Management	3	0	0	3

INTER/ MULTI DISCIPLINARY ELECTIVE COURSES:

Sl. No	Course Code	Course Name	L	T	P	C
1.	19UGM951	Automation in Agriculture Engineering (Common to Mech, Agri, IT)	3	0	0	3
2.	19UGM952	Electric Vehicles (Common to EEE &Mech)	3	0	0	3
3.	19UGM953	Bio Fluid Mechanics (Common to Biomedical &Mech)	3	0	0	3

ONE CREDIT COURSE:

Sl. No	Course Code	Course Name	L	T	P	C
1.	19UME861	Jigs and Fixtures	1	0	0	1
2.	19UME862	Smart Materials	1	0	0	1
3.	19UME863	Solar energy	1	0	0	1
4.	19UME864	Work Study	1	0	0	1
5.	19UME865	CNC programming	1	0	0	1
6.	19UME866	Limits, Fits and Tolerances	1	0	0	1

BASIC SCIENCE COURSES: BS

S.NO	CODE NO	SUBJECT	SEMESTER	CREDITS
1	19UMA102	Engineering Mathematics-I	I	4
2	19UPH103	Engineering Physics	I	3
3	19UCY104	Engineering Chemistry	I	3
4	19UGS113	Basic Science Laboratory (common to All branches)	I	1
5	19UMA202	Calculus, Fourier Series and Numerical Methods	II	4
6	19UPH203	Material Physics (common to Mech& Chemical)	II	3
7	19UGS210	Energy and Environmental Science Laboratory	II	1.5
8	19UMA321	Probability, Statistics and Partial Differential Equations	III	4
9	19UGS431	Reasoning and Quantitative Aptitude	IV	1
Total Credits				**24.5**

ENGINEERING SCIENCE COURSE: ES

S.NO	CODE NO	SUBJECT	SEMESTER	CREDITS
1	19UCS108	Problem Solving and Python Programming	I	3
2	19UME109	Engineering Graphics	I	4
3	19UCS110	Problem Solving and Python Programming Laboratory	I	1.5
4	19UME111	Engineering Practice Laboratory (common to Mech, EEE, Civil,Agri, Chem)	I	1.5
5	19UME205	Introduction toMechanical Engineering	II	3
6	19UEE226	Basic Electrical and Electronics Engineering (common to MECH, Civil, Chemical, Agri)	II	3
7	19UME211	Computer Aided Drafting and Modeling Laboratory	II	1.5
8	19UME305	Engineering Mechanics	III	4
9	19UME306	Materials Engineering	III	3
10	19UME503	Object Oriented Python Programming (Integrated)	V	4
Total Credits				**28.5**

HUMANITIES AND SOCIAL SCIENCES COURSES: HS

S.NO	CODE NO	SUBJECT	SEMESTER	CREDITS
1	19UEN101	English for Technical Communication	I	2
2	19UEN201	Communication Skills for Professionals (common to All branches)	I	1.5
3	19UCY204	Environmental Science (common to All branches)	II	3
4	19UGS533	Interpersonal Skills Laboratory	V	1.5
5	19UGS532	Soft Skill and Communications Laboratory	VI	1.5
Total Credits				**9.5**

PROFESSIONAL CORE COURSE: PC

S.NO	CODE NO	SUBJECT	SEMESTER	CREDITS
1.	19UME302	Fundamentals of Manufacturing Processes**(INTEGRATED)**	III	4
2.	19UME303	Engineering Thermodynamics	III	4
3.	19UME304	Fluid Mechanics and Machinery **(INTEGRATED)**	III	4
4.	19UME401	Theory of Machines	IV	4
5.	19UME402	Applied Thermal Engineering	IV	4
6.	19UME403	Manufacturing Technology**(INTEGRATED)**	IV	4
7.	19UME404	Mechanics of Materials	IV	4
8.	19UME405	Automobile Engineering	IV	3
9.	19UME407	Thermal Engineering Laboratory - I	IV	1.5
10.	19UME408	Design Laboratory	IV	1.5
11.	19UME501	Heat and Mass Transfer	V	3
12.	19UME502	Design of Machine Elements	V	4
13.	19UME504	Measurements and Instrumentation **(INTEGRATED)**	V	4
14.	19UME508	Thermal Engineering Laboratory - II	V	1.5
15.	19UME601	Design of Transmission Systems	VI	3
16.	19UME602	Smart Manufacturing	VI	3
17.	19UME603	Operations Research	VI	4

18.	19UME604	Mechatronics	VI	3
19.	19UME608	CAD/CAM Laboratory	VI	2
20.	19UME609	Smart Manufacturing & Mechatronics Laboratory	VI	2
21.	19UME701	Project Management and Finance	VII	3
22.	19UME702	Finite Element Analysis	VII	3
23.	19UME708	Computational Analysis Laboratory (ANSYS & CFD)	VII	2
Total Credits				**71.5**

PROFESSIONAL ELECTIVE COURSE: PE

S.NO	CODE NO	SUBJECT	CREDITS
1	19UME901	Industrial and Quality Management	3
2	19UME902	Gas Dynamics and Jet Propulsion	3
3	19UME903	Applied Hydraulics and pneumatics	3
4	19UME904	Design of Jigs, Fixtures & Press Tools	3
5	19UME905	Computational Fluid Dynamics	3
6	19UME906	Quality Control and Reliability Engineering	3
7	19UME907	Renewable Sources of Energy	3
8	19UME908	Industrial Tribology	3
9	19UME909	Power Plant Technology	3
10	19UME910	Unconventional Machining Processes	3
11	19UME911	Composite Materials	3
12	19UME912	Process Planning and Cost Estimation	3
13	19UME913	Nano Science and Technology	3
14	19UME914	Vibration and Noise Control	3
15	19UME915	Refrigeration and Air conditioning	3
16	19UME916	Nuclear Engineering	3
17	19UME917	Entrepreneurship Development	3
18	19UME918	Maintenance Engineering	3
19	19UME919	Production Planning and Control	3
20	19UME920	Design of Heat Exchangers	3
21	19UME921	Advanced I.C. Engines	3
22	19UME922	Failure Analysis and Design	3
23	19UME923	Computer Integrated Manufacturing	3
24	19UME924	Cryogenics	3
25	19UME925	Industrial Robotics	3
26	19UME926	Introduction to aircraft industry and aircraft systems	3
27	19UME927	Design of aircraft structures	3
28	19UME928	Non Destructive Testing (NDT)	3
29	19UME929	Statistical Quality Control (SQC)	3
30	19UME930	Additive Manufacturing	3

31	19UME931	Thermal Turbo Machines	3
32	19UME932	Piping Design	3
33	19UME933	Machine Learning	3
Total Credits			**18**

MANDATORY COURSE:MC

S.NO	CODE NO	SUBJECT	SEMESTER	CREDITS
1	19UGM131	Induction Programme	I	P/F
2	19UGM431	Gender Equality	IV	P/F
3	19UGM432	Basics of Biology for Engineers	IV	P/F
4	19UGM631	Indian Constitution	VI	P/F
5	19UGM731	Professional Ethics & Human values (Mandatory)	VII	P/F

PROJECT COURSE: P

S.NO	CODE NO	SUBJECT	SEMESTER	CREDITS
1	19UME307	Seminar	III	1
2	19UME507	Creative Thinking & Innovations	V	1
3	19UME607	Product Development Project	VI	4
4	19UME707	Summer Internship	VII	1
5	19UME801	Project Work	VIII	8
Total Credits				**15**

OPEN ELECTIVES:OE

S.NO	SUBJECT	SEMESTER	CREDITS
1	OE - I	V	3
2	OE - II	VI	3
3	OE - III	VII	3
4	OE - IV	VIII	3
Total Credits			**12**

SUMMARY OF CREDITS:

Sl.No	SUBJECT AREA	SUMMARY OF CREDITs								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1	**HS**	2	4.5	-	-	1.5	1.5	-	-	**9.5**
2	**BS**	11	8.5	4	1	-	-	-	-	**24.5**
3	**ES**	10	7.5	7	-	4	-	-	-	**28.5**
4	**PC**	-	-	12	22	12.5	13	8	-	**71.5**
5	**PE**	-	-	-	-	3	3	9	3	**18**
6	**OE**	-	-	-	-	3	3	3	3	**12**
7	**P**	-	-	1	-	1	4	1	8	**15**
Total		**23**	**20.5**	**24**	**23**	**25**	**28.5**	**21**	**14**	**179**

HS	Humanities and Social Science	**PE**	Professional Electives
BS	Basic Sciences	**OE**	Open Electives
ES	Engineering Sciences	**P**	Project
PC	Professional Cores		

Semester – I

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1	MC	19UGM131	Induction Programme	0	3	0	P/F	45
2	HS	19UEN101	English for Technical Communication	2	0	0	2	30
3	BS	19UMA102	Engineering Mathematics-I	3	1	0	4	60
4	BS	19UPH103	Engineering Physics	3	0	0	3	45
5	BS	19UCY104	Engineering Chemistry	3	0	0	3	45
6	ES	19UCS108	Problem Solving and Python Programming	3	0	0	3	45
7	ES	19UME109	Engineering Graphics	3	1	0	4	60
PRACTICAL								
8	ES	19UCS110	Problem Solving and Python Programming Laboratory	0	0	3	1.5	45
9	ES	19UME111	Engineering Practice Laboratory (common to Mech, EEE, Civil,Agri, Chem)	0	0	3	1.5	45
10	BS	19UGS113	Basic Science Laboratory	0	0	2	1	30
Total Credits : 23				**17**	**5**	**8**	**23**	

19UGM131	INDUCTION PROGRAMME	L	T	P	C
		0	3	0	0

OBJECTIVES:

- To rejuvenate the Body and Mind
- To strengthen Attitude and soft skills
- To practice Moral values of life.

UNIT I PHYSICAL ACTIVITY **10**

Zumba - Bokwa Fitness – Yoga – Mediation – Fine Arts

UNIT II CREATIVE ARTS **5**

Painting – Class Painting – Wall Painting – Art from waste.

UNIT III UNIVERSAL HUMAN VALUES & EMINENT SPEAKERS **5**

Ethical values – Ambition and Family Expectation, Gratitude, Competition and Excellence – Belief – Morality of life – Guest Lecture by Eminent personality.

UNIT IV LITERARY **5**

Elocution - Essay writing Competition - Impromptu Session - Dance and singing competition.

UNIT V PROFICIENCY MODULES **10**

Toastmaster club meet.

UNIT VI INDUSTRIAL & LOCAL VISIT **8**

Vaigai Dam – Theni - VOC- Port-Tuticorin - Madurai Radio City-Madurai - Aavin Milk –Madurai-NSS Activities.

UNIT VII FAMILIARIZATION OF THE DEPT. AND INNOVATION **2**

Department Introduction and Purpose of Course - Eminent speakers – Scope and Feature of the Course - Latest Innovation.

Total = 45 periods

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Practice physical activities regularly.
2. Implement creativity in drawing and waste material.
3. Communicate their ideas effectively.
4. Identify inputs and outputs of different industry process.
5. Describe the scope and features of their programme of study.

Reference Book:

1. Student Induction Programme: A Detailed Guide by AICTE, New Delhi.

19UEN101 ENGLISH FOR TECHNICAL COMMUNICATION L T P C

(Commonto ALL Branches–Except CSBS) 2 0 0 2

OBJECTIVES:

- To enhance the vocabulary of students.
- To strengthen the application of functional grammar and basic skills.
- To improve the language proficiency of students.

UNIT I **8**

Listening–Formal and informal conversations and comprehension. **Speaking-** introducing one self – exchanging personal and social information- **Reading** – Skimming and Scanning. **Writing–** Sentence Formation, Formal Letters (Permission/Requisition) - **Grammar** - Parts of Speech - Tense - **Vocabulary Development** – Technical Word Formation- Prefix- suffix - Synonyms and Antonyms- Phrases and Clauses.

UNIT II **8**

Listening– Telephonic Conversations**. Speaking** – Pronunciation rules with Stress pattern. **Reading** – comprehension-pre-reading, post-reading- comprehension questions **Writing** – Punctuation rules, paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions, Precise writing, Developing Hints - Report Writing (Industrial, Accident) - **Grammar** – Voice **Vocabulary Development**- Words from other languages in English.

UNIT III **7**

Listening – Motivational speech by Great Speakers **Speaking** –Narrating daily events -retelling short stories. **Reading** – Newspaper reading. **Writing** – Job application letter - Transformation of Information (Transcoding) –**Grammar** Subject-Verb Agreement (Concord),— **Vocabulary Development** –Same word in different parts of speech.

UNIT IV **7**

Listening – Understating the instruction. **Speaking** -Intonation and preparing dialogue on various formal and informal situation. **Reading** –Note Making from given text - **Writing** –Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) - **Grammar** – Spot the Errors in English, **Vocabulary Development** – One-word substitution.

Total = 30 periods

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Apply grammar effectively in writing meaningful sentences and paragraphs.
2. Exhibit reading skills and comprehension to express the ideas in the given text.
3. Develop writing skills to present the ideas in various formal situations.
4. Develop oral fluency to express the ideas in various formal situations.
5. Exhibit writing skills to prepare reports for various purposes.

TEXT BOOK:

1. KN Shoba, Lourdes Joavani Rayen, Communicative English, New Delhi, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Raman, Meenakshi, Sangeetha Sharma, Business Communication, New Delhi, Oxford University Press,2014.
2. Lakshminarayanan. K.R, English for Technical Communication, Chennai, Scitech Publications (India) Pvt. Ltd, 2004.
3. Rizvi. Asraf M, Effective Technical Communication, New Delhi, Tata McGraw-Hill Publishing Company Limited,2007.

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1									2	3					
CO.2									2	3					
CO.3									2	3					
CO.4									2	3					
CO.5									2	3					
19UEN101									**2**	**3**					

Ref: 3-Strong 2-Medium 1 –Weak

19UMA102 **ENGINEERING MATHEMATICS – I**

(Common to ALL Branches – Except CSBS)

L	T	P	C
3	1	0	4

OBJECTIVES:

- To make the students capable of identifying linear equations-based problems (Eigen value) from practical areas and obtain the Eigen value-oriented solutions in certain cases.
- To widen the student's knowledge base on linear algebra, growth rate computation and application of integrals.
- Able to integrating various types of functions using various integration methods.
- To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions.
- To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field.

UNITI MATRICES **8 +3**

Eigen value and eigenvector of a real matrix – Characteristic equation – Properties – Cayley-Hamilton theorem (excluding Proof) – Orthogonal reduction – (transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS **9 + 3**

Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation (n^{th} derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling – Heat flow problems, Rate of decay of radioactive materials - Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems)

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

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylor's expansion – Maxima and Minima – Method of Lagrangian Multipliers.

UNIT IV INTEGRAL CALCULUS 8 + 3

Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions.

UNIT V MULTIPLE INTEGRALS 8 + 3

Double integration – Cartesian and Polar coordinates – Change of order of integration – Area as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integration in Cartesian coordinates – Volume as triple integral.

SUPPLEMENT TOPIC (for internal evaluation only-) 3

Evocation /Application of Mathematics, Quick Mathematics – Speed Multiplication and Division Applications of Matrices.

TOTAL: 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES:

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

1. Apply the Characteristic Equation, Characteristic roots and use the applicability of Cayley – Hamilton theorem to find the Inverse of matrix
2. Analyze functions using limits, continuity, derivatives and to solve Physical application problems
3. Apply differentiation techniques and Lagrange multiplier method to predict the extreme values of the functions with constrain
4. Apply the concept of some special function like Gamma, Beta function and their relation to evaluate some definite integral
5. Apply integration to compute Multiple integrals, Area and Volume in addition to change of order and change of variables
6. Understand the basic concept in Matrix, Differentiation and Integration.

TEXT BOOKS:

1. BaliN.PandManishGoyal,"ATextbookofEngineeringMathematics",LaxmiPublications (P) Ltd, New Delhi, 8th Edition, (2011).
2. Veerarajan T, "Engineering Mathematics" tata McGraw Hill Publishing Company, New Delhi, 2008.
3. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 42nd Edition, (2012).

REFERENCE BOOKS:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint,(2010).
2. Glyn James, "Advanced Engineering Mathematics", Pearson Education, New Delhi, 7th Edition,(2007).
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, 3rd Edition,(2007).
4. Bharati Krishna Tirthaji, "Vedic Mathematics - Mental Calculation", MotilalBanarsi Dass Publications, New Delhi, 1st Edition,(1965).
5. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley & Sons, New York, 10th Edition,(2011).
6. P.Sivaramakrishna Das, E.Rukmangadachari "Engineering mathematics", volume1,Pearson Edison New Delhi, 2nd Edition, (2013).

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3			1								1	2	2	
CO.2	3	3		1								1	2	2	
CO.3	3			1								1	2	2	
CO.4	3			1								1	2	2	
CO.5	3			1								1	2	2	
CO.6	3			1								1	2	2	
19UMA102	**3**	**3**		**1**								**1**	**2**	**2**	

Ref: 3-Strong 2-Medium 1 –Weak

19UPH103	ENGINEERING PHYSICS	L	T	P	C
	(Common to ALL Branches)	3	0	0	3

OBJECTIVES:

- To develop the research interest in crystal physics.
- To use the principles of Lasers and its types.
- To apply principles of Quantum physics in engineering field.
- To develop knowledge on properties of materials.

UNITI CRYSTAL STRUCTURE 12

Introduction – Classification of solids –Space lattice –Basis-Lattice parameter – Unit cell – Crystal system –Miller indices –d-spacing in cubic lattice - Calculation of number of atoms per unit cell – Atomic radius-Coordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfection –Point defects-Line defects-Surface defects-Volume defects Burger vector.

UNITII PHOTONICS 10

Introduction- Principles of Laser- Characteristics of laser -Spontaneous and stimulated emission – Population inversion – Einstein's A and B coefficients - Pumping methods – Basic components of Laser - Types of lasers – Nd -YAG laser - CO2 laser –Holography –Construction and Reconstruction of hologram – Industrial and Medical Applications.

UNITIII QUANTUMMECHANICS 13

Introduction - Black body radiation – Planck's law of radiation- Wien's displacement law - Rayleigh Jeans law - Compton Effect – Theory and experimental verification – Matter waves-Schrodinger's wave equation – Time dependent – Time independent equation – Particle in 1-D dimensional box.

UNITIV PROPERTIES OF SOLIDS 10

Introduction - Elasticity- Stress and Strain - Hooke's law – Three moduli of elasticity –stress-strain curve – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending –I- shaped girders.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

1. Classify the types of crystals, lasers, elasticity and quantum behavior of solids. (Understand)
2. Apply the basic knowledge of crystal, quantum mechanics and mechanical behavior of solids to solve engineering problems. (Apply)
3. Apply the principle of laser to estimate the wavelength of emitted photons. (Apply)
4. Analyze the dual nature of matter using the concepts of quantum mechanics.(Analyze)
5. Analyze the structural and optical properties of crystals in industrial and medical applications.(Analyze)
6. Analyze the properties of materials for specific Engineering Applications. (Analyze)

TEXT BOOKS:

1. Dr. Mani.P, “Engineering Physics”, Dhanam Publications, Edition, 2018,Chennai.
2. Rajendran.V, “Engineering, Physics”, Tata Mc-Graw Hill Publishing Company limited, New Delhi, Revised Edition2018.
3. Palanisami P.K., “Physics for Engineers”, Scitech Publications (India), Pvt Ltd., Chennai, 2018.

REFERENCE BOOKS:

1. Raghuvenshi G.S., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2018.
2. Arul doss .G., “Engineering Physics”, PHI Learning Limited, New Delhi, Revised Edition 2018.
3. Marikani .A., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition2017.
4. Sankar B.N., and Pillai .S.O., “A Text book of Engineering Physics”, New Age International Publishers Private Limited, New Delhi, Revised Edition2017.
5. Avadhanulu M.N. and Kshirsagar P.G., “A Textbook: of Engineering Physics”, S.Chand & Company Ltd., New Delhi,2018.

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2											2	1	1	
CO.2	3	2										2			1
CO.3	3	2										2	2		
CO.4	2	3										2			
CO.5	2	3										2			
CO.6	2	3							2			2			1
19UPH103	**3**	**3**							**2**			**2**	**2**	**1**	**1**

Ref: 3-Strong 2-Medium 1 –Weak

19UCY104 ENGINEERING CHEMISTRY L T P C

3 0 0 3

OBJECTIVES:

- To gain the knowledge on Chemical bonding and types.
- To acquire on basic chemical reactions.
- To make the students conversant with boiler feed water requirements related problems and water treatment techniques.
- To understand the principles and control methods of corrosion.

UNITI CHEMICALBONDING 11

Chemical Bonding: Electronic Configuration– Ionic Bond - Covalent Bond – Metallic bond – Aufbau principle, Pauli Exclusion principle, Valence bond theory applications and its limitations, Various types of hybridization (sp, sp^2,sp^3) (C_2H_2, C_2H_4, CH_4) -bond strength and bond energy - Hydrogen bonding, Vander Waals forces.

UNITII BASIC CHEMICAL REACTION ANDCHEMICAL KINETICS 11

Study of basic types of reaction- Displacement and Redox Reactions – Basic properties of Acids, Bases and Salt.

Chemical Kinetics: Basic definitions, Differential equation view of rate - Rate constant, Rate law - Reaction order 1^{st} and 2^{nd} order kinetics - Determination of kinetics from rate laws, Half-life.

UNIT III WATER AND ITSTREATMENTTECHNOLOGIES 11

Hardness of water – types – expression of hardness (Problems) – units – estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External Treatment-Ion exchange process- zeolite process – desalination of brackish water – Reverse Osmosis.

UNIT IV CORROSION AND ITSPREVENTIONTECHNIQUES 12

Introduction- Definition- Types – Chemical corrosion (Dry corrosion, mechanism and its Example)-Electrochemical corrosion (Wet corrosion, mechanism and its Types – Galvanic & Differential aeration Corrosion- Pitting, crevice & Wire fence corrosion). Corrosion prevention - Cathodic protection and Protective coatings – Paint, Electro plating – Gold plating.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students are able to:

1. Understand the basic concept of chemistry involved in chemical bonding, basic chemical reaction, chemical kinetics, water treatment methods and corrosion. (Understand)
2. Apply the knowledge of chemical bonding to identify the types of bond in molecules.(Apply)
3. Analyze the bonding properties of molecules and order of reaction.(Analyze)
4. Analyze the impurities of water to find its hardness and remove the hardness causing substances.(Analyze)
5. Analyze the causes of corrosion, its consequences and methods to minimize corrosion to improve industrial designs.(Analyze)

TEXT BOOKS:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", DhanpatRai Publishing Company (P)Ltd., New Delhi,2010
2. Dr. Sunita Rattan, "A Textbook of Engineering Chemistry" S. K .Kataria & Sons., New Delhi,2013.
3. Pradeep. T "A textbook of Nano science and Nanotechnology", Tata McGraw - Hill Education Private ltd,2012.

REFERENCE BOOKS:

1. Physical chemistry – Samuel Glasstone, Macmillan II edition,1969.
2. Physical Chemistry – P. L. Sony, Sulthan Chand & Sons, Delhi -6.
3. A. K. Kaw, Mechanics of Composite Materials, CRC Press, New Delhi2005.
4. S. C. Sharma, Composite materials, Narosa Publications, New Delhi,2000.

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2					2	2					2			1
CO.2	3														
CO.3	3														
CO.4	3	2				2	2								1
CO.5	3	2				2	2					2			1
19UCY104	**3**	**2**				**2**	**2**					**2**			**1**

Ref: 3-Strong 2-Medium 1 –Weak

19UCS108	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common to ALL Branches – Except CSBS)	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart the concepts in problem solving for computing.
- To familiarize the logical constructs of programming.
- To illustrate programming in Python.

UNIT I INTRODUCTION **9**

Definition and basic organization of computers – classification of computers – Software – Types of software – types of programming paradigms - Translators: compiler and interpreter – Problem solving tools: Algorithms – Flowchart – Pseudo code.

UNIT II INTRODUCTION TO PYTHON **9**

Introduction to python – features of python – modes of working with python. Values and data types: numbers, Boolean, strings; variables, expressions, statements, tuple assignment, precedence of operators, comments – print function- conversion of algorithm in to program – Solving simple problems involving arithmetic computations and sequential logic to solve.

UNIT III CONTROL CONSTRUCTS **9**

Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass – Solving problems involving decision making and iterations.

UNIT IV FUNCTIONS AND PACKAGES **9**

Functions - function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition-Anonymous or Lambda Function, recursion -packages.

UNIT V LISTS, TUPLES, DICTIONARIES AND STRINGS **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension - Strings: string slices; immutability, string functions and methods, string module.

TOTAL: 45 Periods

COURSE OUTCOMES:

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

1. Formulate algorithms for simple problems and translate the algorithms to a working program. (Apply)
2. Formulate algorithms and programs for arithmetic computations and sequential logic. (Apply)
3. Write iterative programs using control constructs. (Apply)
4. Develop programs using functions, packages and use reursion to reduce redundancy. (Apply)
5. Represent data using lists, tuples, dictionaries and manipulate them through a program. (Apply)

TEXT BOOKS:

1. Ashok NamdevKamthane& Amit Ashok Kamthane, “Problem solving and python programming”, McGraw Hill Education, 2018(copyright)
2. Anurag Gupta & G P Biswas, “Python Programming – Problem solving, packages and libraries”, McGraw Hill Education, 2020(copyright).

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. TimothyA.Budd,“ExploringPythonǁ,Mc-GrawHillEducation(India)PrivateLtd.,2015.
4. Kenneth A. Lambert, “Fundamentals of Python: First Programsǁ, 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 to Computer Science using Python 3ǁ, Second edition, PragmaticProgrammers, LLC, 2013.

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	2	2							2			3		
CO.2	3	2	2							2			3		
CO.3	3	2	1							2			1		
CO.4	3	2	2	1						2			3		
CO.5	3	2	1	1						2			1		
19UCS108	**3**	**2**	**2**	**1**						**2**			**3**		

Ref: 3 - Strong 2-Medium 1 - Weak

19UME109	ENGINEERING GRAPHICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.
- To impart knowledge in development of surfaces and isometric projections.

CONCEPTS AND CONVENTIONS (NOTFOREXAMINATION) 4

Importance of Graphics in Engineering Applications – Use of Drafting Instruments – BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets – Lettering and Dimensioning - Introduction to Plane Curves, Projection of Points, Lines and Plane Surfaces.

UNITI PROJECTION OFSOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.

UNITII SECTION OF SOLIDS 10

Section of solids - simple position with cutting plane parallel, perpendicular and inclined to one of the plane.

UNITIII DEVELOPMENTOF SURFACES 10

Development of lateral surfaces of simple and truncated solids - Prisms, pyramids, cylinders and cones - Development of lateral surfaces of sectioned solids.

UNITIV ISOMETRIC PROJECTIONS 12

Principles of isometric projection – isometric scale – isometric view - isometric projections of simple solids and cut solids.

UNITV ORTHOGRAPHIC PROJECTION 12

Representation of Three Dimensional objects – General principles of orthographic projection- Need for importance of multiple views and their placement – First angle projection – layout views Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects.

TOTAL 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Draw orthographic projections of basic geometrical entities in various positions and translate the Geometric information of engineering objects into engineering drawings. **(Understand)**
2. Apply the principles of orthographic projections to draw projections of solids and sections of solids. (Apply)
3. Develop lateral surfaces of regular and sectioned solids. . (Apply)
4. Prepare isometric drawings of simple solids from orthographic views. (Apply)
5. Construct orthographic projection from the given pictorial view. (Apply)
6. Analyze the projections of various solid models using different resting conditions. (Analyze)

TEXT BOOKS:

1. Natarajan K.V., "A Text book of Engineering Graphics", Dhanalakshmi Publishers,(2006).
2. Bhatt N.D., "Engineering Drawing", Charotar Publishing House,(2012).

REFERENCE BOOKS:

1. Venugopal K., and Prabhu Raja V., "Engineering Graphics", New AgeInternational (P) Limited, (2008).
2. Gopalakrishnan K.R., "Engineering Drawing" (Vol.I&II),23rd edition, SubhasPublications.(2014).
3. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to Auto CAD", Tata McGraw Hill Publishing Company Limited,(2012).
4. Saravanan M, Bensan Raj J, Ganesh Kumar S, "Engineering Graphics", JBR Trisea Publishers, Nagarcoil,2020.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1															2
CO.2	3									3					2
CO.3	3									3			3		2
CO.4	3									3			3		2
CO.5	3									3			3		2
CO. 6	3	2			3					3			3		2
19UME109	**3**	**2**			**3**					**3**			**3**		**2**

Ref: 3 - Strong 2-Medium 1 –Weak

19UCS110	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common to ALL Branches)	**0**	**0**	**3**	**1.5**

COURSE OBJECTIVES :

- To familiarize with programming environment.
- To familiarize the implementation of programs in Python.

LIST OF EXPERIMENTS

Problems involve Sequential logic and Decision making

1. Develop a computing solution to process the mark processing system (Record has the following fields: Name, Reg_no, Mark1, Mark2, Mark3, Mark4, Total, average). Generate student information with total and average mark.
2. Provide a software solution to compute the +2 Cutoff mark, given the Mathematics, physics and Chemistry marks. A college has decided to admit the students with a cut off marks of180. Decide whether the student is eligible to get an admission in that college or not.
3. A pizza in a circular shape with 8 inches and which is placed in a square box whose side length is 10 inches. Find how much of the box is “empty”?
4. A person owns an air-conditioned sleeper bus with 35 seating capacity that routes between Chennai to Bangalore. He wishes to calculate whether the bus is running in profit or loss state based on the following scenario:

   Amount he spent for a day for diesel filling is: Rs. 15,000

   Amount he spent for a day for Driver and cleaner beta is: Rs. 3,000

   Ticket amount for a Single person is Rs: 950

   If all the seats are filled, what would be the result? If only

   15 seats are filled, what would be the result?
5. Consider the person ‘X’ has some amount in his hand and the person ‘Y’ has some amount in his hand. If they wish to exchange the amount among them, how they can exchange the amount by using the third party ‘Z’.

Problems involve iterations

6. A man is blessed with a duck that can lay golden eggs. First day it lays one egg, in second day it lays two eggs, in third day it lays three eggs, and it continues to lay eggs in an incremental manner day by day. Now calculate how many golden eggs that duck lays till ‘n’ th day.

7. Four People A, B, C, D are sitting in a Circular arrangement. In how many ways their seating can be arranged.
8. The Greek theater shown at the right has 30 seats in the first row of the center section. Each row behind the first-row gains two additional seats. How many seats are in the 5^{th} row in the center section?

Problem involve functions and recursive functions

9. Develop a solution to identify the right angle triangle while giving the sides of a triangle. (Recall from the Pythagoras theorem that in a right triangle, the square of one side equals the sum of the squares of other two sides)
10. A game has to be made from marbles of five colors, yellow, blue, green, red and Violet where five marbles has to be kept one upon another. Write a python program using recursion, to find how many ways these marbles can be arranged.
11. Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:

    Here is a high-level outline of how to move a tower from the starting pole, to the goal pole, using an intermediate pole:

    1. Move a tower of height-1 to an intermediate pole, using the final pole.
    2. Move the remaining disk to the final pole.
    3. Move the tower of height-1 from the intermediate pole to the final pole using original pole.

Problems involve List and Nested List

12. In a class of 50 numbers of students, 6 students are selected for state cricket academy. Sports faculty of this school has to report to the state cricket academy about the selected students' physical fitness. Here is one of the physical measures of the selected students'; Height in cm is given for those 6 selected students [153,162,148,167,175,151]. By implementing functions, do the following operations.
    (i) State academy selector has to check whether the given height is present in the selected students list or not.
    (ii) State academy selector has to order the height of students in an incremental manner.
    (iii) State academy selector has to identify the maximum height from the list.

Problems involve Dictionary and Tuples

Dictionary

13. A university wishes to create and maintain the details of the students such as Rollno, Regno, Name, Dept, Batch, Contact no, Nativity(Indian/NRI) as key value pairs. Do the following operations:
    (i) Display the complete student details on giving Roll no as input.
    (ii) Display the complete student details whose nativity belongs to NRI.
    (iii) Display the complete student details whose department is CSE.

Tuples

14. A librarian wishes to maintain books details such as ISBN, Book Name, Author Name, Year published, Publisher Name. He wishes to retrieve the book details in the following scenario:
    (i) Retrieve the complete details of the book on giving ISBN.
    (ii) Retrieve the details of the book which published after the year2015.
    (iii) Retrieve the details of the book whose author name is 'Andrew'.
    (iv) Retrieve the details of the book that name of the book is 'Python'

Problems involve Strings

15. A musical album company has 'n' number of musical albums. The PRO of this company wishes to do following operations based on some scenarios:
    (i) Name of the album starts with 's' or'S'.
    (ii) Name of the album which contains 'jay' as substring.
    (iii) Check whether the album name presents in the repository or not.
    (iv) Count number of vowels and consonants in the given album name.

TOTAL: 45 Periods

COURSE OUTCOMES:

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

1. Formulate algorithms for simple problems and translate the algorithms to a working program. (Apply)
2. Formulate algorithms and programs for arithmetic computations and sequential logic.(Apply)
3. Write iterative programs using control constructs.(Apply)
4. Develop programs using functions, packages and use recursion to reduce redundancy.(Apply)
5. Represent data using lists, tuples, dictionaries and manipulate them through a program. (Apply)

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

HARDWARE

LAN SYSTEM WITH 30 NODES (OR) STANDALONE PCS – 30 NOS

SOFTWARE

OS – UNIX CLONE (License free Linux)
EDITOR – IDLE

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	2	2							2			1		
CO.2	3	2	2							2			1		
CO.3	3	2	1							2			2		
CO.4	3	2	2	1						2			3		
CO.5	3	2	1	1						2			1		
19UCS110	**3**	**2**	**2**	**1**						**2**			**3**		

Ref: 3- Strong 2-Medium 1 –Weak

19UME111	ENGINEERING PRACTICES LABORATORY (Common to Mech, EEE, Civil, Chemical and Agriculture)	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To demonstrate the plumbing and carpentry works.
- To train the students to perform welding, fitting and drilling operations.
- To demonstrate residential house wiring, fluorescent lamp wiring, measurement of earth resistance, colour coding of resistors, logic gates and soldering.

GROUP A (CIVIL & MECHANICAL)

CIVIL ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

1) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in house hold fittings.

2) Preparation of plumbing line sketches for water supply and sewage works.

3) Hands-on-exercise: Basic pipe connections–Mixed pipe material connection Pipe connections with different joining components.

4) Demonstration of plumbing requirements of high-rise buildings.

5) Study of the joints in roofs, doors, windows and furniture.

6) Hands-on-exercise: Wood work, cutting, planning and joints by sawing –Half lap joint.

MECHANICAL ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

1) Preparation of arc welding of butt joints, lap joints and tee joints.

2) Drilling Practice.

3) Sheet metal model making – Trays, funnels, etc.

4) Different type of fittings -'V' type, 'L' Type

5) Study of Lathe Machine tool.

6) Study of Plastic Injection Moulding.

7) Study of Moulding.

A minimum of five experiments shall be offered in GROUP A (CIVIL & MECHANICAL)

GROUP B (ELECTRICAL & ELECTRONICS)

ELECTRICAL ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

(a) Residential house wiring using switches, fuse, indicator, lamp and energy meter and Stair case wiring.

(b) Fluorescent lamp wiring.

(c) Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

(a) Study of Electronic components and equipment's – Resistor, colour coding Measurement of AC Signal parameter (peak-peak, rms, period, frequency) using CRO.

(b) Study of logic gates AND, OR, EX-OR and NOT Gate.

(c) Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

Total: 45 Periods

COURSE OUTCOMES:

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

1. Illustrate the centrifugal pump, air conditioner, lathe machine tool, molding, operations of foundry and fittings. (Understand)
2. Demonstrate the carpentry work and plumping work for a given diagram to complete the work. (Apply)
3. Select suitable tools for fabrication of sheet metals like cone, funnel and tray. (Apply)
4. Practice the welding and drilling operations for the various structures. (Apply)
5. Manipulate the components, Logic gates, soldering practices with help of printed circuit boards (PCB). (Understand)
6. Operate the various electronic components and using that for the industrial and housing application (Apply)

EQUIPMENT REQUIREMENT

CIVIL ENGINEERING

S.No.	Name of the equipment	Quantity Required
1.	Assorted components for plumbing consisting of metallic Pipes, plastic pipes, flexible pipes, couplings, unions, Elbows, plugs and other fittings	5 sets
2.	Carpentry vice (fitted to workbench)	15 Nos
3.	Standard working tools	15 sets
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	Power tool rotary hammer	2 Nos
6.	Demolition hammers	2 Nos
7.	Planer	2 Nos
8.	Hand drilling machine	2 Nos
9.	Jigsaw	2 Nos

MECHANICAL ENGINEERING

S.No.	Name of the equipment	Quantity Required
1.	Arc welding transformer with cables and holders	5 Nos
2.	Welding booth with exhaust facility	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	2 Nos
5.	Vice	5 Nos
6.	Hacksaw frame and blade	5 Nos
7.	Files	5 Nos
8.	Study-purpose items: Centre Lathe, pattern, cope & drag box and moulding tools	Each 1 No.

ELECTRICAL ENGINEERING

Sl.No	Name of the equipment /software	Quantity Required
1.	Assorted electrical components for house wiring	15 sets
2.	Electrical measuring instruments	10 sets
3.	Megger (250V/500V)	1 No
4.	Study purpose items: Iron box, fanand regulator, emergency lamp	One each
5	Power Tools: (a) Range Finder	2No 2No

ELECTRONICS ENGINEERING

Sl.No	Name of the equipment/software	Quantity Required
1.	Logic trainer kit	2 No
2.	CRO,AFO	2 Each
3.	Small multipurpose PCBs	10 No
4.	Soldering guns	10 No
5.	Multimeters	5 No
6.	Assorted electronic components for making circuits	Required quantity

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3							3	3				3		2
CO.2	3							3	3		3		3		3
CO.3	3							3	3		3		3		3
CO.4	3							3	3		3		3		3
CO.5	3							3	3		3		3		3
Co. 6	3							3	3		3		3		3
19UME111	**3**							**3**	**3**		**3**		**3**		**3**

Ref: 3- Strong 2-Medium 1 –Weak

19UGS113	BASIC SCIENCES LABORATORY	L	T	P	C
		0	0	2	1

PHYSICS LABORATORY

OBJECTIVES:

- To create scientific Temper among the students.
- To know how to execute experiments properly, presentation of observations and arrival of conclusions.
- To view and realize the theoretical knowledge acquired by the students through experiments.

LIST OF EXPERIMENTS
(Common to All Branches)

1. Laser – Determination of particle size and wavelength of Laser source using Diode Laser.
2. Ultrasonic Interferometer - Determination of velocity of sound and compressibility of liquid.
3. Poiseuille's method - Determination of Coefficient of viscosity of liquid.
4. Spectrometer – Determination of dispersive power of a prism.
5. Air Wedge method - Determination of thickness of a thin wire.
6. Uniform bending method – Determination of Young's modulus of the given rectangular beam.

- **A minimum of FIVE experiments shall be offered**

COURSE OUTCOMES:

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

1. Apply the principles of Optics, Laser physics and Elasticity to determine the Engineering properties of materials. (Apply)
2. Analyze the given liquid sample to determine the viscosity and compressibility of the liquid. (Analyze)
3. Apply the principles of spectroscopy to determine the properties of materials. (Apply)

CHEMISTRY LABORATORY

OBJECTIVES:

- To impart knowledge on basic concepts in applications of chemical analysis
- Train the students to handle various instruments.
- To acquire knowledge on the chemical analysis of various metal ions.

LIST OF EXPERIMENTS
(Common to All Branches)

1. Preparation of molar and normal solutions of the following substances – Oxalic acid , Sodium Carbonate , Sodium Hydroxide and Hydrochloric acid
2. Conductometric Titration of strong acid with strong base
3. Conductometric Titration of Mixture of Acids
4. Estimation of Iron by potentiometry
5. Determination of Strength of given acid using pHmetry
6. Determination of molecular weight of polymer by viscometry
7. Comparison of the electrical conductivity of two samples-conductometric method
8. Estimation of copper in brass by EDTA method

A minimum of FIVE experiments shall be offered

TOTAL: 30 Periods

Laboratory classes on alternate weeks for Physics and Chemistry

COURSE OUTCOMES:

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

4. Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis.(Apply)
5. Analyze the concentration of a given analyte by analytical method. (Analyze)
6. Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents. (Apply)

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	2										2	1		1
CO.2	3	3										2			1
CO.3	3	2										2			
CO.4	3					1	1		1			2			
CO.5	3	2				1	1		1			1			
Co. 6	3	2				1	1		1			1			1
19UGS113	**3**	**3**				**1**	**1**		**1**			**2**	**1**		**1**

Ref: 3- Strong 2-Medium 1 - Weak

Semester – II

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	HS	19UEN201	Communication Skills for Professionals	1	1	0	1.5	30
2.	BS	19UMA202	Calculus, Fourier Series and Numerical Methods	3	1	0	4	60
3.	BS	19UPH203	Material Physics (common to Mech & Chemical)	3	0	0	3	45
4.	HS	19UCY204	Environmental Science (common to All branches)	3	0	0	3	45
5.	ES	19UME205	Introduction to Mechanical Engineering	3	0	0	3	45
6.	ES	19UEE226	Basic Electrical and Electronics Engineering (common to MECH, Civil, Chemical & Agri)	3	0	0	3	45
PRACTICAL								
7.	BS	19UGS210	Energy and Environmental Science Laboratory	0	0	2	1.5	45
8.	ES	19UME211	Computer Aided Drafting and Modeling Laboratory	0	0	3	1.5	45
Total Credits : 20.5				**16**	**2**	**6**	**20.5**	

Course offered to EEE Department

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
1.	ES	19UME226	Basic Civil and Mechanical Engineering (for EEE)	3	0	0	3	45

COMMUNICATION SKILLS FORPROFESSIONALS

19UEN201	L	T	P	C
	1	1	0	1.5

OBJECTIVES:

- Improve their oral expression and thought.
- Develop their confidence and ability to speak in public.
- Develop their capacity for leadership.

5 Oral Projects

Project 1 **SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE**

(Time: 5 to 7 minutes)

- To Speak in front of an audience with courage.
- Make your message clear, with supporting material.
- Create a strong opening and conclusion.

Project2 SPEAK ON THE CHOSEN CONTENT (Time: 5 to 7minutes)

- Select a general topic and bring out specific purposes.
- Avoid using notes.
- Use symbolic ideas to develop your ideas.

Project3 USE EFFECTIVE BODY LANGUAGE & INTONATION (Time: 5 to 7minutes)

- Use appropriate posture, gestures, facial expressions and eye contact to express your ideas.
- Use proper intonation and adequate speech module.

Project4 PRESENT YOUR TOPIC WITH VISUAL AIDS (Time: 5 to 7minutes)

- Persuade your points with suitable illustration, specific facts, examples
- Use suitable visual aids to present your topic with confidence.

Project 5 GRASP THE ATTENTION OF THE AUDIENCE (Time: 5 to 7minutes)

- Influence your listeners by adopting holistic viewpoint.
- Use emotions, stories, and positive quotes in your speech.

Total Hours = 45 Periods

COURSE OUTCOMES

After successful completion of this course the students will be able to:

1. Communicate information ideas and opinions in any given situations
2. Use language appropriately with clarity and fluency in any given circumstances
3. Appraising the audience with clarity of thoughts with leadership quality
4. Present the ideas creatively with coherence for given topic
5. Evaluate the use of language to provide suggestions for correct usage

REFERENCE BOOKS:

1. Competent Communication- A Practical Guide to becoming a better speaker, Toastmasters International, USA.

2. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.

COURSE ARTICULATION MATRIX:

CO/PO/ PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1									2	3					2
CO.2										3					2
CO.3															
CO.4									2						
CO.5										3					2
19UEN201									**2**	**3**					**2**

Ref: 3-Strong 2-Medium 1-Weak

Internal and External Assessment plan

Internal Assessment plan

S.No	Criteria	Marks
1	Submission of 5 Project scripts	5x2= 10 marks
2	Prepared speech based on the Projects	5x5= 25 marks
3	<u>Performance in other Roles</u> 1. TMOD 2. Speech Evaluator 3. Table Topic Speaker and Master 4. GeneralEvaluator 5. JIG and TAG Team member	5x3= 15 marks
	Total	**50 marks**

External Assessment plan

S.No	Criteria	Marks
Prepared speech based on the Toastmasters Projects (5-7 minutes)		
1	Confident, Eye Contact, Body Language	5 marks
2	Content and clarity	20 marks
3	Command over Language	15 marks
4	Error free language	10 marks
	Total	**50 marks**

Internal = 50marks

External = 50marks

Total = 100 marks

Minimum Pass Mark = 50marks

		L	T	P	C
19UMA202	**CALCULUS, FOURIER SERIES AND NUMERICAL METHODS**	**3**	**1**	**0**	**4**

OBJECTIVES :

- To acquaint the student with the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.
- To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them.
- To familiarize the students to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them numerically and interpret the results.

UNIT I NUMERICALSOLUTION OF SIMULTANEOUS EQUATIONS ANDEIGENVALUEPROBLEMS **9 +3**

Iteration method – Newton-Raphson method – Gauss Elimination method – Pivoting – Gauss Jordan methods –iterative methods : Gauss Jacobi method ,Gauss Seidel method - Eigen values of a matrix by Power method – Jacobi's method for a real symmetric matrix.

UNITII SOLUTIONS OF ORDINARYDIFFERENTIALEQUATIONS **9 +3**

Exact, linear and Bernoulli's Equations, Euler's Equation- Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Applications of ODE in Mechanical Engineering.

UNITIII VECTORCALCULUS **9 + 3**

Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields –Vectorintegration–Green'stheoreminaplane,GaussdivergencetheoremandStokes' theorem(excludingproofs)–Simpleapplicationsinvolvingcubesandrectangularparallelopiped. Applications of Vector calculus in Mechanical Engineering.

UNITIV FOURIERSERIES 9 +3

Dirichlet'sconditions–GeneralFourierseries–Oddandevenfunctions–Halfrangesineseries – Half range cosine series - Parseval's identity – Harmonic analysis - Application of Fourier series.

UNITV FOURIERTRANSFORMS 9 +3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application of Fourier Transform.

SUPPLEMENT TOPIC (for internal evaluation only)

Evocation / Application of Mathematics.

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES:

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

1. Apply various techniques to solve linear , nonlinear equations and Eigen value problems of a Matrix Numerically
2. Apply the knowledge of higher order ordinary differential equations in real life engineering problems
3. Apply the uses of vector identities in problem solving and evaluate the line, surface and volume integrals
4. Apply the knowledge of Fourier series for the given function or Discrete data and compute the Periodic function arising in the study of Engineering problems
5. Apply the acquired knowledge of Fourier transform and its properties which are used to transform signals between time and frequency domain
6. Understand the basic concept of periodic function, scalar potential and order of differential equation

TEXT BOOKS:

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 42nd Edition,(2012).
2. Bali N.P., Manish Goyaland Watains, "Advanced Engineering Mathematics", Firewall Media (An imprint of Laxmi Publication Private limited) New Delhi, 7th Edition, (2009).
3. Iyengar S.R.K , Jain R.K. , Mahiden Kumar Jain " Numerical Methods for Scientific and Engineering Computations" New Age International Publishers 7th Edition 2019.

REFERENCE BOOKS:

1. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Engineering Mathematics III, S.Chand & Company Ltd., New Delhi, 3rd Edition,(1996).
2. Ramana.B.V,"HigherEngineeringMathematics"TataMcGrawHill,NewDelhi,11th Reprint(2010).
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 3rd Edition, (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10thEdition, (2011).

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3			1								1	2	2	
CO.2	3			1								1	2	2	
CO.3	3			1								1	2	2	
CO.4	3			1								1	2	2	
CO.5	3			1								1	2	2	
CO.6	3			1								1	2	2	
19UMA202	**3**			**1**								**1**	**2**	**2**	

Ref: 3-Strong 2-Medium 1 -Weak

19UPH203	MATERIAL PHYSICS	L	T	P	C
	(Common to Chemical &Mechanical Branches)	3	0	0	3

OBJECTIVES:

- To improve Cold work properties by increasing ductility and retaining most of the hardness.
- To cover the fundamental scientific principles for the different synthesis techniques and assembly of the advanced materials.
- To achieve an understanding of principles of thermodynamics and to be able to use it for physical systems like boiler, pressure vessels etc.,

UNITI STRENGTHENINGMECHANISM 13

Introduction - Strengthening mechanisms in metals-Work hardening-Solid solution strengthening –Precipitation hardening-Grain boundary strengthening- Transformation hardening-Strengthening mechanisms in amorphous materials-Polymer-Glass-Composite strengthening-Fiber reinforcement- Tensile strength-Anisotropy -Laminar reinforcement-Mechanical Testing methods-Applications.

UNITII THERMAL PHYSICS 10

Introduction-Law of Thermodynamics-Entropy-Thermal conduction, convection and Radiation- Newton’s law of cooling- Searle's apparatus and Lee's disc apparatus for determination of thermal conductivity-Thermal Expansion- Applications: Heat exchangers-Refrigerators-solar collector.

UNITIII NEW ENGINEERINGMATERIALS 12

Introduction-Metallic glasses– preparation – properties & applications -Shape memory alloys– preparation – properties & applications - Ceramic Materials: Introduction - Classification – Methods of Processing – Slip casting – Isostatic pressing - Gas pressure bonding -Properties – Application.

UNITIV NANO MATERIALS 10

Introduction to Nano materials –Various forms-Nano Dots-Nano rods-Nano fluids-Nano colloidal-Fullerene-Fabrication methods – Top-down and bottom up approach –Chemical Vapour deposition - ball milling - Carbon nanotubes-structure-properties –Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Analyze the suitable strengthening mechanism to improve the properties of materials relevant to industrial application. (Analyze)
2. Describe the laws of thermodynamics from both a macroscopic and microscopic point of view. (Understand)
3. Apply the strategies of new engineering materials and their manufacturing methods encountered in mechanical engineering. (Apply)
4. Analyze the various form of nanomaterial's for engineering and industrial applications (Analyze)
5. Apply the strengthening mechanism and testing methods involved in metals, non-metals and polymers. (Apply)
6. Analyze the principles of material physics to develop new projects in the field of nanotechnology and strengthening mechanism of new engineering materials. (Analyze)

TEXT BOOKS:

1. V. Raghavan, Material Science and Engineering: A First Course, 5th Ed, Prentice-Hall of India, 2018.
2. W.D. Callister (Jr.), Materials Science and Engineering: An Introduction, 6th Ed., 2018.

REFERENCE BOOKS:

1. Dr. Mani.P ,"Material science ", Dhanam Publications, Chennai Revised Edition, 2018
2. Pillai S.O, "Solid State Physics", New Age Inc, Revised Edition 2018.
3. Kingery W.D., Bowen H.K. and Dr. Uhlmann, "Introduction to Ceramics', Forth Edition, Wiley and sons, Revised Edition 2016.
4. Raghavan.V, "Material Science and Engineering", Prentice Hall of India Private Limited, New Delhi, Revised Edition 2018.
5. Vijayakumari, "Engineering Physics", Vikas Publishing, New Delhi, Revised Edition 2016.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	2													2
CO.2	2	2												2	
CO.3	2	2										2			
CO.4	3														
CO.5	2	2													
CO.6	3	2													2
19UPH203	**3**	**2**										**2**		**2**	**2**

Ref: 3-Strong **2-Medium** **1-Weak**

19UCY204	ENVIRONMENTAL SCIENCE (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of Environment and ecosystem.
- To acquire knowledge about the impact of environmental pollution.
- To understand the importance of environmental issues in the society.
- To gain knowledge about the impact of environment related to human health.
- To gain knowledge in alternative energies.

UNITI ENVIRONMENT AND ECOSYSTEMS 9

Definition, scope and importance of environment – Need for public awareness – Concept of ecosystem – Structure and function of ecosystem – Producers, consumers and decomposers-Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grassland ecosystem.

UNITII 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 - pollution case studies - Role of an individual in prevention of pollution –Disaster management: floods, earthquake, cyclone and landslides.

UNITIII SOCIAL ISSUES ANDTHE ENVIRONMENT 9

Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).

UNITIV HUMAN POPULATION ANDTHEENVIRONMENT 9

Population growth, variation among nations – Population explosion – Human rights – Family welfare programme – Environment and Human Health – Human Rights - Value education –HIV / AIDS – Women and child welfare – Role of information technology in environment and human health.

UNITV FUTURE POLICYANDALTERNATIVES 9

Introductiontofuturepolicyandalternatives-fossilfuels-nuclearenergy-solarenergy-windenergy - hydroelectric energy-geothermal energy - tidal energy – sustainability - green power-nanotechnology**.**

Total: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Understand the basic concept of structure and function of ecosystem (Understand)
2. Apply the knowledge of various pollution types to prevent the ecosystem and Environment (Apply)
3. Analyze the environmental problem to report the social issues and the Environment (Analyze)
4. Device suitable methods for conservation and sustainable development of natural resources (Analyze)
5. Apply the principles of value education with respect to human population to preserve Environment (Apply)
6. Analyze the current energy crisis and suggest suitable sustainable alternatives that promotes social health and environmental prospects (Analyze)

TEXT BOOKS

1. Anubha Kaushik, kaushik C.P., "Environmental Science and Engineering", Third Edition, New Age International, New Delhi,2009.
2. Benny Joseph "Environmental Science and Engineering", Tata Mc-Graw Hill, New Delhi, 2006.

REFERENCE BOOKS:

1. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', Pearson Education, Upper saddle River, New Jersey,2008.
2. Miller T.G. Jr., Environmental Science", Wadsworth Publishing Company, Belmont, California,2005.
3. De A.K., "Environmental Chemistry", Wiley Eastern Ltd., New Delhi,2001.
4. TrivediR.K.,GoelP.K.,"IntroductiontoAirPollution",Techno-SciencePublication,Jaipur, 2005.

COURSE ARTICULATION MATRIX: CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2	1				2	3					2			
CO.2	3	1				2	3					2		1	
CO.3	3	1				2	3					2		1	
CO.4	3	1				2	3					2			
CO.5	3	1				2	3					2			
CO.6	3	1				2	3					2		1	1
19UCY204	**3**	**1**				**2**	**3**					**2**		**1**	**1**

Ref: 3-Strong 2-Medium 1–Weak

		L	T	P	C
19UME205	**INTRODUCTION TO MECHANICAL ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES :

- To provide a general understanding about mechanical engineering
- To enable the students to understand the details about the energy systems and IC engines.
- To demonstrate the various machine elements, materials and its function.
- To help the students acquire knowledge about the various manufacturing process.

UNIT I ELEMENTS OF MECHANICAL ENGINEERING 9

Concepts of Mechanical - Thermal engineering, Machine design, Industrial engineering, and Manufacturing technology. Overview of Mechanical Industries, Career opportunities to Mechanical Engineering, Role of alumni in Mechanical Engineering-case study.

UNIT II. ENERGY SYSTEMS AND IC ENGINES 9

Classification of Power Plants – Working principle of steam, Hydro- electric and Nuclear Power plants -Working principle of Petrol and Diesel Engines, Introduction to E-Vehicles. Principle of Vapour compression and absorption system.

UNIT III ENGINEERING DESIGN 9

Introduction to Design Process, Machine elements and Mechanisms, and Engineering Materials- Types of materials.

UNIT IV MANUFACTURING PROCESSES 9

Manufacturing, Classification- Introduction to casting- Introduction to metal joining process- Gas welding-Equipment'sused-Flamecharacteristics-Arcwelding(explanationwithsketch)Arcwelding Equipment's- Machine tools- Lathe, parts of Lathe.

UNIT V INDUSTRIAL ENGINEERING 9

Introduction to Industrial Engineering: - Introduction to TQM-Deming principles, Introduction -5S, KAIZEN, PDSA CYCLE, Industrial Automation- impact on automation.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the basic concept and fundamentals of mechanical engineering. (Understand).
2. Explain about the various working process of power plant, E-Vehicle and I.C engines. (Understand)
3. Illustrate the various components of machine elements, materials and its function. (Understand)
4. Explain the various working process of casting, arc welding, gas welding and machine tool. (Understand)
5. Explain the basic concepts of industrial engineering and automation. (Understand)
6. Outline the basic concepts and importance of various components by using TQM technique. (Understand)

TEXT BOOKS:

1. Lecture notes prepared by Department of Mechanical Engineering.
2. Elements of Mechanical Engineering, K. R. Gopalakrishna, Subhas Publications, Bangalore-2008.

REFERENCEBOOKS:

1. A Text Book of Elements of Mechanical Engineering – S. Trymbaka Murthy I. K. International Pvt Ltd, 2010 – Mechanical Engineering
2. Elements of Mechanical Engineering – Dr. A.S. Ravindra, Best Publications, 7thedition,2009.
3. Elements of Mechanical Engineering, Vol.1 & 2, Hajra Choudhury, Media Promoters, New Delhi,2001.
4. Venugopal K., Prabhu Raja V., and Sreekanjana G., “Basic Civil and Mechanical Engineering”, Anuradha Publications, Third Edition 2010.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3												3		2
CO.2	3												3		2
CO.3	3												2		2
CO.4	3												3		2
CO.5	3												3		2
CO.6	3												3		2
19UME205	**3**												**3**		**2**

Ref: 3- Strong 2-Medium 1 –Weak

19UEE226	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
	(COMMON TO MECH, CIVIL, CHEMICAL & AGRI)	3	0	0	3

OBJECTIVES :

- This course facilitates the students to get a comprehensive exposure to electrical and electronics engineering.

UNIT I DC AND AC CIRCUITS **9**

Direct currents and voltages, power, Kirchoffs Laws, Alternating current and voltage, Peak, RMS and average values, circuit elements R,L &C, Phasor Diagram, impedance, real and reactive power in single phase circuits.

UNIT II DC MACHINES AND TRANSFORMERS **9**

DC machines Construction, principle of operation and applications, Single phase transformer – construction, principle of operation, Introduction to three phase systems.

UNIT III AC MACHINES **9**

Synchronous and Induction machines -Construction, Principle of operation, and applications.

UNIT IV SPECIAL MACHINES **9**

Brushless D.C Motor, Stepper Motor, Linear motor and Universal Motor – Construction, Principle of operation and applications.

UNIT V INTRODUCTION TO ELECTRONICS **9**

Diode- PN Diode, Zener Diode, BJT Configurations, Rectifiers, Data acquisition system- ADC, DAC – principles of operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the basic laws of electrical circuits to linear circuit problems.
2. Summarize the working principle and construction of DC machines and transformers.
3. Explain the principle of operation and construction of AC machines.
4. Explain the working principle and construction of Special machines.
5. Illustrate the characteristics of basic semiconductor devices.

REFERENCE BOOKS:

1. V K Mehta and Rohit Mehta, *"*Principles of Electrical Engineering and Electronics", S. Chand Publishing, New Delhi, 2019.
2. Arumugam M. and Premkumar N., "Electric circuits theory", Khanna Publishers, 7th edition, NewDelhi,2007.
3. Kothari D.P. Nagrath I.J, "Electric Machines", Tata McGraw Hill,2009.
4. K. Venkataratnam, Special Electrical Machines, Universities Press,2014.
5. R.J.Smith, R.C.Dorf, Circuits devices and systems, 5th edition, John Wiley and sons,2001. Malvino, A.P, Leach D.P and Gowtham Sha, Digital Principles andApplications,6th Edition, Tata McGraw hill,2007.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	3	2												
CO.2	3	2													
CO.3	3	2													
CO.4	3	2													
CO.5	3	2													
19UEE226	**3**	**3**	**2**												

Ref: 3-Strong 2-Medium 1-Weak

19UGS210	ENERGY AND ENVIRONMENTAL SCIENCE LABORATORY (MECH, CHEM, ECE, EEE, CSE, IT, BME, AGRI, CIVIL)	L	T	P	C
		0	0	2	1.5

OBJECTIVES :

- To analyze the Band gap, moment of inertia, thermal conductivity and rigidity modulus of the materials.
- To gain knowledge in PHOTONICS.
- Apply the theoretical concepts to perform lab experiments.
- To assess the water quality parameters.
- To acquire knowledge on water quality parameters for the analysis of industrial effluents.

PHYSICS LABORATORY (COMMON TO ALL BRANCHES)

LIST OF EXPERIMENTS

1. Determination of Energy band gap of a semiconductor.
2. Torsion pendulum – Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire.
3. Spectrometer - Determination of wavelength of mercury spectrum using grating.
4. Laser – Determination of numerical aperture and acceptance angle of an optical fiber
5. Newton's rings – Determination of radius of curvature of a convex lens
6. Lee's Disc - Determination of thermal conductivity of a bad conductor.
7. Determination of Solar cell Characteristics using optical transducers kit.

A minimum of FIVE experiments shall be offered

CHEMISTRY LABORATORY (Common to All Branches)

LIST OF EXPERIMENTS

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of Chloride in water sample (Argentometric method)
4. Determination of DO in water
5. Estimation of chromium in tannery wastes
6. Estimation of available chlorine in bleaching powder
7. Estimation of iron by Spectrophotometry.
8. Determination of acidity of industrial effluents.

A minimum of FIVE experiments shall be offered

TOTAL: 45 Periods

COURSE OUTCOMES:

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

1. Apply the principles of Light and Elasticity to determine the Engineering properties of materials (Apply)
2. Analyze the thermal conductivities of different bad conductors (Analyze)
3. Analyze the Characteristics of a semiconductor (Analyze)
4. Apply the basic knowledge of water quality testing for environmental sustainability (Apply)
5. Analyze the water quality parameters for industrial effluents to prevent eater pollution (Analyze)
6. Estimate the quality of water that suits for domestic and industrial applications (Apply)

Laboratory classes on alternate weeks for Physics and Chemistry

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	3										2	1		
CO.2	3	3										2		3	1
CO.3	3	3										2			
CO.4	3	2				2	3		1			2		1	1
CO.5	3	2				2	3		1			2		1	1
CO.6	3	2				2	3		1			2		1	1
19UGS210	**3**	**3**				**2**	**3**		**1**			**2**	**1**	**3**	**1**

Ref: 3-Strong 2-Medium 1–Weak

		L	T	P	C
19UME211	**COMPUTER AIDED DRAFTING AND MODELING LABORATORY**	**0**	**0**	**3**	**1.5**

OBJECTIVES :

1. To demonstrate the capabilities of software for drafting and modeling.
2. To train the students understand and draw simple solids, isometric projection of simple objects and residential building.

LIST OF EXPERIMENTS:

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi- line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V- block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.).
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc.
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

A minimum of nine experiments shall be offered

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Construct the parabola and involutes using B spline or cubic spline. (Apply)
2. Draw the 2D view of simple solids like V-block, base of a mixie and regular solid. (Apply)
3. Construct the 3D view of objects in Isometric projection using AutoCAD software. (Apply)
4. Draw the sectional view of solids like prism, pyramid, cylinder and cone. (Apply)
5. Sketch a plan of residential building using AutoCAD software (Apply)
6. Sketch the simple steel truss using AutoCAD software. (Apply)

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3				3			3	3				3		2
CO 2	3				3			3	3				2		2
CO 3	3				3			3	3				3		2
CO 4	3				3			3	3				3		2
CO 5	3	3			3			3	3				3		3
CO 6	3	3			3			3	3				3		3
19UME211	**3**	**3**			**3**			**3**	**3**				**3**		**3**

Ref: 3-Strong 2-Medium 1 -Weak.

19UME226	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

(Course offered to EEE Department)

OBJECTIVES :

- To understand the fundamentals of thermal systems
- To understand the basics of building construction and infrastructures

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying:

Objects – types – classification – principles – measurements of distances – angles –leveling – determination of areas – illustrative examples.

Civil Engineering Materials:

Bricks – stones – sand – cement – concrete – steel sections

UNIT II BUILDING COMPONENTS AND STRUCTURES 9

Foundations:

Types, bearing capacity – Requirement of good foundations - Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 9

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV IC ENGINES 9

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Summarize the measurement of landscape and different building materials with norms. (Apply)
2. Classify the different building structure and its applications relevant to civil engineering practice. (Apply)
3. Interpret the ideas of variety of energy sources considering the norms of engineering practice.(Understand)
4. Explain the working principle of I.C engines. (Understand)
5. Discuss the working principle of Refrigeration and Air conditioning systems. (Understand)
6. Explain the energy sources and operating principles of power plants in order to analyse the engineering problem. (Understand)

TEXT BOOKS:

1. Shanmugam G. and Palanichamy M.S., “Basic Civil and Mechanical Engineering”, Tata Mc-Graw Hill Publishing Co., New Delhi, 2012.
2. Venugopal K., Prabhu Raja V., and Sreekanjana G., “Basic Civil and Mechanical Engineering”, Anuradha Publications, Third Edition 2010.

REFERENCE BOOKS:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai, Publishing Co. (P) Ltd, 2008.
2. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.
3. Shantha Kumar S.R.J., “Basic Mechanical Engineering”, Hi-Tech Publications, Mayiladuthurai, 2000.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2					3	2	3							
CO.2	2					3	3	2							
CO.3	2					2	2	3							
CO.4	2														
CO.5	2					2		2							
CO.6	2					2		2							
19UME226	**2**					**3**	**3**	**3**							

Ref: 3 - Strong 2 - Medium 1 - Weak

Semester – III

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	BS	19UMA321	Probability, Statistics and Partial Differential Equations	3	1	0	4	60
2.	PC	19UME302	Fundamentals of Manufacturing Processes **(INTEGRATED)**	3	0	2	4	75
3.	PC	19UME303	Engineering Thermodynamics	3	1	0	4	60
4.	PC	19UME304	Fluid Mechanics and Machinery **(INTEGRATED)**	3	0	2	4	75
5.	ES	19UME305	Engineering Mechanics	3	1	0	4	60
6.	ES	19UME306	Materials Engineering	3	0	0	3	45
7.	P	19UME307	Seminar	0	0	2	1	30
Total Credits : 24				**18**	**3**	**6**	**24**	

19UMA321	PROBABILITY, STATISTICS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To make the student acquire sound knowledge of fundamentals and applications of statistics which will greatly help at the data analysis stage of comparative experiments.
- To make the student acquire sound knowledge of standard distributions that can describe real life phenomena.
- To make the student knowledgeable in formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.

UNIT I TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Normal, t, Chi-square and F distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9 + 3

Completely randomized design – Randomized block design – Latin square design.

UNIT III PROBABILITY & RANDOM VARIABLES 9 + 3

Axioms of probability - Conditional probability - Total probability - Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Normal and Exponential- Joint probability distributions - Marginal and Conditional distributions – Covariance - Correlation and Regression

UNIT IV PARTIALDIFFERENTIALEQUATIONS 9 + 3

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

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Introduction of Partial differential equations - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES:

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

1. Analyse the concept of testing of hypothesis for small and large samples in Real life Problems
2. Analyse a process, to find its significance using design of experiments
3. Apply the knowledge of concepts of probability to acquired knowledge of standard Distributions, Correlation and regression
4. Apply the knowledge of partial differential equation in solving linear and higher order partial differential equation
5. Apply the knowledge of PDE in solving linear, higher order and one dimensional Wave, Heat flow equation
6. Understand the knowledge of small sample and large sample, axioms of probability and Nature of PDE

TEXT BOOKS:

- Gupta S.C, Kapoor V.K. “Fundamental of Mathematical Statistics” 10th Edition Sultan Chand and Sons, New Delhi2002.
- Grewal, B.S. “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 35th Edition, (2010).
- Guptha S.K. “Numerical Methods For Engineers” New Age international Private Limited Publishers ,2015

REFERENCE BOOKS:

- Walpole. R.E., Myers .R.H., Myers S.L., and YE. K, “Probability and Statistics for Engineers and Scientists”, Pearson Education, New Delhi, 8th edition,(2007).
- Veerarajn.T “Probability and Statistics” Tata McGraw Hill Publishing company Limited2008.
- Spiegel M.R., Schiller J. and Srinivasan R.A., “Schaum’s Outlines Probability and Statistics”, Tata McGraw Hill, New Delhi,(2004).

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	3		1								1	2	2	
CO.2	3	3		1								1	2	2	
CO.3	3			1								1	2	2	
CO.4	3			1								1	2	2	
CO.5	3			1								1	2	2	
CO.6	3			1								1	2	2	
19UMA321	**3**	**3**		**1**								**1**	**2**	**2**	

Ref: 3-Strong 2-Medium 1-Weak

19UME302	FUNDAMENTALS OF MANUFACTURING PROCESSES	L	T	P	C
		3	0	2	4

(An Integrated Core Course)

OBJECTIVES :

- To impart the knowledge on the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.
- To expose the various manufacturing methods employed in industries.

UNIT I METAL CASTING PROCESSES 9

Sand casting - Sand moulds - Type of patterns - Pattern materials - Pattern allowances -Types of Moulding sand - Properties - Core making - Methods of Sand testing - Moulding machines - Types of moulding machines - Melting furnaces - Working principle of Special casting processes - Shell, investment casting - Ceramic mould- Lost Wax process -Pressure die casting- Centrifugal casting - CO2 process - Sand Casting defects and remedies - Inspection methods, Gating and risering. Fettling and cleaning of casting. Introduction to Metal forming and flow analysis software (for metallic /plastic components).

UNIT II JOINING PROCESSES 9

Fusion welding processes - Types of Gas welding - Equipments used - Flame characteristics - Filler and Flux materials - Arc welding equipments - Electrodes - Coating and specifications - Principles of Resistance welding - Spot/butt, seam welding –Per cusion welding - Gas metal arc welding - Flux cored - Submerged arc welding - Electro slag welding - TIG welding - Principle and application of special welding processes - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding - Diffusion welding, Friction stir welding and Ultra sonic welding - Weld defects - Brazing and soldering process - Methods and process capabilities - Filler materials and fluxes - Types of Adhesive bonding.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals - Forging processes - Open impression and closed die forging - Characteristics of the process - Types of Forging Machines - Typical forging operations - Rolling of metals - Types of Rolling mills - Flat strip rolling - Shape rolling operations - Defects in rolled parts - Principle of rod and wire drawing - Tube drawing, Drawing applications, defects. Types of presses - Principles of Extrusion - Types of Extrusion - Hot and Cold extrusion - Equipment’s used.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics - Typical shearing operations, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods - Working principle and application of special forming processes - Hydro forming - Rubber pad forming - Metal spinning - Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming, electromagnetic forming, electro hydraulic forming

.

UNIT V MANUFACTURING OF PLASTIC COMPONENTS 9

Types of plastics - Characteristics of the forming and shaping processes - Moulding of Thermoplastics - Working principles and typical applications of - 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. powder metallurgy process, composite Mouldings.

LABORATORY EXERCISE 30

1. Mould with solid pattern
2. Mould with split pattern
3. Mould with ‘T’ Pipe
4. Mould with Bend Pipe
5. Welding Process - Lap joint, Butt joint, ‘T’ joint & ‘L’ joint
6. Gas Cutting, Gas Welding - for demonstration purpose
7. Plain Turning and Step Turning
8. Taper Turning, Thread Cutting and Knurling

TOTAL : 45 (L) + 30 (P) = 75 Periods

COURSEOUTCOMES:

After successful completion of this course the students willbe:

1. Interpret the most important manufacturing processes with respect to applications, economics and environmental impact. **Understand**
2. Illustrate the fundamental manufacturing concepts of sheet metal and plastic components processes. **Understand**
3. Select the role of manufacturing processes in a production system, including the necessity of appropriate equipment, tooling and automation. **Apply**
4. Make use of the manufacturing process like casting, welding, hot and cold working and sheet metal forming in the context of a process chain for a finished part. **Apply**
5. Identify how some of the most common parts and products in modern industry are manufactured. **Apply**
6. Operate the lathe to machine the simple components as per the given specifications. **Apply**
7. Join the two similar metal as per the given shape, size and dimensions of a components. **Apply**
8. Analyze the moulding processes using any solid and split patterns. **Analyze**

REFERENCE BOOKS:

1. Pn. Rao “Manufacturing Technology Vol 1 Foundary Forming & Welding”, Tata Mcgraw Hill Publishing Co Ltd, 4th Edition 2016.
2. Serope Kalpakjian, Steven Schmid. “Manufacturing Engineering & Technology”, Pearson Edu Asia, 7th Edition, 2014.
3. Ghosh A., Malik A.K. “Manufacturing Science”, Affiliated East-West Press Ltd, 2nd Edition, 2010.
4. A Text-Book of Foundry Technology, O.P. Khanna, Dhanpat Rai Publications, 2011
5. Principles of metal casting, Carl R Loper, Philip C Rosenthal, Richard W Heine, Tata McGraw-Hill, 2013.
6. A Text-Book of Welding Technology, O.P Khanna, Dhanpat Rai Publications, 2011.
7. Manufacturing Process: Casting & Welding Process, Radhakrishna K, Sapna Book House, 2015.
8. Powder Metallurgy Technology, G. S. Upadhyaya, Cambridge International science publishing, 2007.
9. Hajra Choudhury, “Elements of Workshop Technology, Vol. I and II”, Media Promotors Pvt. Ltd, Mumbai, 2001.
10. Sharma. P.C, “A text book of production technology”, S. Chand and Company, I Edition, 2003.

E-Books / Website References

1. Principles of foundry technology, P L Jain, 4th edition, Tata McGrawHill,2006. (https://books.google.co.in/books?id=NOotk64Grx0C&printsec=frontcov)
2. Advanced Welding Processes technology and process control, John Norrish, Wood Head Publishing,2006.(http://www.elcoweld.com/files/editor/downloads/elmi/AWP1.pdf)
3. E-Foundry - IIT Bombay -http://efoundry.iitb.ac.in/Academy/index.jsp
4. NPTEL -http://nptel.ac.in/courses/112107145
5. http://www.astm.org/DIGITAL_LIBRARY/STP/SOURCE_PAGES/STP494.htm

Content beyond the syllabus:

1. Introduction to Additive manufacturing(Theory);
2. Demonstration of casting processes (Lab).

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2						2						2		
CO.2	3	3													
CO.3		3													
CO.4		3	2												
CO.5		3			2										
CO.6		3					2								3
CO.7		3			3				3						3
CO.8	3	3			3			3	3						3
19UME302	**3**	**3**	**2**		**3**		**2**	**3**	**3**				**2**		**3**

Ref: 3- Strong 2-Medium 1 - Weak

19UME303 ENGINEERING THERMODYNAMICS

L	T	P	C
3	1	0	4

(Use of standard Steam table and Mollier diagram, Psychrometric Chart are permitted)

OBJECTIVES:

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

- Convey knowledge on the basics and application of laws of thermodynamics.
- Impart knowledge on the analyzing the performance of thermal devices.
- Demonstrate the various properties of steam through steam tables and Mollier chart.
- Impart knowledge on the properties of ideal and real gases and various thermodynamic relations.
- .Analyzing the psychrometric properties and various Psychrometric processes.

UNITI BASIC CONCEPTS ANDFIRSTLAW 9+3

Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics, concept of temperature and heat. First law of thermodynamics - application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNITII SECOND LAWANDENTROPY 9+3

Second law of thermodynamics – Kelvin's and Clausius statements of second law, perpetual-motion machines, Heat Engines, Refrigerator and Heat Pump, Coefficient of Performance, Reversibility and irreversibility, Carnot cycle - reversed Carnot cycle, Carnot theorem, Thermodynamic temperature scale. Clausius theorem, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – absolute entropy

UNITIII PROPERTIES OF STEAM AND STEAMPOWERCYCLES 9+3

Properties of pure substances - Formation of steam at constant pressure, Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam., Calculations of work done and heat transfer in non- flow and flow processes.,– steam tables and Mollier chart uses, standard Rankine cycle.

UNITIV IDEAL AND REAL GASES ANDTHERMODYNAMICRELATIONS 9+3

Gas mixtures ,Properties ideal and real gases, equation state, Avogadro's Law, VanderWall's equation of state, compressibility factor, compressibility chart- Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule-Thomson coefficient.

UNITV PSYCHROMETRY 9+3

Properties of Atmospheric air, Psychrometry, Psychrometry charts, Property calculation of air-vapour mixtures, Psychrometric processes, Sensible heat exchange processes, Latent heat exchange processes, Adiabatic mixing, Evaporation cooling, Adiabatic saturation-Steam injection

Total 45 (L)+15 (T) = 60 Periods

Course outcomes

Course outcomes after successful completion of the course, the student would be able to

1. Explain the basic concepts of thermodynamics , steam properties and various psychometric processes.(Understand)
2. Apply the first and second law of thermodynamics to solve problems in various thermal equipments. (Apply)
3. Apply the concept of thermodynamics derive the energy equation and various thermodynamic relations. (Apply)
4. Apply the thermodynamic properties of steam and concepts to calculate workdone and heat transfer in various thermal devices. (Apply)
5. Analyse the performance of energy conversion devices and steam power cycles.(Analyse)
6. Design the refrigeration system by estimating the cooling load in various environment Conditions. (Evaluate)

TEXT BOOKS:

1. Rajput.R.K , “Engineering Thermodynamics”, Laxmi Publication, Fourth edition, New Delhi,2010.
2. Yunus a. Cengel and michael a. Boles, Thermodynamics, 8th edition 2015.

REFERENCE BOOKS:

1. Holman.J.P, “Thermodynamics”, Tata McGraw-Hill, Third Edition,2006.
2. Cengel Y., “Thermodynamics An Engineering Approach”, Tata McGraw-Hill, New Delhi, 2008.
3. Venwylen, Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987.
4. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi,2004.
5. Natarajan. E, “Engineering Thermodynamics”, Anuragam Publications, First Edition, 2012.
6. Nag.P.K, “Engineering Thermodynamics”, Tata McGraw-Hill, Third reprint, New Delhi, 2017.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2													2	
CO.2	3	2						2						3	
CO.3	3	2												3	
CO.4	3	2				2		2						3	
CO.5	3	3							3			2		3	
CO.6	3	3	3		2	2	2	3	3			2	3	3	2
19UME303	**3**	**3**	**3**		**2**	**2**	**2**	**3**	**3**			**2**	**3**	**3**	**2**

Ref: 3-Strong 2-Medium 1 –Weak

19UME304	FLUID MECHANICS AND MACHINERY (Integrated Course)	L	T	P	C
		3	0	2	4

OBJECTIVES :

- To understand the structure and the properties of the fluid.
- To analyze the complexities involved in solving the fluid flow problems.
- To familiarize the flow measurement devices, roto dynamic machines and positive displacement machines.
- The laboratory exercises aim at imparting practical knowledge on concepts of fluid mechanics by conducting experiments in flow through pipes / pumps and turbine.

UNIT I INTRODUCTION 9

Units & Dimensions. Properties of fluids - Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws - capillarity and surface tension. Types of flow - laminar, turbulent, unsteady, steady, non-uniform and uniform flows. Stream line, streak line and path line. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation. Manometry.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 9

Pressure at a point. Hydrostatic law and aerostatic law Statement of Navier Stokes equation, derivation of Euler's equation and Bernoulli's energy equation, examples illustrating the use of energy equations. Laminar flow though circular conduits and circular annuli. Hydraulic and energy gradient. Darcy – Weisbach equation. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.

UNIT III DIMENSIONAL ANALYSIS 9

Dimension and units: Rayleigh method, Buckingham’s π theorem. Discussion on dimensionless parameters Reynolds, Froude, Euler, Weber and Mach number and their application in model testing. Models and similitude. Applications of dimensionless parameters.

UNIT IV HYDRAULIC TURBINES 9

Impact of jets - Velocity triangles - Theory of roto-dynamic machines - Classification of turbines – Pelton wheel, Francis turbine (inward and outward) and Kaplan turbine- Working principles-Workdonebywaterontherunner-Efficiencies–Drafttube-Specificspeed-
Performance curves for turbines – Governing of turbines.

UNIT V HYDRAULIC PUMPS 9

Classification of pumps- Centrifugal pumps– working principle -Hydraulic accumulator- Heads and efficiencies– Velocity triangles- Work done by the impeller - performance curves - Reciprocating pump working principle – indicator diagram and it's variations – work saved by fitting air vessels.

LAB EXERCISES

1. Determination of rate of fluid flow through a uniform diameter pipe using orificemeter.
2. Determination of rate of fluid flow through a uniform diameter pipe using venturimeter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set of pipes.
5. Determination of losses in pipe section.
6. Performance test on Pelton wheel / Francis turbine.
7. Performance test on centrifugal pump / reciprocating pump.

TOTAL : 45 (L) + 30 (P) = 75 Periods

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Outline the fundamental concepts and working principle of various fluid flow systems. (Understand)
2. Apply the fundamental concept of fluid mechanics to calculate the various fluid properties for the given problem. (Apply)
3. Apply the velocity triangle concept to calculate the various parameters of hydraulic turbines and centrifugal pump. (Apply)
4. Apply the concept of conservation laws and Buckingham's π theorem to compute losses in circular pipes and solve the dimensional analysis of a given set of variables. (Apply)
5. Analyze the performance characteristics of hydraulic turbines and pumps. (Analyze)
6. Calculate the coefficient of discharge for flow through pipes using venturimeter and orifice meter. (Apply)
7. Draw the performance characteristics of hydraulic turbines and pumps to determine the efficiency. (Apply)
8. Perform the major loss in flow through pipes to calculate the friction factor using virtual lab. (Apply)

REFERENCE BOOKS:

1. Bansal .R.K, “Fluid Mechanics and Hydraulics Machines ”, Laxmi Publications (P) Ltd, Ninth Edition, New Delhi,2010.
2. Ramamritham.S, “Fluid Mechanics, Hydraulics and FluidMachines”,Dhanpat Rai & Sons, New Delhi, 2012.
3. Kumar. K.L, “Engineering Fluid Mechanics ”, Eurasia Publishing House (P) Ltd, Seventh Edition, New Delhi, 1995.
4. Streeter. V. L,Wylie, E.B “Fluid Mechanics ”, Tata McGraw-Hill,1983.
5. Rathakrishnan. E, “Fluid Mechanics ”, Prentice Hall of India, Second Edition,2007.
6. Frank White, “Fluid Mechanics ”, Tata Mcgraw Hill Education Pvt. Ltd, Seventh Edition, New Delhi,2011.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2											2	2		
CO 2	3													2	
CO 3	3														
CO 4	3														
CO 5	3	3					2								
CO 6	3							3							
CO 7	3							3		2					2
CO 8	3							3					3		
19UME304	**3**	**3**					**2**	**3**		**2**		**2**	**3**	**2**	**2**

Ref: 3- Strong 2-Medium 1 –Weak

19UME305	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand the vectorial and scalar representation of forces and moments.
- To apply static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. To comprehend the effect of friction one quilibrium.
- To understand the principle of work and energy, the laws of motion, the kinematics of motion.
- To write the dynamic equilibrium equation.

UNIT I BASICS & STATICS OF PARTICLES 9+3

Introduction - Units and Dimensions - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces - Equivalent systems of forces - Principle of transmissibility - Single equivalent force - Resolution and Composition of forces - Equilibrium of a particle. Vectors - Vectorial representation of forces and moments - Coplanar Forces - Forces in space - Equilibrium of a particle in space.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Moments and Couples - Moment of a force about a point and about an axis - Types of supports and their reactions - Varignon's theorem - Free body diagram - Equilibrium of Rigid bodies in two and three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+3

First moment of area and the Centroid of sections T section, I section, Angle section, Hollow section, Parallel axis theorem and perpendicular axis theorem, Theorem of Pappus Theorem of Pappus and Guldinus Theorem - second and product moments of plane area of T section, I section. Polar moment of inertia, Principal axes of inertia of I section, L section- Mass moment of inertia simple sections.

UNIT IV DYNAMICS OF PARTICLES 9+3

Displacements, Velocity and acceleration, their relationship-Relative motion– Rectilinear Motion and Curvilinear- Newton's law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.

UNIT V FRICTION 9+3

Frictional force - Laws of Coloumb friction - Angle of Repose- Cone of friction -Simple contact friction - Rolling resistance –Screw jack friction – Belt friction

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the vectorial and scalar representation of forces and moments. Understand
2. Apply laws of mechanics, momentum, work energy and friction to calculate the resultant force, friction and motion of rigid bodies. Apply
3. Apply the concept of dynamics of particles and frictional force to solve the given problem. Apply
4. Apply the different mechanisms concept to build mathematical models and develop position, velocity and acceleration relations using virtual lab. Apply
5. Solve planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction. Apply
6. Compare the analytical result of centroid, moment of inertia of the given problem with software tool. Analyze

TEXT BOOKS:

1. Kottiswaran.N, “Engineering Mechanics, Statics and Dynamics”, Sri Balaji Publications, 2019

2. Hibbeller.R.C, “Engineering Mechanics: Statics & Dynamics”, Pearson Education Asia Pvt. Ltd, 2012.

REFERENCE BOOKS:

1. Ferdinand P. Beer, E. Russell JohnstonJr.,David F. Mazurek, Phillip J. Cornwell and Elliot R. Eisenberg “Vector mechanics for Engineers: Static and Dynamic”, McGraw-Hill International, Ninth Edition,2010.
2. Palanichamy.M.S, Nagan.S, “Engineering Mechanics: Statics and Dynamics”, Tata McGraw Hill,2011.
3. Rajasekaran.S, Sankarasubramanian.G, “Fundamentals of Engineering Mechanics”, Vikas Publishing House Pvt. Ltd,2012.
4. Irving H. Shames, “Engineering Mechanics – Statics and Dynamics”,Pearson Education Asia Pvt. Ltd, IV Edition, 2013.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2												2		
CO.2	3							2					3		
CO.3	3												3		
CO.4	3							2	3				3		
CO.5	3								3				3		
CO.6	3	3			3			3	3			2	3		
19UME305	**3**	**3**			**3**			**3**	**3**			**2**	**3**		

Ref: 3- Strong 2-Medium 1 –Weak

19UME306	MATERIALS ENGINEERING	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.
- To explain the various tests and experiments available to improve the quality characteristics.

INTRODUCTION TO MATERIAL PHYSICS (NOT FOR EXAM)

Crystal structure - BCC, FCC and HCP structure - unit cell - crystallographic planes and directions, miller indices - crystal imperfections, point, line, planar and volume defects - Grain size, ASTM grain size number.

UNIT I CONSTITUTION OF ALLOYS & SELECTION OF MATERIAL S 9

Constitution of alloys - Solid solutions, substitution and interstitial - phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron - Iron carbide equilibrium diagram. selection for mechanical properties, strength, toughness, fatigue and creep, Selection for surface durability, corrosion and wear resistance – Criteria for selection of materials for casting, welding, forging, rolling, extrusion, drawing, forming and machining- Motivation - cost basis service requirements — selection of aerospace materials.

UNIT II MATERIAL PROCESSING 9

Processing of engineering materials, primary and secondary manufacturing processes – Heat treatment-Full annealing, stress relief, recrystallization and spheroidizing-normalizing, hardening and tempering of steel.– . Isothermal transformation diagrams - cooling curves superimposed on I.T. diagram, CCR- Hardenability -Austempering, martempering- case hardening - carburising, nitriding, cyaniding, carbonitriding, flame and induction hardening.

UNIT III MATERIAL TESTING 9

Mechanism of plastic deformation, slip and twinning - Types of fracture - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers, Rockwell & Barcol), Impact test - Izod and Charpy, S-N curves Fatigue and creep tests, fracture toughness tests.

UNIT IV FERROUS AND NON FERROUS METALS 9

FERROUS MATERIAL: Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti &W) - stainless and tool steels - HSLA - maraging steels. Classification of steel and cast Iron, microstructure, properties and applications.

NON FERROUS MATERIALS: Copper and Copper alloys - Nickel, Magnesium, Titanium, Lead, Tin. Important alloys - their composition properties and applications of Brass, Bronze and Cupronickel - Aluminum and Al-Cu alloy. Properties and Applications

UNIT V NON-METALLIC MATERIALS 9

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS,

PEEK,PTFE Polymers - Urea and Phenol Formaldehydes - Engineering Ceramics – Introduction to Fiber reinforced plastics.- Natural Fiber composites – Processing, fabrication & its Applications

TOTAL : 45 PERIODS

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the concepts of basic material science, material processing and mechanical properties testing procedures. (Understand)
2. Apply the mechanical engineering concepts for selecting the suitable engineering materials for various applications. (Apply)
3. Apply the characteristics and properties of non-metallic materials for various engineering applications. (Apply)
4. Select suitable heat treatment techniques for the given ferrous materials.(Apply)
5. Analyse the material deformations and fracture behaviours for different materials. (Analyze)
6. Evaluate the suitable mechanical properties of metallic materials for different engineering applications.(Analyze)

REFERENCE BOOKS:

1. Kenneth G Budinski, Michael K.Budinski, ”Engineering Materials”, Prentice-Hall of India Private Limited, 4th IndianReprint,2002
2. William DCallister, ”Material Science and Engineering”, John Wiley and Sons,2007
3. Srinivasan. R, “Engineering Materials and Metallurgy”,Tata McGraw-Hill Publishing Limited,2013.
4. Raghavan. V, “Materials Science and Engineering,” Prentice Hall of India Pvt., Ltd, 2007.
5. Sydney H. Avner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 2007.
6. O.P. Khanna, “A text book of Materials Science and Metallurgy”, Khanna Publishers, 2003.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	3			2	2	2	3	2			2	2	3
CO 2	3		3			2	2	2							3
CO 3	3		3			2	2	2							3
CO 4	3		2											3	2
CO 5	3	3		3	2			2	2	2		2	2		2
CO 6	3	2		3	2			2	2	2		2	2		2
19UME306	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**2**		**2**	**2**	**3**	**3**

Ref: 3- Strong 2-Medium 1 –Weak

Semester – IV

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME401	Theory of Machines	3	1	0	4	60
2.	PC	19UME402	Applied Thermal Engineering	3	1	0	4	60
3.	PC	19UME403	Manufacturing Technology **(INTEGRATED)**	3	0	2	4	75
4.	PC	19UME404	Mechanics of Materials	3	1	0	4	60
5.	PC	19UME405	Automobile Engineering	3	0	0	3	45
6.	BS	19UGS431	Reasoning and Quantitative Aptitude	1	0	0	1	15
7.	MC	19UGM431	Gender Equality	1	0	0	P/F	15
8.	MC	19UGM432	Basics of Biology for Engineers	2	0	0	P/F	30
PRACTICAL								
9.	PC	19UME407	Thermal Engineering Laboratory - I	0	0	3	1.5	45
10.	PC	19UME408	Design Laboratory	0	0	3	1.5	45
Total Credits : 23				**19**	**3**	**8**	**23**	

19UME401	THEORY OF MACHINES	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To understand the principles basic motions and impart knowledge to analyze velocity and acceleration at any point in a link of a mechanism.
- To understand the dynamic force analysis of the forces, torques and energy involved in different machine members
- To impart knowledge in cam profile and balancing of masses for a specified output motions.
- To understand the basic concepts, terminologies and kinematics of gears, gear trains
- To impart knowledge in the concept of vibratory systems and their analysis.

UNIT I KINEMATIC CONCEPTS &KINEMATIC ANALYSIS 9+3

Definitions: Link, kinematic pairs, kinematic chain, mechanism, structure, degrees of freedom, Classification: links, pairs based on type of relative motion, Grubler's criterion, mobility of mechanism, Groshoff's criteria, inversion of mechanism. velocity of rubbing, graphical method of velocity and acceleration analysis of four bar mechanism, slider crank mechanism.

UNIT II DYNAMIC FORCE ANALYSIS OF MECHANISM 9+3

Static force analysis of mechanisms – D' Alemberts principle - Inertia force and Inertia torque - Dynamic force analysis of mechanisms including slider crank mechanism-Governors - Types - Centrifugal governors - Characteristics of Porter governor. Gyroscopes - Gyroscopic couple - Gyroscopic effects in ships.

UNIT III KINEMATICS OF CAMS & BALANCING OF MASSES 9+3

Types of cams, types of followers, cam profiles: Radial cam with followers such as knife-edge and roller followers, inline with uniform velocity, Simple Harmonic Motion. Static and dynamic balancing - Balancing of rotating masses – Primary Balancing of a multi cylinder Engine

UNIT IV GEARS & GEAR TRAINS 9+3

Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear. Interference in involute gears. Simple gear trains, compound gear trains, Epicyclic gear trains: tabular methods of finding velocity ratio of gear trains.

UNIT V FREE VIBRATION & FORCED VIBRATION 9+3

Basic features of vibratory systems-Types of vibration - degrees of freedom, Natural frequency of longitudinal vibration, transverse vibration, Whirling of shafts and critical speed. Types of Damping - Natural frequency of Damped free vibration. Response to periodic forcing - forced vibration caused by unbalance of reciprocating masses - Force transmissibility and Vibration isolation

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Illustrate the various concepts of simple kinematic mechanisms for various applications. (Understand)
2. Calculate the various parameters of given mechanism using kinematic concepts. (Apply)
3. Analyze the static and dynamic force in mechanical systems for various industrial applications. (Analyze)
4. Analyze the various mechanical vibration system and damping for the various applications. (Analyze)
5. Solve various problems on the gear and gear train in these various applications.(Apply)
6. Construct a working model of mechanism used in domestic appliances, automobiles and agricultural machines (Create)

REFERENCE BOOKS:

1. Khurmi R.S, GupthaJ. K, “Theory of Machines”, S.Chand Company Ltd., Prentice Hall of India, Fourteenth Revised Edition, New Delhi, 2012.
2. Uicker J.J, Pennock G.R, Shigley J.E, “Theory of Machines and Mechanisms”, (Indian edition) Oxford University Press, Fifth edition, 2017.
3. S. S. Rattan, “Theory of Machines” McGraw-Hill Education (India) Private, Fourth edition, 2014
4. Ghosh A, Mallick.A.K, “Theory of Mechanisms and Machines”, Affiliated East- West Pvt. Ltd, New Delhi, 2012.
5. David H. Myszka, “Machines and Mechanisms applied Kinematic Analysis”, pearson publishing house, Fourth edition, 2012.
6. F.B. Sayyad, “Kinematics of Machinery”, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.

E-Books / Web References

1. http://nptel.ac.in/courses/112104121/
2. https://freevideolectures.com/course/2359/kinematics-of-machines

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3												2		
CO.2	3												3		2
CO.3	3	3			3								2		2
CO.4	3	3			3								3		2
CO.5	3	3			3				2				3		2
CO.6	3	3	3		3				3	3			3		2
19UME401	**3**	**3**	**3**		**3**				**3**	**3**			**3**		**2**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME402	APPLIED THERMAL ENGINEERING	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To familiarize the concepts, laws and different gas power cycles.
- To impart knowledge on the working principles of IC engines, Steam Turbines, Steam Nozzles, Compressors, Refrigeration and Air conditioning systems.

UNIT I GAS POWER CYCLES 9+3

Air standard cycles-Otto, Diesel, Dual, Brayton cycles, Brayton with Reheat and Regenerative cycle, Comparison of Otto, Diesel and Dual cycles, Calculation of mean effective pressure and air standard efficiency.

UNIT II INTERNAL COMBUSTION ENGINES 9+3

Classification - Components and their function, Carburetor system, Diesel pump and injector system, Ignition Systems, Lubrication system and Cooling system, Performance and Heat balance Analysis.

UNIT III STEAM NOZZLES AND TURBINES 9+3

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.

UNIT IV AIR COMPRESSOR 9+3

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.

UNIT V REFRIGERATION AND AIR CONDITIONING 9+3

Vapour compression refrigeration cycle, vapour absorption system, Alternate refrigerants - Air conditioning system, - Types, GSHF ESHF RSHF calculations, Introduction about Aircraft air conditioning, Application of Air conditioning in food preservation.

TOTAL : 45 (L) + 15 (T) = 60 Periods

NOTE: Use of Steam Table, Refrigeration table, Mollier Chart, Psychrometric Chart is Permitted in the End Semester Examination.

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the concepts of gas power cycles, vapour power cycles, I.C Engines, steam nozzles, turbines and air compressor. (Understand)
2. Apply the various gas power cycle principles to find the MEP and efficiency. (Apply)
3. Apply the properties of steam to measure the steam nozzle performance. (Apply)
4. Calculate the performance of steam turbine by applying properties of steam. (Apply)
5. Identify the suitable refrigeration and air conditioning system for a requirement considering the environmental issues. (Apply)
6. Analyze the performance of air compressors with help of compression processes. (Analyze)

TEXT BOOKS:

1. Sarkar.B.K, “Thermal Engineering”, Tata McGraw-Hill,2017.
2. Kothandaraman.C.P, Domkundwar.S, Domkundwar.A.V, “A course in thermal engineering”, Dhanpat Rai & sons, Fifth edition,2016.

REFERENCE BOOKS:

1. Rajput. R. K, “Thermal Engineering”, S.Chand Publishers,2017.
2. Arora.C.P, “Refrigeration and Air Conditioning”, Tata McGraw-Hill Publishers,2016.
3. Ganesan. V, “Internal Combustion Engines”, Tata Mcgraw-Hill, Third Edition,2017.
4. Rudramoorthy. R, “Thermal Engineering”, Tata McGraw-Hill, New Delhi,2017.

COURSE ARTICULATION MATRIX
CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2													2	
CO.2	3													3	
CO.3	3													3	
CO.4	3						2	2						3	
CO.5	3						3	3	3			2		3	3
CO.6	3	3					3	3	3			2		3	3
19UME402	**3**	**3**					**3**	**3**	**3**			**2**		**3**	**3**

Ref: 3- Strong 2-Medium 1 –Weak

19UME403	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	2	4

(An Integrated Core Course)

OBJECTIVES :

- To understand the working of machine tools such as lathe, shaper, planner, slotter, milling, hobbing, and grinding and nonconventional machining process.`
- To impart knowledge on selection of suitable machine tools for the typical component.

UNIT I METAL CUTTING THEORY 9

Introduction: material removal processes, mechanics of metal cutting and types of machine tools - theory of metal cutting: chip formation, orthogonal cutting and oblique cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids- environmental issues-merchant's equation, heat generation - recent developments and applications (Dry machining and high speed machining).

UNIT II LATHE, SEMI AUTOMATS AND AUTOMATS 9

Centre lathe, constructional features, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes - automats - single spindle- Swiss type, automatics crew type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.

UNIT III RECIPROCATING MACHINES, DRILLING MACHINES 9

Shaper, Planer and Slotter - Introduction, types, specification and crank and slotted link quick return mechanism. Broaching - Introduction and types. Drilling - Introduction, types, specifications, construction of Radial drilling machine, types of drills and nomenclature of twist drill. Calculation of machining time for drilling. Introduction to fixtures and jigs.

UNIT IV MILLING MACHINE AND GEAR CUTTING MACHINES 9

Milling - Introduction, types, specifications, up milling, down milling and operations-Plain milling, machining time calculation. Indexing -simple and differential indexing methods.

Gear cutting-gear milling, gear shaper and gear hobbing machine

UNIT V FINISHING PROCESSES AND NON-TRADITIONAL MACHINING PROCESSES 9

Finishing processes - Grinding -Introduction and Types. Grinding wheel- selection, glazing, loading, dressing and truing. Fine finishing processes - Honing, lapping, polishing, buffing and super finishing. Non-traditional machining processes: Principle, need, equipment, operation and LBM, plasma arc machining, Electro chemical machining, ultrasonic machining, abrasive let machining, water jet machining.

LIST OF EXPERIMENTS :

30

1. Measurement of cutting forces acting on the tool during drilling operation in various metals using dynamometer
2. Assembly of Machined Components for different fits.
3. Machining Bush turning using capstan lathe.
4. Making 'V' groove using shaping machine tool.
5. Machining of Pentagonal/Hexagonal/octagonal sides from cylindrical work piece using Shaping machine tool.
6. Machining an internal key way using Slotter machine.
7. Machining a spur gear using Milling machine.
8. Machining a metal using surface grinding machine and cylindrical grinding machine
9. Study of gear hobbling machine tool and its working principle.

TOTAL : 45 (L) + 30 (P) = 75 Periods

COURSEOUTCOMES:

After successful completion of this course the students will be:

1. Summarize the working principles and operations of the machine tools such as lathe, shaping, milling, broaching, drilling, gear cutting and finishing process. (Understand)
2. Illustrate the working concepts of non-conventional machining process. (Understand)
3. Apply the concepts of metal cutting theory to calculate tool life, various cutting forces and application of cutting tools and cutting fluids. (Apply).
4. Identify the various unconventional machining process parameters and applications with their influence on performance. (Apply)
5. Conduct experiment to calculate the cutting forces acting on the tool in the given work piece using drill tool dynamometer. (Apply)
6. Apply the concepts of material removing processes for the different fits to assemble machined Components. (Apply)
7. Select the appropriate machining processes and tools to make a given part. (Apply)
8. Examine the machining time for the traditional machining operations. (Analyze)

REFERENCE BOOKS:

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited., New Delhi, 2013.
2. Serope kalpakjian, Steven R Schmid, 'Manufacturing Engineering and Technology', Pearson Education, 6th edition, 2015.
3. P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013
4. S. K. Hajra Choudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.
5. P.CSharma,ManufacturingTechnology-II,S.Chand&CompanyLimited.NewDelhi, 2012.

E-Books / Web References

1. Hanmin Shi,Metal Cutting Theory: New Perspectives and New Approaches, Springer international publishing, 2018https://www.google.co.in/books/edition/Metal_Cutting_Theory/q2BODwAAQBAJ?hl=en&gbpv=1&dq=metal+cutting+process&printsec=frontcover)
2. http://web.mit.edu/2.810/www/files/lectures/lec5-machining-2018.pdf
3. https://nptel.ac.in/courses/112/105/112105126/

Content beyond the syllabus:

1. Design for Manufacturing and assembly

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2					2		2				2	2		
CO.2															3
CO.3	3														3
CO.4	3											2	2		3
CO.5		3						2							2
CO.6		3							2						3
CO.7		3						2	2						3
CO.8	3	3						3		3					2
19UME403	**3**	**3**				**2**		**3**	**2**	**3**		**2**	**2**		**3**

Ref: 3- Strong 2-Medium 1 –Weak

19UME404	MECHANICS OF MATERIALS	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To impart knowledge of simple stresses, strains and deformation in components due to external loads.
- To familiarize the student to calculate stresses, deflections and torsion for beams, twisting bars for various engineering applications
- Analyse the thin and thick shells and principal stresses in beam for various engineering applications.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9+3

SIMPLE STRESS AND STRAIN:

Introduction - stress, strain and mechanical properties of materials - Stress and strain due to axial force - elastic limit - Hooke's law - factor of safety - stepped bars - uniformly varying sections - stresses in composite bar due to axial force and temperature - Strain Energy due to axial force - Lateral strain - Poisson's ratio - volumetric strain - changes in dimensions and volume - relationship between elastic constants.

COMPOUND STRESSES:

Introduction - plane stress - Stresses on inclined planes - Principal stresses and maximum shear stresses - graphical method -Mohr's circle for plane stress.

UNIT II SHEAR FORCE, BENDING MOMENT AND STRESSES IN BEAMS 9+3

SHEAR FORCE AND BENDING MOMENT IN BEAMS:

Shear force and bending moment - Relation between load, shear force and bending moment - Construction of Shear force diagrams and Bending moment diagrams for different types of static loading on cantilever, simply supported and overhanging beams.

BENDING AND SHEAR STRESSES IN BEAMS:

Introduction - theory of simple bending - assumptions in simple bending- Determination of bending stresses - Modulus of section - bending stress and shear stress distribution across various beam sections.

UNIT III DEFLECTION OF BEAMS AND TORSION IN SHAFT 9+3

DEFLECTION OF BEAMS:

Introduction - differential equation for deflection - slope and moments - Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams.

TORSION OF CIRCULAR SHAFTS:

Theory of torsion and assumptions-derivation of the equation - polar modulus - stresses in solid and hollow circular shafts - power transmitted by solid and hollow circular shafts. Statically indeterminate torsion members- Alternative differential equation approach for torsion.

UNITIV COLUMNS 9+3

Long and short columns - Buckling load - Types of end conditions for column - concept of equivalent length - eccentric loading - Euler's column theory and its limitations - Rankine and Johnson formula for columns.

UNITV THIN AND THICK WALLED PRESSURE VESSELS 9+3

Stresses in a thin cylindrical shell due to internal pressure – Change in dimensions – Change in volume – Thin spherical shells – Lame's theory – Stresses in a thick cylindrical shell.

TOTAL : 45 (L) + 15 (T) = 60 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Illustrate the behavior of materials under given loading conditions. **(Understand)**
2. Apply the knowledge of solid mechanics to calculate the stresses in various beams, solid and hollow shafts. **(Apply)**
3. Estimate the stresses involved in columns and thin cylinders for the given circumstance. **(Apply)**
4. Calculate shear force, bending moment and deflection of the given beam using software resources. **(Apply)**
5. Compute the modulus of the given material using suitable testing methods. **(Apply)**
6. Analyze structural designs, columns and pressure vessels subjected to various forces and loads. **(Analyze)**

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Ramamrutham.S, Narayanan.R, "Strength of Materials", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2012.
3. Beer, Johnston & Dewolf, "Mechanics of Materials", Tata McGraw-Hill Education, 2012
4. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCE BOOKS:

1. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
2. Gere & Timoshenko, “Strength of Materials”, Second edition, CBS Publisher,2006
3. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2010.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2												2		
CO.2	3												3		
CO.3	3												3		
CO.4	3				3				3				3		
CO.5	3				3			3	3	2			3		
CO.6	3	3	3	2	3	3		3	3	2		3	3		3
19UME404	**3**	**3**	**3**	**2**	**3**	**3**		**3**	**3**	**2**		**3**	**3**		**3**

Ref: 3- Strong 2-Medium 1 –Weak

		L	T	P	C
19UME405	**AUTOMOBILE ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES :

- To familiarize the construction and working principle of various parts of an automobile.
- To impart knowledge for alternate fuels, emission control and smart vehicles.

UNIT I VEHICLE STRUCTURE 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, resistances to vehicle motion, vehicle aerodynamic resistance, Sensors and actuators for various engine applications.

UNIT II TRANSMISSION AND AUXILIARY SYSTEMS 9

Clutch and its construction, need for a gearbox, Automatic gear box- gear shift mechanisms, Over drive, transfer box, propeller shaft, Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive. Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system, Electronic ignition system.

UNIT III STEERING,BRAKES AND SUSPENSION SYSTEM 9

Steering geometry and types of steering gear box, Power Steering-types, Suspension Systems -Types, Braking system - Pneumatic and Hydraulic Braking Systems, Antilock Braking System.

UNIT IV ALTERNATE FUELS AND EMISSION CONTROL 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- safety precautions for handling hydrogen, Fuel Cell. Engine emission control by three way catalytic converter system, Particulate filters, Selective Catalytic Reduction, Exhaust gas recirculation. Emission norms and emission control techniques -Euro norms-Bharath stage norms.

UNIT V SMART VEHICLES 9

Hybrid Vehicles, Electric vehicles, Artificial Intelligence –machine learning-deep learning-Autonomous vehicles, Introduction to Big data, blockchain, IoT for vehicles. Biometric vehicle access, Adaptive Cruise Control, Traction Control- comprehensive Vehicle Tracking, airbag, Automatic High-Beam control, Automatic Emergency Braking.

TOTAL : 45 PERIODS

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the vehicle structure, transmission systems, auxiliary systems, steering, brakes and suspension, Alternate Fuels, Emission Control and smart vehicles system. Understand
2. Design and explain the working of basic elements in automobile transmission, auxiliary systems and brakes. Apply
3. Apply the automobile engineering concepts to design aerodynamic resistance model, injection system, ignition system and braking system for a vehicle using modeling software. Apply
4. Select possible alternate sources of energy for IC Engines and explain the Engine modifications required. Apply
5. Explain the emission norms and emission reduction techniques to choose and judge the suitable alternate fuel for various applications/vehicles. Apply
6. Examine and apply big data and IoT in smart vehicles with considering safety, societal needs and environmental constraints. Analysis

TEXT BOOKS:

1. Kirpal Singh, “Automobile Engineering Vol 1 &2”, Standard Publishers, 13th Edition, New Delhi, 2014
2. Hand notes, “Emission norms, emission control techniques, smart vehicles, big data, IoT”, Mechanical Engineering Department, SIT.

REFERENCE BOOKS:

1. K.K.Jain, R.B.Asthana, “Automobile Engineering”, Tata McGraw Hill Publishers, New Delhi,2002.
2. Heinz Heisler, “Advanced Engine Technology”, Prentice Hall (India) Pvt. Ltd, 2006
3. R.K.Rajput, Automobile Engineering, Laxmi Publications (P) Ltd., New Delhi, 2007.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2				2							2	2	3	
CO.2	3				3									3	
CO.3	3				3									3	
CO.4	3													3	
CO.5	3						3	3						3	
CO.6	3						3	3						3	
19UME405	**3**				**3**		**3**	**3**				**2**	**2**	**3**	

Ref: 3- Strong 2-Medium 1 –Weak

19UGS431	REASONING AND QUANTITATIVE APTITUDE	L	T	P	C
		1	0	0	1

OBJECTIVES :

1. To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.
2. To familiarize the student with various principles involved in solving mathematical problems.
3. To develop an understanding of the basic concepts of reasoning skills.

UNIT I QUANTITATIVE APTITUDE 8

Numbers – HCF and LCM - Arithmetic and Geometric Progression – Averages –Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest - Ratio and Proportion –Time –Speed–Distance-TimeandWork–PipesandCistern–ProblemsonTrains–Permutationand Combination – Clocks – Calendars.

UNIT II VERBAL AND NON VERBAL REASONING 7

Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams – Letter series & arrangement – Alpha Numeric Series – Syllogism - Coding – Decoding.

TOTAL = 15 Periods

COURSE OUTCOMES:

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

1. Select an appropriate technique to solve the quantitative problems within the stipulated time (Apply)
2. ApplyVerbalandNonVerbalReasoningskillstosolvetheproblemsbasedonlogicaland analytical reasoning (Apply)

WEBSITES:

www.m4maths.com, www.indiabix.com , www.fresherworld.com , www.campusgate.co.in,

www.indianstudyhub.in, www.tcyonline.com.

TEXT BOOKS:

1. Dr. R.S.Agarwal, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20th Edition, (2013).
2. Abijit Guha, “Quantitative Aptitude for Competitive Examinations”, Tata McGrawHill Publication, New Delhi, 4th Edition,(2011).
3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2nd Edition,(2013).

REFERENCE BOOKS:

1. Ashish Aggarwal, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition,(2014).
2. Dr.V.A.Sathgurunath’s “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition,(2011).

19UGM431	GENDEREQUALITY	L	T	P	C
		1	0	0	P/F

Objectives:

- To introduce basic concepts relating to gender and to provide logical understanding of gender roles.

UNITI GENDER SENSITIZATION

Definition of gender, Perspectives-Gender sensitive approach- Gender and sex- Social construction of gender and gender roles- Socialisation- institutions of socialization- changing content and context of gender-need for re-socialization. Gender Stereo typing and Gender Discrimination.

UNITII GENDER EQUALITY ANDCONSTITUTION

Indian constitution related to equality - Fundamental rights - Directive principles of state policy - right to equality - rights against exploitation - cultural and educational rights - the right to constitutional remedy - University Declaration of Human Rights - Enforcement of Human Rights for Women and Children - Role of Cells and Counselling Centres- Internal Complaints Committee - Legal AID cells, Help line, State and National level Commission.

UNITIII GENDER ROLES & EQUALITY

Gender & Morality – Structural and functionalist views of Gender- Gender in the Classroom-Beyond access for girls and boys-Gender equality in schools-Gender equality and adult basic education-Developing capacity to achieve gender equality in education-Individuality and removal of gender stereotypes- Respect for each other's-Promote equal Opportunity.

REFERENCES:

1. Sheila Aikman and Elaine Unterhalter, "Practising Gender Equality in Education", Oxfam GB,2007.
2. Pasadena and Hackensack, "Gender roles and Equality", SalemPress,2011.

19UGM432	BASICS OF BIOLOGY FOR ENGINEERS	L	T	P	C
		2	0	0	P/F

OBJECTIVES:

- To explain the essentials of basic biological principles.
- To familiarize the different clinical and industrial applications of biology for solving societal problems with engineering tools.

UNIT I INTRODUCTION AND CLASSIFICATION 5

Characteristics of living organisms – Basic classification – Cell theory – Structure of prokaryotic and eukaryotic cell – Introduction to Bio-molecules: Definition – General classification and important functions of Carbohydrates – Lipids – Proteins – Nucleic acids, Vitamins and Enzymes – Genes and Chromosome.

UNIT II BIODIVERSITY 5

Plant System: Basic concepts of Plant growth – Nutrition – Photosynthesis and Nitrogen fixation – Animal System: Elementary study of Digestive, Respiratory, Circulatory, Excretory systems and their functions.

UNIT III BASICS OF CELL AND MOLECULAR BIOLOGY 6

Discovery of cell and Cell Theory – Comparison between plant and animal cells – Cell wall – Plasma membrane – Modification of plasma membrane and intracellular junctions – Stem cells and Tissue engineering.

UNIT IV HUMAN DISEASES 7

Infectious and Non-infectious diseases – Causative agents – Epidemiology – Pathogenicity, Control and prevention – Treatment of AIDS – Tuberculosis – Pathology of non-infectious and genetic diseases and disorders – Cancer, Diabetes mellitus, Cardiac diseases – Neurological disorders – Parkinson's disease.

UNIT V BIOLOGY AND ITS INDUSTRIAL AND CLINICAL APPLICATIONS 7

Transgenic plants and animals – Bioreactors – Bio-pharming – Recombinant vaccines – Cloning – Artificialmemoryandneuralnetworks–Bioremediation–Biofertilizer–Biocontrol–Biofilters – Biosensors – Biopolymers – Bioenergy –Biochips.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

1. Explain the fundamentals of living things, their classification, cell structure and biochemical constituents. (Understand)
2. Apply the concept of plant, animal and microbial systems and growth in real life situations. (Apply)
3. Analyze biological engineering principles, procedures needed to solve societal issues. (Analysis)

TEXT BOOKS:

1. Satyanarayana, U. “Biotechnology”, 4th Edition, Books and Allied Pvt. Ltd. Kolkata, 2007.
2. Carol D. Tamparo and Marcia A. “Diseases of the Human Body”, Lewis, F.A. Davis Company,2011.
3. R.Khandpur,“Biomedicalinstrumentation-Technologyandapplications”,McGrawHill Professional, 2004.

REFERENCE BOOKS:

1. Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry”, CBS Publications 2017.
2. Arthur T. Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2nd Edition, 2019.
3. Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, “Cell Biology and Genetics (Biology: The unity and diversity of life Volume I)”, Cengage Learning, 12th Edition, 2008.
4. B.D. Singh, “Biotechnology: Expanding horizon”, Kalyani Publishers, 2015.

19UME407	THERMAL ENGINEERING LABORATORY I	L	T	P	C
		0	0	3	1.5

OBJECTIVES :

- To study the engine components and working principles of SI and CI engines.
- To study the performance characterization of diesel and petrol engines.
- To study the performance of steam generator and steam turbine.

LIST OF EXPERIMENTS : 45

1. Determination of Valve Timing Diagrams.
2. Determination of Port Timing Diagrams.
3. Determination of Flash and Fire point using cleave land apparatus.
4. Determination of viscosity using red wood viscometer.
5. Performance Test on 4-stroke Diesel Engine with mechanical loading.
6. Heat Balance Test on 4-stroke Diesel Engine.
7. Performance Test on Petrol Engine with electrical loading.
8. Performance test on 4 stroke diesel engine with eddy current dynamometer using Data Acquisition system.
9. Performance test on 4-stroke variable Compression ratio Diesel Engine using Data Acquisition system.
10. Determination of exhaust emissions from 4-stroke Diesel Engine using exhaust gas analyzer.
11. Determination of smoke opacity from 4-stroke Diesel Engine using smoke meter.
12. Performance and energy balance test on a steam generators.
13. Performance and energy balance test on steam turbine.

A minimum of nine experiments shall be offered

TOTAL: 45 PERIODS

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Demonstrate the components of steam generator and steam turbine.(Understand)
2. Draw the valve and port timing diagram of the given IC engines. (Apply)
3. Calculate the fuel properties of different fuels using redwood viscometer and flash& fire point apparatus (Apply)
4. Calculate the performance characteristics of the petrol and diesel engines.(Apply)
5. Estimate the heat losses in multi cylinder diesel engine and prepare the heat balance sheet.(Apply)
6. Determine the various pollutant level for the given fuel using gas analyzer and smoke meter.(Analyze)

EQUIPMENT REQUIREMENT

Sl. No.	Name of the equipment	Quantity required
1.	I.C Engine – 2 stroke and 4 stroke model	1 set
2.	Red Wood Viscometer	1 No.
3.	Apparatus for Flash and Fire Point	1 No.
4.	4-stroke Diesel Engine with mechanical loading.	1 No.
5.	4-stroke Diesel Engine with hydraulic loading.	1 No.
6.	4-stroke Diesel Engine with electrical loading.	1 No.
7.	Multi-cylinder Petrol Engine	1 No.
8.	Single cylinder Petrol Engine	1 No.
9.	Data Acquisition system with any one of the above engines	1 No.
10.	Steam Boiler with turbine setup.	1 No

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3					3	3	3	3					3	3
CO2	3								3					3	
CO3	3							3	3					3	2
CO4	3							3	3					3	2
CO5	3					2		3	3					3	2
CO6		3				3	3	3	3					3	3
19UME407	**3**	**3**				**3**	**3**	**3**	**3**					**3**	**3**

Ref: 3-Strong 2 -Medium 1 –Weak

19UME408	DESIGN LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To impart practical knowledge on experimentally test the tension, shear, torsion, deflection, hardness and impact for different materials.
- To realize how certain measuring devices are used for dynamic testing.
- Students will be able to learn and practice preparation of mounted samples, identification of microstructure, vickers hardness and understand the mechanical engineering applications of various furnaces.

LIST OF EXPERIMENTS:

1. Determine the modulus of rigidity and stiffness of the given rod using torsion testing machine.
2. Determine the impact resistance of the given specimen.
3. Determine the modulus of rigidity and stiffness of the given spring using spring testing machine.
4. Determine the Rockwell hardness number for the given specimen.
5. Determine the Young's modulus of the given beam material.
6. Draw the stress strain curve of the given rod using Universal Testing Machine.
7. Determine the shear strength of the given specimen using Double shear test.
8. Determine the hardness number of the given specimen using Brinnell/Rockwell hardness test.
9. Determine the mass moment of inertia using connecting rod and flywheel, bifilar suspension, turn table apparatus.
10. Determine the equilibrium speed, sensitiveness, power and effort of Porter / Proell / Hartnell Governor.
11. Determine the Natural / Torsional frequency of the given system.
12. Balancing of rotating and reciprocating masses.
13. Experiments on Gyroscope: To find the gyroscope couple on a motorized gyroscope experimentally and compare with applied couple.
14. Preparation of specimen for metallographic observation and identify the material of the given specimen (steel, cast iron, copper and aluminium alloying element)
15. Determine the Vickers harness number for the given specimen before and after of heat treatment by using muffle furnace.
16. Determine the Vickers harness number for the given specimen by using Jominy end quench test.

A minimum of nine experiments shall be offered.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Determine the mechanical behavior of mild steel specimen by performing tensile test, shear test, impact test, hardness test and deflection test apparatus. (Apply)
2. Calculate the modulus of rigidity of the given material using torsion test and spring test machine. (Apply)
3. Calculate the frequency of helical spring, moment of inertia of the flat bar, fly wheel and connecting rod. (Apply)
4. Conduct experiments to draw the performance characteristics of governors and gyroscopic couple. (Apply)
5. Identify the given material or alloy through the effective utilization of metallurgical microscope. (Apply)
6. Analyze and compare the various mechanical properties of given material using suitable testing method. (Analyze)

COURSE ARTICULATION MATRIX

CO/PO/PEO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3				2			3					2		3
CO 2	3							3							
CO 3	3														
CO 4	3							3							
CO 5	3														
CO 6	3	3						3					3		3
19UME408	**3**	**3**			**2**			**3**					**3**		**3**

Ref: 3- Strong 2-Medium 1 - Weak

EQUIPMENT REQUIREMENT

S. No.	Name of the equipment	Quantity required
1.	Universal Tensile Testing machine with double	1 No.
2.	Shear attachment – 40 Ton Capacity	1 No.
3.	Torsion Testing Machine (60 NM Capacity).	1 No.
4.	Impact Testing Machine (300 J Capacity).	1 No.
5.	Spring Testing Machine for tensile and compressive loads (2500 N)	1 No.
6.	Rockwell hardness testing machine	1 No.
7.	Brinell hardness testing machine	1 No.
8.	Muffle Furnace (800 °C)	1 No.
9.	Motorized gyroscope	1 No.
10.	Governor apparatus	1 No.
11.	Compound pendulum attachment with flywheel & connecting rod	1 No.
12.	Vibration test facilities apparatus.	1 No.
13.	LYZER Trinocular Co-Axial Metallurgical Microscope LT-22C With Metallographic Software With 2 MP USB Video Eye piece.	1 No.
14.	KRISH Abrasive Cut Off Machine Open type	1 No.
15.	KRISH Lineisher polisher model:KMT-02	1 No.
16.	High Temperature Tubular furnance-1600 o C	1 No.
17.	Speciman mounting press	1 No.
18.	Jominy End Quench apparatus	1 No.

Semester – V

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME501	Heat and Mass Transfer	3	0	0	3	45
2.	PC	19UME502	Design of Machine Elements	3	1	0	4	60
3.	ES	19UME503	Object Oriented Python programming **(INTEGRATED)**	3	0	2	4	75
4.	PC	19UME504	Measurements and Instrumentation **(INTEGRATED)**	3	0	2	4	75
5.	PE	E1	Professional Elective – I	3	0	0	3	45
6.	OE	OE 1	Open Elective – I	3	0	0	3	45
7.	HS	19UGS533	Interpersonal Skills Laboratory	0	0	3	1.5	45
PRACTICAL								
8.	P	19UME507	Creative Thinking & Innovations	0	0	2	1	30
9.	PC	19UME508	Thermal Engineering Laboratory - II	0	0	3	1.5	45
Total Credits : 25				**18**	**1**	**12**	**25**	

19UME501	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the concepts of heat transfer under steady and transient conditions.
- To explain the basic concepts of mass transfer.

PRE-REQUISITES:

- Thermodynamics
- Thermal Engineering

UNIT I CONDUCTION 9

Basic Concepts - Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction - Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction - Conduction through Plane Wall, Cylinders and Spherical systems - Composite Systems - Conduction with Internal Heat Generation - Extended Surfaces - Unsteady Heat Conduction - Lumped Analysis - Semi-Infinite and Infinite Solids

UNIT II CONVECTION 9

Basic Concepts - Boundary Layer Concept - Types of Convection - Forced Convection - Dimensional Analysis - External Flow - Flow over Plates, Cylinders and Spheres - Internal Flow - Laminar and Turbulent Flow - Combined Laminar and Turbulent flows - Flow over Bank of tubes - Free Convection - Dimensional Analysis - Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Introduction to boiling and condensation

UNIT III RADIATION 9

Basic Concepts, Laws of Radiation - Stefan Boltzmann Law, Kirchhoff's Law Emissive power– Black Body Radiation - Grey body radiation, Radiation heat transfer between surfaces, -Shape Factor Algebra - Electrical Analogy - Radiation Shields –Introduction to Gas Radiation.

UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's theory of condensation- Regimes of pool boiling and flow boiling, correlations in boiling and condensation. Heat exchanger Types-tube arrangements, single and multi-tube types, parallel, counter and cross flow - Heat Exchanger Analysis -Heat exchanger effectiveness- LMTD Method and NTU Methods –Overall Heat Transfer Coefficient - Fouling Factors

UNIT V MASS TRANSFER 9

Basic Concepts - Diffusion Mass Transfer - Fick's Law of Diffusion – Steady state Molecular Diffusion - Convective Mass Transfer Rate equations. Mass diffusion in binary mixtures, Momentum, Heat and Mass Transfer Analogy - Convective Mass Transfer Correlations.

TOTAL : 45 PERIODS

NOTE: Use of Steam Tables, HMT tables are permitted in the End Semester Examination.

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the concepts of heat transfer, heat exchanger and mass transfer and its applications with the suitable examples. (Understand)
2. Apply the heat transfer concepts of conduction, convection and radiation to solve the given problem. (Apply)
3. Apply the mass transfer concepts to solve the given problem .(Apply)
4. Analyze the heat exchanger effectiveness for the given input conditions. (Analyze)
5. Analyze the conduction heat transfer for various systems using ANSYS software. (Analyze)
6. Evaluate the heat transfer characteristics under steady state and transient conditions. (Evaluate)

TEXT BOOKS:

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer", New Age International, 2010.
2. Frank.P.Incropera, David P. DeWitt "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 2007.

REFERENCE BOOKS:

1. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 2010
2. .Kothandaraman C.P, "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2006
3. Holman J.P, "Heat and Mass Transfer," Tata McGraw-Hill, 2004.
4. Nag P.K, "Heat Transfer",Tata McGraw Hill, New Delhi, 2007.

COURSE ARTICULATION MATRIX

CO/PO/PSO MAPPING

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2				2									3	
CO2	3					2	3							3	
CO3	3					2								3	
CO4	3	3				2	2		3					3	
CO5	3	3			3	3	3		3			3		3	3
CO6	3	3		3		2	3		3					3	
19UME501	**3**	**3**		**3**	**3**	**3**	**3**		**3**			**3**		**3**	**3**

Ref: ***1- Weak*** ***2- Medium*** ***3- Strong***

19UME502	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To familiarize the students about various steps involved in the Design Process.
- To explain the principle involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Preferred numbers, limits, fits and tolerances - Calculation of principle stresses for various load combinations, eccentric loading - Design of curved beams - crane hook and 'C' frame - Factor of safety - theories of failure – Stress concentration - Design for variable loading -Soderberg, Goodman and Gerber relations.

UNIT II DESIGN OF SHAFTS, KEYS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed under static and fatigue loadings - Design of keys, key ways and splines - Design of Knuckle joints - Design of Rigid couplings – Sleeve couplings, Clamp Couplings and Flange Coupling - Design of Flexible couplings – Bushed-Pin type flange couplings, Gear Coupling, Disc type flexible coupling.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Design of bolt for static, dynamic and eccentric loads — Design of welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF SPRINGS AND FLYWHEELS 9

Design of helical, helical torsion, spiral, leaf, belleville springs - Design of flywheels considering stresses in rims and arms, for engines and punching machines.

UNIT V DESIGN OF BEARINGS AND ENGINE ELEMENTS 9

Sliding contact and rolling contact bearings - Design of hydrodynamic journal bearings, McKee's Equation. Sommerfield Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings

TOTAL : 45 PERIODS

Note: Use of P S G Design Data Book is permitted in the End Semester examination.

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the concepts of theories of failures and machine elements like shafts, couplings, joints, springs and bearings.(Understand)
2. Apply the knowledge of suitable design process to design the given machine element.(Apply)
3. Calculate the various stresses and failure modes for the given machine element (Apply)
4. Analyze the stresses in the machine element using software tools under the given loading conditions (Analyze)
5. Calculate the suitable design parameters to design the given component for a specific application.(Analyze)
6. Test the given specimen using appropriate equipment as per ASTM standards. (Analyze)

TEXT BOOKS:

1. Bhandari V, “Design of Machine Elements”, 4 th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 9th Edition, Tata McGraw-Hill, 2011.

REFERENCE BOOKS:

1. Khurmi.R.S, Gupta.J.K, “Machine Design ”, Eurasia Publishing House , 2005.
2. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill BookCo.(Schaum’s Outline), 2010
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 th Edition, Wiley**,**

STANDARDS:

- IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 1: Construction.
- IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 2: Friction and Wear.
- IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 3 : Lubrication.

COURSE ARTICULATION MATRIX

CO/PO/PSO MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2			2								2		
CO2	3												2		
CO3	3	3											2		
CO4					3								3		
CO5			3	3				2					2		3
CO6		3	3										2		
19UME502	3	3	3	3	3			2					3		3

Ref: 1- Weak 2- Medium 3- Strong

19UME503	OBJECT ORIENTED PYTHON PROGRAMMING	L	T	P	C
		3	0	2	4

COURSE DESIGNATION :

PRE-REQUISTIES:

COURSE OBJECTIVE:

- To acquire programming skills in core python
- To learn about the usage of python shell for running programs
- To understand the different data types available in python.
- To acquire object oriented skills in python
- To understand the creation and usage of various modules and packages.

UNIT I PYTHON FUNDAMENTALS AND DATA STRUCTURES 9

Introduction – Data types – Numbers – Variables – Strings – Lists – Dictionaries – Tuples – Sets – Boolean – Basic I/O operations – Python Operators

UNIT II PYTHON STATEMENTS, METHODS AND FUNCTIONS 9

Decision Making – Loops – If.. Else, Elif – While Loops – For Loops – Nested Loop – Break – Continue Methods – Functions – Built in Functions – Lambda Functions – Python Arrays

UNIT III MODULES PACKAGES AND LIBRARIES 9

Modules and Packages – Standard Libraries – Python Maths – Queues – FIFO Queue – LIFO Queue – Priority Queue – Third Party Library – Numpy – Organizing Modules

UNIT IV OBJECT ORIENTED PROGRAMMING METHODOLOGIES 9

Object Oriented Programming – Creating Python Classes – Initializing Objects – Python Object Recognition – Objects and Classes – Inheritance and its Types – Basic Inheritance – Multiple Inheritance – Polymorphism

UNIT V STRINGS FORMATING, FILE AND EXCEPTION HANDLING 9

String Formatting – File Handling - Escaping Braces – Keyword Arguments – Exception Handling – Raising Exception – Effects of Exception – Handling the Exception – Exception Hierarchy – Creating our own Exceptions

Total: 45Periods

AUGMENTED TOPICS

Python Data Manipulation & Analytics

LABORATORY EXERCISE **30 Periods**

1. Develop a program to implement basic I/O operations in python.
2. Develop a program to demonstrate a list in python.
3. Develop a program to demonstrate a dictionary in python.
4. Develop a program to implement if, else and elif loops in python.
5. Develop a program to implement while loop in python.
6. Develop a program to implement for loop in python.
7. Develop a program to demonstrate functions in python.
8. Develop a program to demonstrate FIFO queue in python.
9. Develop a program to demonstrate LIFO queue in python.
10. Develop a program to demonstrate Priority queue in python.
11. Develop a program to create class in python.
12. Develop a python program to implement single and multiple inheritance.
13. Develop a python program to implement single and multiple polymorphism.
14. Develop a python program to implement string handling and string formatting.
15. Develop a python program to implement Exception handling.
16. Develop a python program to read and write files.

A minimum of nine experiments shall be offered

COURSE OUTCOMES:

1. Explain the various concepts of object oriented python programming language. (Understand)
2. Apply the knowledge of python programming fundamentals, statements and functions to give solution for engineering problems. (Apply)
3. Make use of python modules and libraries to solve engineering problems for the required condition. (Apply)
4. Apply the knowledge of python class, inheritance, string formatting, file handling and exception handling to write programs for the given condition. (Apply)
5. Formulate and analyze complex engineering problems using object oriented python programming methodologies. (Analyze)
6. Conduct experiments to develop programs using python fundamentals, data structures, loops, functions, modules and packages. (Apply)
7. Develop program for the required condition using class, inheritance, string formatting, file handling and exception handling. (Apply)

TEXT BOOKS:

1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey,and Chris Meyers," How to Think Like a Computer Scientist: Learning with Python 3 ", O'reilly, Third Edition, 2020.
2. MarkLutz, "Powerful Object Oriented Programming Python", O'reilly, Fourth Edition, 2012.

REFERENCE BOOKS

1. Python crash course – 2nd Edition, "A hands-on project based introduction to programming" by Eric Matthes.
2. Learning Python – 5th Edition by Mark Lutz – O'Reilly media.
3. Introduction to python, Kenneth A. Lambert, Cengage.

WEB REFERENCES:

1. https://docs.python.org/3/tutorial/
2. https://www.learnpython.org/
3. https://pynative.com/

COURSE ARTICULATION MATRIX

CO/PO/PSO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2				2										
CO 2	3				3				3						2
CO 3	3				3				3						2
CO 4	3				3				3						2
CO 5	3	3			3			3	3				3		2
CO 6	3				3			3	3	2		2			3
CO 7	3				3			3	3	2		2			3
19UME503	**3**	**3**			**3**			**3**	**3**	**2**		**2**	**3**		**3**

Ref: 1- Weak 2- Medium 3- Weak

19UME504	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To explain the basic principles of measurements.
- To impart knowledge in the various measurements and instruments.

UNIT I PRINCIPLES OF MEASUREMENT 9

General concept - Generalized measurement system-Units and standards-measuring instruments: sensitivity, stability, range, difference between precision and accuracy -static and dynamic response-repeatability- Errors in Measurements -correction, calibration

UNIT II LINEAR, ANGULAR AND FORM MEASUREMENTS 9

Linear measuring instruments and Angular measurements - Tool Makers Microscope- Interferometer, Principle of interferometry, autocollimator, Optical flats - Comparators -Measurement of screw thread and gear elements.

UNIT III ADVANCES IN METROLOGY 9

Coordinate measuring machine (CMM) - Basic concept of CMM – Types of CMM – Constructional features – Applications. Machine Vision - Basic concepts of Machine Vision System, Advanced Computed Tomography (CT).

UNIT IV MEASUREMENT OF MECHANICAL PARAMETERS 9

Measurement of Force, torque, motion -mechanical, pneumatic, hydraulic and electrical type-Pressure measurement – manometers, bourdon tube pressure gauge – Temperature measurement - bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor. Flow-Venturi, orifice, rotameter, and pitot tube.

UNIT V SENSORS, TRANSDUCERS AND DATAACQUISITION SYSTEM 9

Sensors and Transducers - Selection of Sensors, Sensors for Displacement, Position - Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system

Total: 45Periods

LABORATORY EXERCISE **30 Periods**

1. Calibration of Vernier caliper / Micrometer/ Dial gauge using Slip gauges.
2. Measurements of Gear Tooth Dimensions using gear tooth vernier
3. Measurement of Angle using bevel protector & sine bar.
4. Measurement of thread parameters using tool makers microscope & profile projector.
5. Inspection of the component using different probe in CMM.
6. Measurement of Force using force measuring setup
7. Measurement of Torque using torque measuring setup
8. Digital measurement methods -Data acquisition systems

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the concepts of generalized measurement system, mechanical parameters and data acquisition system for various measuring instruments. (Understand)
2. Apply the concepts of measurement system and advances in metrology for various measuring instruments in mechanical industries. (Apply)
3. Apply mechanical parameters and data acquisition system to conduct experiments in metrology using CMM and Advanced Computed Tomography (Apply)
4. Analyze the force, torque, motion and temperature using measuring instruments for different applications. (Analyze)
5. Apply the concepts of sensors and transducers for data acquisition to measure various mechanical parameters in measurements. (Apply)
6. Analyze the data received from the measuring instruments using data acquisition system for production industries. (Analyze)

TEXT BOOKS:

1. Jain R.K, “Engineering Metrology”, Khanna Publishers, 2009.
2. A.K.Sawhney, “Mechanical Measurement and Instrumentation”, 3rd Edition, DhanpatRai, 2004

REFERENCE BOOKS

1. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.

2. Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley &Sons, 2015
3. Alan S Morris, Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann, 2001
4. D.V.S. Murthy, ‘Transducers and Instrumentation’, Prentice Hall of India Pvt Ltd, 2015
5. Jayal A.K, ―Instrumentation and Mechanical Measurements‖, Galgotia Publications 2000

EQUIPMENT REQUIREMENT

Sl. No.	Name of the equipment	Quantity required
1.	Micrometer	5
2.	Vernier Caliper	5
3.	Vernier Height Gauge	1
4.	Vernier Depth Gauge	1
5.	Slip Gauge Set	1
6.	Gear Tooth Vernier	1
7.	Sin Bar	1
8.	Bevel Protractor	1
9.	Force Measuring Setup	1
10.	Torque Measuring Setup	1
11.	Coordinate measuring machine	1
12.	Tool makers microsciope	1
13.	Dial gauge	1
14.	Data acquisition systems	1

COURSE ARTICULATION MATRIX

CO/PO/PSO MAPPING

CO	PO’s												PSO’s		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2												2		2
CO 2	3														
CO 3		3											3		
CO 4		3													
CO 5				3									3		
CO 6					3				3	3			3		3
19UME504	**3**	**3**		**3**	**3**				**3**	**3**			**3**		**3**

Ref: 1- Weak 2- Medium 3- Weak

19UGS533	INTERPERSONAL SKILLS LAB	L	T	P	C
		0	0	3	1.5

LIST OF EXERCISES

Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6. Speech Master of the Day
7. General Evaluator
8. Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Communicate orally with fluency and clarity in a given contextual situation (Responding - Affective Domain)
2. Evaluate a speech and offer constructive evaluation of the speech (Evaluating - Cognitive Domain)
3. Adapt themselves to work in a group as a member or a leader for efficiently executing the given task (Organization – Affective Domain)
4. Analyze a problem and find appropriate solution (Analyze - Cognitive Domain)
5. Take decision by organizing relevant information and defining alternatives (Create - Cognitive Domain)

19UME507	CREATIVE THINKING AND INNOVATION	L	T	P	C
		0	0	2	1

PREAMBLE:

Creativity is vital in nearly every industry and occupation. Creativity and innovation are key to generation of new ideas and methods of improving goods and services for customer satisfaction. This course enhances the creative thinking and innovation skills of the students. Being creative helps one to be a better problem solver in all areas of life and work.

COURSE OBJECTIVES:

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses
- To use a range of creative thinking tools to develop Out of the Box Ideas

Course Content

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

List of Activities:

Duration	What does the Faculty do?	What do the students do?
Week 1	Explains creativity and innovation	Team Formation (Team Size: 3)
Week 2	Explains the Creative Techniques (Through Video / Presentation)	Discovering Consumer Need through Need Analysis (Customer Segment)
Week 3	Facilitates the brain storming	Problem Identification through brain storming
Week 4	Facilitates problem solving	Identify the solution for the chosen problem through creative techniques

Week 5	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 6	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 7	Explains about the Market Research / Competitor Analysis, Revenue Model and Business Model	Market Analysis after the explanation
Week 8	Facilitates the students work	Preparation of Innovation Development Plan, Business Development Plan and Financial Plan
Week 9	Facilitates the students work	Preparing product promotional material
Week 10	Facilitates the students work	Improvement through Feedback

Total Hours: 30 Periods

Assessment Pattern

1. Internal Assessment: Presentation on the Innovative Idea
2. End Semester Assessment:
    - Submission of Business Plan
    - Presentation on My Startup Idea (Evaluator : From Industry)

Course Outcomes:

After successful completion of the course students will be able to:

1. Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice (Valuing – Affective Domain)
2. Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development (Organization – Affective Domain)
3. Adapt themselves to work in a group as a member or a leader for efficiently executing the given task (Organization – Affective Domain)

19UME508	THERMAL ENGINEERING LABAROTARY-II	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To demonstrate the concept of various modes in heat transfer.
- To understand the concept of refrigeration and air conditioning system.
- To calculate the performance of air compressor.

LIST OF EXPERIMENTS:

HEAT TRANSFER **30**

1. Thermal conductivity measurement by guarded plate method.
2. Thermal conductivity of pipe insulation using lagged pipe apparatus.
3. Natural convection heat transfer from a vertical cylinder.
4. Forced convection inside the tube.
5. Heat transfer from pin-fin apparatus by 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 **15**

1. Determination of COP of a refrigeration system.
2. Determination of COP on the air conditioning system.
3. Performance test on single/two stage reciprocating air compressor.

A minimum of nine experiments shall be offered

TOTAL: 45PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Apply the knowledge of conduction to examine the thermal conductivity of a given material in guarded hot plate and lagged pipe apparatus (Apply)
2. Apply the knowledge of radiation to determine the Stefan Boltzmann constant and the emissivity of grey surface (Apply)
3. Apply the concept of refrigeration and air conditioning to calculate the co – efficient of performance. (Apply)
4. Apply the knowledge of Single stage air compressor to identify its performance. (Apply)
5. Examine the heat transfer co-efficient of the fluid in the given test section for the natural and Forced Convection mode (Analyze)
6. Analyze the Effectiveness of the Parallel flow and counter flow heat exchanger (Analyze).

EQUIPMENTREQUIREMENT

Sl. No.	Name of the equipment	Quantity required
1.	Guarded plate apparatus	1
2.	Lagged pipe apparatus	1
3.	Natural convection-vertical cylinder apparatus	1
4.	Forced convection inside tube apparatus	1
5.	Pin-fin apparatus	1
6.	Stefan-Boltzmann apparatus	1
7.	Emissivity measurement apparatus	1
8.	Parallel/counter flow heat exchanger apparatus	1
9.	Single/two stage reciprocating air compressor	1
10.	Refrigeration test rig	1
11.	Air-conditioning test rig	1

COURSE ARTICULATION MATRIX

CO/PO/PSO MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3					3	3	3	3					3	3
CO2	3	3												2	
CO3	3	3						2						2	
CO4	3	3						2						2	
CO5	2	3		3					3	2				3	2
CO6	2	3		3					3	2				3	2
19UME508	**3**	**3**		**3**		**3**	**3**	**3**	**3**	**2**				**3**	**3**

Ref: 3- Strong 2- Medium 1- Weak

Semester – VI

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME601	Design of Transmission Systems	3	0	0	3	45
2.	PC	19UME602	Smart Manufacturing	3	0	0	3	45
3.	PC	19UME603	Operations Research	3	1	0	4	60
4.	PC	19UME604	Mechatronics	3	0	0	3	45
5.	PE	E 2	Professional Elective – II	3	0	0	3	45
6.	OE	OE 2	Open Elective - II	3	0	0	3	45
7.	MC	19UGM631	Indian Constitution	1	0	0	P/F	15
PRACTICAL								
8.	P	19UME607	Product Development Project	0	0	8	4	120
9.	PC	19UME608	CAD/ CAM Laboratory	1	0	2	2	60
10.	PC	19UME609	Smart Manufacturing & Mechatronics Laboratory	0	0	4	2	60
11.	HS	19UGS532	Soft Skill and Communications Laboratory	0	0	3	1.5	45
Total Credits : 28.5				**20**	**1**	**17**	**28.5**	

19UME601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the principles and procedure for the design of power Transmission components.
- To impart knowledge on the design aspects of gear boxes, clutches and brakes.
- To familiarize the usage of standard data and catalogues.

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Design of V belts and pulleys - Wire ropes and pulleys - Design of Transmission chains and Sprockets - Introduction to timing belt and silent chain.

UNIT II DESIGN OF SPUR AND HELICAL GEARS 9

Design of straight tooth spur helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears - Estimating the size of the helical gears – Cross Helical Gear: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT III DESIGN OF BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.

Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT IV DESIGN OF GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Constant mesh gear box – Design of multi speed gear box.

UNIT V DESIGN OF CLUTCHES AND BRAKES 9

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic Clutches.

Band and Block brakes – external shoe brake – Internal external shoe brakes

TOTAL :45 PERIODS

Note: Use of P S G Design Data Book is permitted in the End Semester examination

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the various design of transmission system concepts for flexible elements, gears, gear boxes, brakes and clutches. (Understand)
2. Apply the design concepts to solve flexible elements, gear boxes, brakes and clutches. (Apply)
3. Compute the various terminology of spur gear, helical gear, worm gear and bevel gears for the given problem. (Apply)
4. Compare the design stresses and induced stresses of spur gear, helical gear, worm gear and bevel gears and justify. (Evaluate)
5. Design and analyze the flat belt, V-belt, chain drive, gear boxes, brakes and clutches. (Analyze)
6. Design and model a suitable flexible elements, gears, gear boxes, for the given problem with using modern tool. (Evaluate)

TEXT BOOKS:

1. Sundararajamoorthy.T.V, Shanmugam.N ,“Machine Design”,Anuradha Publications , Chennai, 2015.
2. Joseph Shigley,CharlesMischke,RichardBudynas and Keith Nisbett “Mechanical Engineering Design”, 10th Edition, Tata McGraw-Hill, 2015.

REFERENCE BOOKS:

1. Prabhu. T.J, “Design of Transmission Elements”, Mani Offset, Chennai,2000.
2. Bhandari.V.B, “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007.
3. Maitra G.M, Prasad L.V, “Hand book of Mechanical Design”, Tata McGraw-Hill, New Delhi,2011.
4. Ugural A, C, “Mechanical Design Integrated Approach”, Tata McGraw-Hill, 2004.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2														
CO.2	3												2		
CO.3	3												2		
CO.4	3	3	2		3			3	3				3		3
CO.5	3	3	3		3			3	3				3		3
CO.6	3	3	3	3	3			3	3			3	3		3
19UME601	**3**	**3**	**3**	**3**	**3**			**3**	**3**			**3**	**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME602	SMART MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the concept of IoT connected systems for industrial automation.
- To expose the insights of Robot applications in manufacturing and various additive manufacturing systems.

UNIT I INDUSTRY 4.0 9

Introduction to Industrial revolutions - Industry 4.0 environment - Drivers of industry 4.0 - Digital integration in smart factory - Cyber Physical System – Internet of Things and Industrial Internet of Things - Benefits and Challenges of Industry 4.0

UNIT II ROBOTS IN MANUFACTURING 9

Introduction about robotics in automation - Robot classification –Robot applications in manufacturing – Material handling – Processing Operations – Assembly and Inspection – Future Robot Technology and tasks – Social and Labor Issues.

UNIT III LIQUID BASED ADDITIVE MANUFACTURING SYSTEMS 9

Introduction to Additive Manufacturing (AM) systems- Classification of AM process – Generic AM process - Principle, pre-build, part-building and post-build processes of Stereo-lithography Apparatus (SLA) - Photo polymerization of SL resins - Re-coating issues, materials, advantages, limitations and applications.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Introduction to Selective Laser Sintering (SLS) – Working principle- process description- Indirect and direct SLS- Post processing - advantages, limitations and applications. Laser Engineered Net Shaping (LENS): Working principle - process description - advantages, limitations and applications – Electron Beam Melting - Working principle - process description- - advantages, limitations and applications.

UNIT V SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 9

Introduction to Solid Ground Curing (SGC) - Working Principles, details of processes, products, materials, advantages, limitations and applications - Fused deposition Modeling (FDM) - Working Principles, details of processes, products, materials, advantages, limitations and applications - Laminated Object Manufacturing (LOM) - Working Principles, details of processes, products, materials, advantages, limitations and applications

Total: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Able to apply the concept of Industry 4.0 and IoT to the solution of complex engineering problems in modern industrial sector.(Apply)
2. Able to select suitable robot for the manufacturing industrial applications. (Apply)
3. Able to describe the behavior and properties of materials as they are subjected into additive manufacturing processes. (Understand)
4. Able to demonstrate about liquid based additive manufacturing systems. (Understand)
5. Able to select appropriate additive manufacturing method for particular industrial product. (Apply)
6. Able to analyze the advantages and limitations of the various additive manufacturing processes. (Analyze)

Content beyond the syllabus: "Design for Additive Manufacturing**"**

REFERENCE BOOKS:

1. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cybermanufacturing Systems, Springer, 1st edition, 2017.
2. The Concept Industry 4.0 : An Empirical Analysis of Technologies and Applications in Production Logistics, Bartodziej, Christoph Jan, 1st Edition, Springer Gabler, 2017.
3. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, A press, Berkeley CA, 2016.
4. Additive Manufacturing Technologies (3D printing, Rapid prototype and Direct Digital Manufacturing, Gibson, Ian, Rosen, David, Stucker, Brent, Springer, 2015.
5. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
6. Industrial Robotics (SIE): Technology, Programming And Applications – Nicholas Odrey, Mitchell Weiss, Mikell Groover, Roger N Nagel and Ashish Dutta – Tata McGraw-Hill Publishing Company, 2012.
7. Tom Page "Design for Additive Manufacturing" LAP Lambert Academic Publishing,2012.
8. Gebhardt A, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardener Publications, 2011.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3												2		
CO.2	3	2											3		3
CO.3	3	3		3									3		3
CO.4	3	2	2	2									2		
CO.5	3	2		2											
CO.6	3	2	2	2		2									2
19UME602	**3**	**3**	**2**	**3**		**2**							**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME603 **OPERATIONS RESEARCH**

L	T	P	C
3	1	0	4

OBJECTIVES :

- To familiarize knowledge about optimization and utilization of resources.
- To impart knowledge on operations research techniques in industrial operations.

UNIT I LINEAR MODEL 9 +3

Introduction to OR–Meaning and scope –characteristics – modes in OR LPP– LPP Formulation– Graphical method–Simplex method– Big M method.

UNIT II TRANSPORTATION AND ASSIGNMENT MODEL 9+3

Transportation model –Basic feasible solution– Balanced and Unbalanced TP –Formulation solving a TP– Assignment models– Balanced and Unbalanced – Formulation solving.

UNIT III SEQUENCING AND NETWORK MODEL 9+3

Sequencing Problems – Processing 'n' jobs through two machines and three machines - Network models – Basic Concepts – Construction of Networks–Shortest route – Minimal spanning tree – Maximum flow – Project Network – CPM and PERT.

UNIT IV INVENTORY AND REPLACEMENT MODEL 9+3

Types of Inventory– EOQ – Deterministic inventory problems –Selective inventory control techniques – Replacement of items that deteriorate with time –Value of money changing with time – not changing with time –Optimum replacement policy – Individual and group replacement.

UNIT V GAME THEORY AND SIMULATION 9+3

Queuing theory – models- queuing systems and structures – notation –parameter – single server and multi server models – Poisson input – exponential service – constant rate service – infinite population- Game theory –Two person zero-sum games – Maximin - Minimax principle – Saddle point –Value of the game – Mixed and pure strategies –Dominance property– Arithmetic method–Graphical method – Simulation– Monte-Carlo technique – Uses of simulation.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the various concepts of operations research techniques. (Understand)
2. Apply the knowledge of linear programming technique to find optimal solution for the given problem. (Apply)
3. Make use of decision making to solve replacement, inventory, game theory and queuing theory problems. (Apply)
4. Utilize excel solver for linear programming problems to determine the optimal solution. (Apply)
5. Analyze the optimum replacement policy to select the individual or group replacement for the given situation. (Analyze)
6. Compare the different operation research technique problems using TORA software. (Analyze)

ONLINE RESOURCES

1. https://nptel.ac.in/courses/110/106/110106062/
2. https://freevideolectures.com/course/5012/nptel-introduction-operations-research
3. https://cosmolearning.org/courses/advanced-operations-research-527/video-lectures/

TEXT BOOKS:

1. Sundaresan V, Ganapathy Subramanian K S, Ganesan K, “Resource Management Techniques Operations Research”, AR Publications, 10th edition, 2016.
2. Hamdy A. Taha, “Operation Research an Introduction”,Prentice-Hall, Eigth Edition, 2006.

REFERENCE BOOKS:

1. Srinivasan G, “Operations Research Principles and Applications”, PHI Learning Private Limited, Third Edition, 2017.
2. Wayne L.Winston, “Operations Research Applications and Algorithms”, Thomson Learning, Fourth Edition,2007.
3. Panneerselvam R, “Operations Research”, PHI Learning Private Limited, Second Edition, 2009.
4. Hira and Gupta “Operations Research”, S.Chand and Company Pvt. Ltd, Seventh Edition, 2014.

COURSE ARTICULATION MATRIX:

CO/PO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2										2				
CO 2	3										2		2		
CO 3	3										2		2		
CO 4	3				3			2			2	2	2		
CO 5	3	3							3		3	3	2		3
CO 6	3	3			3			3	3		3	3	2		
19UME603	**3**	**3**			**3**			**3**	**3**		**3**	**3**	**2**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME604	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems.
- To impart knowledge on mechanical system with pneumatic, hydraulic components integrated with sensor and actuators.

UNIT I INTRODUCTION TO MECHATRONICS, SENSORS AND TRANSDUCERS. **9**

Introduction to Mechatronics systems – Need for mechatronics - Emerging areas of mechatronics – Classification of mechatronics - Introduction to sensors and transducers and classifications - principle and working of Resistive, capacitive, inductive and resonant transducers –optical measurement systems for absolute and incremental encoders – Photo electric sensor and vision system – Fiber optic transducers – Solid state sensors and transducers for magnetic measurements – Temperature measurements – chemical measurements, piezoelectric sensor and accelerometers - Ultrasonic sensors for flow and distance.

UNIT II ACTUATION SYSTEMS **9**

Pneumatic and Hydraulic Systems - Directional Control Valves - Rotary Actuators. Electrical Actuation Systems - Mechanical Switches - Solid State Switches - Solenoids - Construction and working principle of DC and AC Motors - speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor - AC & DC Servo motors.

UNIT III SYSTEM MODELS AND CONTROLLERS **9**

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational - Transnational Systems, Electromechanical Systems - Hydraulic - Mechanical Systems. Continuous and discrete process Controllers - Control Mode - Two - Step mode - Proportional Mode - Derivative Mode - Integral Mode - PID Controllers - Digital Controllers - Velocity Control - Adaptive Control - Digital Logic Control - Micro Processors Control.

UNIT IV PROGRAMMING LOGIC CONTROLLERS **9**

Programmable Logic Controllers - Basic Structure - Input / Output Processing - Programming - Mnemonics - Timers, Internal relays and counters - Data Handling - Analogs Input / Output - Selection of a PLC – Programming the PLC using Ladder diagram for simple applications.

UNIT V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics Systems - Traditional and Mechatronics Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Engine Management system- Automatic car park barrier.

TOTAL: 45 PERIODS

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the concepts of sensors, transducers, actuators, system models, controllers and PLC for various applications (Understand)
2. Apply the concepts of sensors, transducers, actuators, system models, controllers and PLC for given scenario. (Apply)
3. Apply the function of actuators, system models and controllers in mechatronics system (Apply)
4. Analyze the function of Programmable Logic Controllers in mechatronics system(Analyze)
5. Analyze the various actuators in mechatronics system using software's for the given applications. (Analyze)
6. Construct a proto type model of a mechatronics system for various applications (Create)

TEXT BOOKS:

1. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2011.
2. Rajput. R.K, "A textbook of mechatronics", S. Chand & Co,2007.

REFERENCE BOOKS:

1. Godfrey C. Onwubolu, "Mechatronics Principles and Applications" Butterworth-Heeinemann, New Delhi, 2006.
2. David G. Alciatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, McGraw Hill; second edition, 2002.
3. Sabricetinkunt, "Mechatronics", Wiley,2006
4. Smaili.A,Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press,2008
5. HMT Ltd., "Mechatronics", Tata McGraw Hill Publishing Co. Ltd.,2000.
6. Ogata k., "Modern Control Engineering" Prentice Hall, 2010, ISBN 81-7808 - 579-8
7. S. Brain Morriss, "Automated Manufacturing Systems: Sensors, Actuators", McGraw Hill, 1995
8. https://www.electricaltechnology.org/2016/08/distributed-control-system-dcs.html.

COURSE ARTICULATION MATRIX:

CO/PO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2			2			2				2	2		2
CO 2	3														
CO 3		2													
CO 4		3													
CO 5					2								3		
CO 6			2						3	3			3		3
19UME604	**3**	**3**	**2**		**2**			**2**	**3**	**3**		**2**	**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UGM631	INDIAN CONSTITUTION	L	T	P	C
		1	0	0	P/F

Pre-requisites: Nil

COURSE OBJECTIVE:

- The students will be exposed to fundamental rights & duties in Indian Constitution.
- The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development.
- The student will have knowledge on powers and functions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB…
- The student will know about the functions of judiciary and electoral process followed in the country.

UNIT I INTRODUCTION ON INDIAN CONSTITUTION 4

Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articles of constitution- important Amendments of constitution.

UNIT II PARLIAMENTARY SYSTEM 4

Parliamentary System – parliamentary system of other countries - Indian parliamentary system- Federal System – LS and RS,Centre-State Relations-Election of member of parliaments- Union Executive - President, Prime Minister, Union Cabinet. State Legislature -State Executives –election of MLA- Governor, Chief Minister, State Cabinet.

UNIT III JUDICIARY AND ELECTION COMMISSION 4

Supreme Court of India: Structure, Power and Functions of Supreme Court-- Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. – Lokadhalats. Elections- Electoral Process - Election Commission of India - Election Laws – Emergency Provisions - types of Emergencies and its consequences.

UNIT IV LOCAL ADMINISTRATION 3

Local Administration: Powers and functions of Municipalities and Panchayats System-Panchayat Raj- Co–operative Societies and Constitutional and Non-constitutional Bodies.

Total: 15 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Able to apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations.
2. Able to manage complex societal issues in society with the knowledge of judiciary and local administration.
3. Able to interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills.
4. Able to understand the ethical responsibilities of municipalities, panchayats and co-operative societies.
5. Able to understand and distinguish the functioning of the parliamentary system followed in various countries.

TEXT BOOKS:

1. Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” by Cengage Learning India Private Limited, 2018.
2. Subhash C. Kashyap,”Our Constitution: An Introduction to India’s Constitution and constitutional Law”, NBT, 2018.
3. Brij Kishore Sharma, “Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., New Delhi, 2011.
4. M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.
5. Durga Das Basu, “Introduction to the Constitution on India”, Prentice Hall, 2001.

19UME607	PRODUCT DEVELOPMENT PROJECT	L	T	P	C
		0	0	8	4

OBJECTIVES:

- To make the student in integrated activities of reading, research, discussion and presentation around a designated subject.
- To impart knowledge to implement their skills acquired in the previous semesters to practical problems.
- To familiarize the students to make fabrication work.

PROJECT DESCRIPTION:

The students in convenient groups of not more than 4 members have to take one small item for design and fabrication. Every project work shall have a guide who is the member of the faculty of the institution and if possible with an industry guide also.

The item chosen may be small machine elements (Example-screw jack, coupling, machine vice, cam and follower, governor etc), attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic /pneumatic devices etc.

The students are required to design and fabricate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts relating to fabrication.

TOTAL: 120 PERIODS

COURSEOUTCOMES:

After successful completion of this course the students will be able to:

1. Identify the systematic way of organizing various resources for completing the project in time.
2. Implement most appropriate manufacturing processes for a specific task.
3. Build the proto type model for engineering applications.
4. Demonstrate the working of fabrication project.
5. Prepare and present the project along with report.

COURSE ARTICULATION MATRIX:

CO/PO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3				3							3	3	3
CO 2		3	3										3	3	3
CO 3				3	3								3	3	3
CO 4									3		3		3	3	3
CO 5										3			3	3	3
19UME607	**3**	**3**	**3**	**3**	**3**	**3**			**3**	**3**	**3**		**3**	**3**	**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME608 CAD/CAM LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES :

- To demonstrate the knowledge on interpret drawings of machine components and assembly drawings using standard CAD packages.
- To train the students in the Indian standards on drawing practices and standard components.

LIST OF EXPERIMENTS :

CAD ASSEMBLY DRAWING (USING APPLICATION PACKAGES) **20**

1. Practice various commands using Creo software
2. Develop the part modeling using Creo software
3. Develop the assembled views of Shaft coupling
4. Develop the assembled views of Plummer block
5. Develop the assembled views of Screw jack
6. Develop the assembled views of Universal Joint **10**
7. Develop the assembled views of Sleeve and Cotter Joint
8. Develop the assembled views of Socket and Spigot Joint

CAM

1. Practice various CNC codes using CADEM software
2. Develop CNC Program For Step Turning and Generate the Tool Path Simulation
3. Develop CNC Program for Multiple Turning and Generate the Tool Path Simulation
4. Develop CNC Program for Thread Cutting, Grooving and Generate the Tool Path Simulation
5. Develop CNC Program for Drilling and Generate the Tool Path Simulation
6. Develop CNC Program for Rectangular Pocketing and Generate the Tool Path Simulation
7. Develop CNC Program for Rectangular and Circular Pocketing and Generate the Tool Path Simulation

A minimum of nine experiments shall be offered

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the basics of modeling and simulation using Creo & CADEM Software. (Understand)
2. Apply the knowledge of modeling software to develop different mechanical components. (Apply)
3. Apply the concepts of assemble module to combine various mechanical components for the given engineering application. (Apply)
4. Develop CNC program for turning, grooving and thread cutting operations using CNC Lathe. (Apply)
5. Apply the knowledge of simulation software to build CNC program for drilling and pocketing operations using CNC Mill. (Apply)
6. Design and analyze the given mechanism using modeling (Analyze)

EQUIPMENT REQUIREMENT

Sl. No.	Name of the equipment/software	Quantity required
1.	Computer Server	1
2.	A3 size plotter	1
3.	Laser Printer	1
4.	Trainer CNC Lathe	1
5.	Trainer CNC milling	1
6.	Computer system	30
7.	SOLIDWORKS /Auto CAD/Pro-E	30
8.	CAD/CAM software (Pro-E or IDEAS or Unigraphics or CATIA	15
9.	CAM Software (CNC Programming and tool path simulation for FANUC /Sinumeric and Heiden controller)	15
10.	Licensed operating system	Adequate

COURSE ARTICULATION MATRIX:

CO/PO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2				2								2		
CO 2	3				3								3		
CO 3	3				3								3		
CO 4	3				3								3		
CO 5	3				3								3		
CO 6			3		3					2			3		2
19UME608	**3**		**3**		**3**					**2**			**3**		**2**

Ref: 3 - Strong 2 - Medium 1 – Weak

		L	T	P	C
19UME609	**SMART MANUFACTURING AND MECHATRONICS LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES :

- To impart the knowledge in servo controller, micro controller, PLC, hydraulics and pneumatics systems,
- To learn the concepts and application of industrial robots and Additive Manufacturing

LIST OF EXPERIMENTS :

1. Design and testing of fluid power circuits to control velocity and direction of double acting cylinder.
2. Servo Controller Interfacing for Open and Closed Loop System.
3. Stepper motor interfacing with 8051 micro controller Full step / Half step revolutions
4. Design and simulation of a hydraulic circuits:
   - Design and simulation of a hydraulic circuit to actuate a double acting cylinder by using one hand operated 4/2 way valve.
   - Design and simulation of a hydraulic circuit to actuate two double acting cylinders by using single solenoid 4/2 way valve.
5. Design and simulation of a pneumatic circuits:
   - Design and simulation of a pneumatic circuit to actuate one double acting cylinder by using one hand operated 5/2 way valve.
   - Design and simulation of a pneumatic circuit to actuate one double acting cylinder by using two 3/2 way valve operated 4/2 way valve.
6. Design a circuit using electro pneumatic trainer kit:
   - Design a circuit of extend/retract of single acting cylinder using push button and 3/2 solenoid valve by using electro pneumatic trainer kit.
   - Design a circuit of extends and retraction of double acting cylinder using two push buttons and 5/2 double solenoid valve by using electro pneumatic trainer kit.
7. Design and control of a circuit using versa pro with PLC:
   - Design of a circuit to extend and retract the cylinder with the help of the two sensors to control with PLC.
   - Design of a circuit for synchronization of two cylinders to control with PLC.

8. Study of Advanced Applications in Industrial Robotics
9. Study of Introduction to Additive Manufacturing
10. Study and application of Fused deposition Modelling (FDM) in Additive Manufacturing

A minimum of nine experiments shall be offered

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Explain the concepts of hydraulics, pneumatics systems, servo controller, micro controller, industrial robots and additive manufacturing for various applications (Understand)
2. Apply the knowledge of hydraulics and pneumatics to design and simulate the different circuits using software. (Apply)
3. Apply the knowledge of pneumatics system to design and operate different circuits using electro pneumatic trainer kit. (Apply)
4. Apply the concepts of industrial robots and additive manufacturing for various applications. (Apply)
5. Analyze the performance of servo motor for open and closed loop system and stepper motor interfacing with 8051 Micro controller. (Analyze)
6. Analyze the functions of PLC in hydraulics and pneumatics systems. (Analyze)

EQUIPMENT REQUIREMENT

Sl. No.	Name of the requirement	Quantity required
1.	SYSCO simulation of speed control in hydraulic system kit	1 No.
2.	Hydraulic and Pneumatic system simulation software – FLUID SIM and HYDRO SIM	5users
3.	Basic Electro Pneumatic Trainer kit (VMT-05) with Electrical control Trainer (VMT – 07)	1 No.
4.	Servo controller using closed / Open loop system and drive circuit set (VPAT-22) using WINPRO LADDER software	1 No.
5.	8051 – Micro controller with Stepper motor and drive circuit sets	1 No.

6	Raspberry pi and Arduino boards with drive circuit sets	1 No.
7	Basic Electro Pneumatic Trainer kit (VMT-04) with PLC control Trainer (VPLCT-02) using VERSA PRO software	1 No.
8	Multi process station (VMPA – 620 with Data Acquisition card set using Process Control (Win 98)	1 No.
9	CAM Software (CNC Programming and toolpath simulation for FANUC /Sinumeric and Heiden controller)	20 users
10	MTAB CNC XL Turn Lathe	1No.
11	MTAB CNC MILL	1No.

COURSE ARTICULATION MATRIX:

CO/PO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2			2				2				2		
CO 2	3				2								3		
CO 3		2													
CO 4		3													
CO 5		3							3	3			3		3
CO 6		3			2										
19UME609	**3**	**3**			**2**				**3**	**3**			**3**		**3**

19UGS532	SOFT SKILLS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To develop a requisite knowledge in Communication skills and Soft skills.
- To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.

UNIT I SPEAKING SKILLS 9

Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills.

UNIT II WRITING SKILLS 9

Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation.

UNIT III READING AND LISTENING SKILLS 9

Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking.

UNIT IV SOFTSKILLS 9

Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution.

UNIT V INTERVIEW SKILLS 9

Types of Interview – Body Language – Professional Grooming – Basic Etiquette.

Total: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

Answer the queries precisely after carefully listening to the conversation or speech.(Affective domain - Responding)

Communicate orally with fluency and clarity in a given contextual situation (Affective domain - Responding)

Debate with clarity of thought and expression to convey their ideas politely to others (Affective domain - Valuing)

Apply correct usage of English grammar in writing, fluent speaking and comprehending. (Cognitive Domain - Apply)

REFERENCE BOOKS:

1. Skills for Success, Listening and Speaking – Level 4 by Brooks and Margret – Oxford University Press, Oxford 2011 Edition.
2. Professional Communication by Raman, Meenakshi and Sangeetha Sharma – Oxford University Press, 2014 Edition.
3. Developing Soft Skills by Sherfield, Robert M, R J Montgomery and Patricia G Moody – Pearson Education Publishers.

Semester – VII

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
THEORY								
1.	PC	19UME701	Project Management and Finance	3	0	0	3	45
2.	PC	19UME702	Finite Element Analysis	3	0	0	3	45
3.	PE	E 3	Professional Elective III	3	0	0	3	45
4.	PE	E 4	Professional Elective – IV	3	0	0	3	45
5.	PE	E 5	Professional Elective – V	3	0	0	3	45
6.	OE	OE 3	Open Elective III	3	0	0	3	45
7.	MC	19UGM731	Professional Ethics & Human values	2	0	0	P/F	30
PRACTICAL								
8.	P	19UME707	Summer Internship	0	0	2	1	30
9.	PC	19UME708	Computational Analysis Laboratory (ANSYS & CFD)	0	0	4	2	60
Total Credits : 21				**20**	**0**	**6**	**21**	

19UME701	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge to find solutions and approaches for various projects.
- To familiarize the utilization of project within time, resource and financial constraints.

UNIT I PROJECT MANAGEMENT CONCEPTS 9

Concept and characteristics of a project, importance of project management, types of project, project organizational structure, project life cycle, Statement of Work, Work Breakdown Structure.

UNIT II PROJECT PLANNING 9

Project Planning and Scheduling techniques - developing the project network using CPM/PERT, Limitations of CPM/PERT, Precedence Diagramming Method, constructing diagram and computations using precedence diagramming method, PERT/CPM simulation, reducing project duration.

UNIT III RESOURCE SCHEDULING & CRITICAL CHAIN SCHEDULING 9

Resource Scheduling - Resource allocation method, splitting and multitasking, Multi project resources scheduling - Critical Chain Scheduling -Concept of critical chain scheduling - critical chain scheduling method, application of Critical chain scheduling and limitations.

UNIT IV PROJECT QUALITY MANAGEMENT 9

Concept of project quality, responsibility for quality in projects, quality management at different stages of project, tools and techniques, Quality Management Systems, TQM in projects - Project Performance Measurement and Control - Monitor and assess project performance, schedule, and cost. Earned Value Management, performance measurement methods to monitor, evaluate and control planned cost and schedule performance - Project Closure/ Termination - Meaning of closure/ termination, project audit process, termination steps, final closure.

UNIT V FINANCIAL ACCOUNTING 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis – Comparative financial statements. Investments - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

Total: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Describe the concept and characteristics of project management and application of resource scheduling and critical chain scheduling. (Understand)
2. Estimate the suitable resources required for given project work. (Apply)
3. Construct the balance sheet to identify the fund flow and cash flow statements. (Apply)
4. Apply the concept of CPM and PERT to develop the project network. (Apply)
5. Examine the various tools and techniques at different stages of Quality management. (Analyze)
6. Evaluate the decision related to forecasting, inventory, quality control problems etc. for the industries (Evaluate)

TEXT BOOKS:

1. Prasanna Chandra, "'Fundamentals of Financial Management' ", Tata Mcgraw-Hill Publishing Ltd,2015.
2. Jack Meredith, Samuel J.Mantel, "Project Management- A Managerial Approach", John Wiley andSons.

REFERENCE BOOKS:

1. Clifford F Gray, Erik W Larson, "Project Management-The Managerial Process", Tata Mcgraw-Hill Publishing Co Ltd.
2. John M Nicholas, "Project Management for Business and Technology", Prentice Hall of India Pvt Ltd.
3. Paresh Shah, "Basic Financial Accounting for Management", Oxford University Press, 2020.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2										2				
CO.2	3										3				
CO.3	3					2					3				
CO.4	3				3	2					3		2		
CO.5	3	3			3	2	3		3		3		2		2
CO.6	3	3	3	2	3	2			3		3		2		3
19UME701	**3**	**3**	**3**	**2**	**3**	**2**	**3**		**3**		**3**		**2**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME702	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the principles involved in discretization and finite element approach.
- To impart knowledge to calculate the stiffness matrices and force vectors for simple elements.

UNIT I FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS 9

Introduction to FEA – Weighted residuals methods (Least square method, collocation, sub-domain collocation, Galerkin's method) –Variational approach – Rayleigh Ritz method.

UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS 9

General form of total potential for 1-D applications - generic form of finite element equations - nodal approximation - development of shape functions - element matrices and vectors -One Dimensional finite element analysis: bar element, beam element, spring element and truss element, quadratic element.

UNIT III TWO DIMENSIONAL FINITE ELEMENT ANALYSIS 9

Two dimensional finite element analysis: types of elements, shape functions, natural coordinate systems -Iso-parametric elements -transformations to natural coordinates - Gaussian quadrature - plane stress, plane strain and axisymmetric applications.

UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD 9

Introduction - vibration problems - equations of motion based on weak form - longitudinal vibration of bars - transverse vibration of beams – consistent mass matrices- element equations - solution of Eigenvalue problems - vector iteration methods - normal modes - transient vibrations - modeling of damping - mode superposition technique - direct integration methods.

UNIT V APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS 9

One dimensional heat transfer element - application to one-dimensional heat transfer problems - scalar variable problems in 2-Dimensions- Applications in heat transfer and fluid mechanics in 2D Problems. Introduction to FEA software's.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the various finite element concepts for structural, non-structural, Vibrational, Heat Transfer and Fluid mechanics. (Understand)
2. Apply the finite element equations to solve 1D, 2D and 3 D problems. (Apply)
3. Apply the FEM concepts to derivate shape function, displacement function, Temperature function for various ID, 2D elements. (Apply)
4. Analyze beams and shafts using finite element analysis. (Analyze)
5. Compare 1D, 2D problems by analytical method and commercial FEA software packages. (Analyze)
6. Evaluate the given heat transfer, solid mechanics and fluid mechanics problems. (Evaluate)

TEXT BOOKS:

1. Seshu.P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd, New Delhi, 2018.
2. Reddy .J.N, “An Introduction to the Finite Element Method”, McGraw-Hill International 3rd Editions, 2017.

REFERENCE BOOKS:

1. Chandrupatla, Belagundu, “Introduction to Finite Elements in Engineering”, Prentice-Hall of India Eastern Economy 4th Editions, 2015.
2. Senthil.S.Dr, Panneerdhass.R, “Finite Element Analysis”, Lakshmi Publications, Chennai, 2012.
3. Cook.Robert. D, Plesha. Michael. E, Witt. Robert.J, “Concepts and Applications of Finite Element Analysis”, Wiley Student 4th Edition, 2004.
4. David V., “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition, 2005.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2														
CO.2	3	2			2								2	2	
CO.3	3	2			2								2	2	
CO.4	3	3	3		3			3	3				3	3	2
CO.5	3	3	3		3			3	3				3	3	2
CO.6	3	3	3	3	3			3	3			2	3	3	3
19UME702	**3**	**3**	**3**	**3**	**3**			**3**	**3**			**2**	**3**	**3**	**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UGM731	PROFESSIONAL ETHICS & HUMAN VALUES	L	T	P	C
		2	0	0	P/F

OBJECTIVES :

- To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others

UNIT I HUMAN VALUES 7

Morals- Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage - Valuing Time - Co-operation –Commitment – Empathy- self-Confidence –Character.

UNIT II ENGINEERING ETHICS 7

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues –Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 4

Engineering Harmony in the family – Harmony in the society – Trust and Respect – Universal harmonious order

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 6

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.

UNIT V GLOBAL ISSUES 6

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development– Engineers as Managers – Consulting Engineers – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
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.

L T P C

19UME708	COMPUTATIONAL ANALYSIS LABORATORY (ANSYS & CFD)	0	0	4	2

OBJECTIVES :

- To train the student to interpret drawings of components and analyze using analyzing packages.

LIST OF EXPERIMENTS :

1. Stress analysis of cantilever beam.
2. Stress analysis of simply supported beam.
3. Stress analysis of fixed ends beam.
4. Stress analysis of an axi-symmetric component.
5. Mode frequency analysis of a 2 D component.
6. Mode frequency analysis of cantilever beams.
7. Mode frequency analysis of simply supported beam.
8. Thermal stress analysis of a 2D component.
9. Conductive heat transfer analysis of a 2D component.
10. Convective heat transfer analysis of a 2D component.
11. Introduction to ANSYS Modeling and simulation software to aerodynamic problems Numerical simulation of Flow over an airfoil.
12. Numerical simulation of Supersonic flow over a wedge.
13. Numerical simulation of Flat plate boundary layer.
14. Numerical simulation of Laminar flow through pipe.
15. Numerical simulation of Flow past cylinder.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Outline the basic concepts of FEA and CFD using ANSYS software for different structures (Understand)
2. Apply the vibration concepts to calculate the mode frequency for different beams. (Apply)
3. Apply heat transfer concept to compute the conduction, convection and temperature distribution for the given structures. (Apply)
4. Analyze the given structural problem to determine the deflection and stresses in different types of beams. (Analyze)
5. Analyze the given 2D axisymmetric component and find stress and deflection for different load conditions. (Analyze)
6. Analyze the fluid flow properties of flat plate, pipe and aero foil using CFD. (Analyze)

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2				2								2		
CO 2	3				3				2				3		
CO 3	3				3				2				3	3	
CO 4	3	3	2		3			3	3			2	3		2
CO 5	3	3	2		3			3	3			2	3		2
CO 6	3	3	3	3	3			3	3			2	3	3	3
19UME708	**3**	**3**	**3**	**3**	**3**			**3**	**3**			**2**	**3**	**3**	**3**

*** 3 – Strong 2 – Medium 1 – Weak**

LIST OF EQUIPMENTS:

1. HARDWARE – COMPUTERS DELL i5 – 40 Numbers
2. SOFTWARE – ANSYS 19.0 (academic Teaching mechanical and CFD) – 50 Users

Semester –VIII

Sl.No	Course Category	Course Code	Course Name	L	T	P	C	H
1.	P	19UME801	Project Work	0	0	16	8	240
2.	PE	E6	Professional Elective VI	3	0	0	3	45
3.	OE	OE4	Open Elective IV	3	0	0	3	45
Total Credits : 14				**6**	**0**	**16**	**14**	

19UME801	PROJECT WORK	L	T	P	C
		0	0	16	8

OBJECTIVES :

- To demonstrate the comprehension of principles by applying them to a new problem wh maybethedesignandmanufactureofadevice,aresearchinvestigation,acomp based project or management project.

PROJECT DESCRIPTION:

1. The project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study.
2. Every project work shall have a guide who is the member of the faculty of the institution.
3. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.
4. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.
5. The progress of the project is evaluated based on a minimum of three reviews.

TOTAL : 240 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge.
2. Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion.
3. Utilize the new tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice.
4. Test and Evaluate the performance of the developed solution using appropriate techniques and tools.
5. Apply management principles to function effectively in the project team for project execution.
6. Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs.
7. Write effective reports and make clear presentation to the engineering community and society.

COURSE ARTICULATION MATRIX:

CO/PO/PEO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3		3				3						3	3	3
CO.2		3		3									3	3	3
CO.3					3			3					3	3	3
CO.4		3			3								3	3	3
CO.5									3		3		3	3	3
CO.6						3	3					3	3	3	3
CO.7										3			3	3	3
19UME801	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Ref: 3- Strong 2-Medium 1 -Weak

PROFESSIONAL ELECTIVE:

Sl. No	Course Category	Course Code	Course Name	L	T	P	C
1.	PE	19UME901	Industrial and Quality Management	3	0	0	3
2.	PE	19UME902	Gas Dynamics and Jet Propulsion	3	0	0	3
3.	PE	19UME903	Applied Hydraulics and pneumatics	3	0	0	3
4.	PE	19UME904	Design of Jigs, Fixtures & Press Tools	3	0	0	3
5.	PE	19UME905	Computational Fluid Dynamics	3	0	0	3
6.	PE	19UME906	Quality Control and Reliability Engineering	3	0	0	3
7.	PE	19UME907	Renewable Sources of Energy	3	0	0	3
8.	PE	19UME908	Industrial Tribology	3	0	0	3
9.	PE	19UME909	Power Plant Technology	3	0	0	3
10.	PE	19UME910	Unconventional Machining Processes	3	0	0	3
11.	PE	19UME911	Composite Materials	3	0	0	3
12.	PE	19UME912	Process Planning and Cost Estimation	3	0	0	3
13.	PE	19UME913	Nano Science and Technology	3	0	0	3
14.	PE	19UME914	Vibration and Noise Control	3	0	0	3
15.	PE	19UME915	Refrigeration and Air conditioning	3	0	0	3
16.	PE	19UME916	Nuclear Engineering	3	0	0	3
17.	PE	19UME917	Entrepreneurship Development	3	0	0	3
18.	PE	19UME918	Maintenance Engineering	3	0	0	3
19.	PE	19UME919	Production Planning and Control	3	0	0	3
20.	PE	19UME920	Design of Heat Exchangers	3	0	0	3
21.	PE	19UME921	Advanced I.C. Engines	3	0	0	3
22.	PE	19UME922	Failure Analysis and Design	3	0	0	3
23.	PE	19UME923	Computer Integrated Manufacturing	3	0	0	3
24.	PE	19UME924	Cryogenics	3	0	0	3
25.	PE	19UME925	Industrial Robotics	3	0	0	3
26.	PE	19UME926	Introduction to aircraft industry and aircraft systems	3	0	0	3
27.	PE	19UME927	Design of aircraft structures	3	0	0	3
28.	PE	19UME928	Non Destructive Testing (NDT)	3	0	0	3
29.	PE	19UME929	Statistical Quality Control (SQC)	3	0	0	3
30.	PE	19UME930	Additive Manufacturing	3	0	0	3
31.	PE	19UME931	Thermal Turbo Machines	3	0	0	3
32.	PE	19UME932	Piping Design	3	0	0	3
33.	PE	19UME933	Machine Learning	3	0	0	3

19UME901	INDUSTRIAL AND QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart the knowledge on quality management.
- To familiarize the TQM techniques and ISO system

INTRODUCTION TO OVERVIEW OF MANAGEMENT (Not for examination):
Organization – Management – Role of managers.

UNIT I PLANNING AND ORGANISING 9

Nature and Purpose planning- Planning process - Types of plans - Objectives - Managing byobjective (MBO) Strategies - Types of strategies - Policies - Decision Making –Typesof decision - Decision Making Process - Nature and purpose of organizing - Organization structure - Line and Staff authority -Departmentation- Span of Control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment.

UNIT II DIRECTING AND CONTROLLING 9

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories Leadership - Leadership theories - Communication - Hurdles to effective communication - Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

UNIT III INTRODUCTION AND TQM PRINCIPLES 9

Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM. Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement –Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle,5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating

UNIT IV TQM TOOLS & TECHNIQUES 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA Stages, Types. Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function - TPM – Concepts

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Apply the knowledge of planning, decision making processes for different organizational structure. (Apply)
2. Apply the knowledge of leadership qualities and motivation theories in various organizations. (Apply)
3. Apply the TQM concepts for continuous improvement in industries. (Apply)
4. Investigate the performance of industries by using TQM tools and techniques and Design of Experiments, analyze and interpret the performance and provide valid solution for improved performance. (Evaluate)
5. Apply the knowledge of quality and environmental management system in organization. (Apply)

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich, mark V Cannice "Management – A global & Entrepreneurial Perspective ", Tata Mcgraw Hill, 12th Edition, New Delhi, 2012.
2. Dale H.Besterfiled, et al., "Total Quality Management", Pearson Education Asia, III Edition, Indian Reprint, 2006.

REFERENCE BOOKS:

1. Hellriegel, Slocum & Jackson, "Management – A Competency Based Approach", Thomson South Western, 10th Edition, 2007.
2. Andrew J. Dubrin, "Essentials of Management", Thomson Southwestern, 7th Edition, 2007.
3. Suganthi. L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd, 2006.
4. Oakland. J.S, "TQM – Text with Cases", Butterworth – Heinemann Ltd, Oxford, 3rd Edition, 2003.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3							3	3	3	3	3	2		
CO.2	2							3	3	3	3	3	2		
CO.3	3							3	3	3	3	3	3		
CO.4	3	3	3	3	2			2		3	3	3	3		
CO.5						3	3	3		3	2	3	3		
19UME901	3	3	3	3	2	3	3	3	3	3	3	3	3		

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME902	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the basic difference between incompressible and compressible flow.
- To impart knowledge in the phenomenon of shock waves and its effect on flow

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Governing equations for compressible flows - static and stagnation properties - speed of sound and Mach number. Effect of Mach number on compressibility, isentropic flow through variable area passage ducts – Nozzle and Diffusers, Chocking of flow.

UNIT II RAYLEIGH FLOW AND FANNO FLOW 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalized gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Variation of flow parameters across the normal and oblique shocks– Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION 9

Fundamentals of jet propulsion –Propulsion cycle - Power and efficiency calculations. Working of turbojet, turbofan and turbo prop engines.

UNIT V ROCKET PROPULSION 9

Fundamentals of rocket propulsion, Types of rocket engines, Applications, Space flights.

TOTAL : 45 PERIODS

Note: Use of Gas table is permitted in End Semester Examination

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the various properties of compressible fluid flow, jet propulsion and rocket propulsion. (Understand)
2. Outline the environmental impact of jet and rocket propulsion engine. (Understand)
3. Apply isentropic flow concept to calculate the characteristics of flow in constant and variable area duct.(Apply)
4. Apply the concept of Isentropic flow to calculate the properties of variable area duct and shockwave.(Apply)
5. Compute the properties of a constant area duct and calculate the efficiency of jet engines using the principle of isentropic flow.(Apply)

6. Analyze the characteristics of shockwave in duct using ANSYS fluid flow software. (Analyze)

TEXT BOOKS:

1. Anderson, J.D, “Modern Compressible flow ”, McGraw Hill,Third Edition,2017.
2. S.M. Yahya, “Fundamentals of Compressible Flow”, New Age International (P) Limited, New Delhi, 2018.

REFERENCE BOOKS:

1. Senthil, “Gas Dynamics and Jet Propulsion”, A.R.S Publications, Chennai, 2021.
2. Zucrow.N.J, “Principles of Jet Propulsion and Gas Turbines”, John Wiley, New York, 1970.
3. Sutton.G.P, “Rocket Propulsion Elements ”, John wiley, New York,2017
4. Shapiro.A.H, “Dynamics and Thermodynamics of Compressible fluid Flow”, John wiley, New York, 1997.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1														1	
CO.2							3							2	
CO.3	3	2												1	
CO.4	3	2												1	
CO.5	3	2												1	
CO.6					3								3		
19UME902	**3**	**2**			**3**		**3**						**3**	**2**	

Ref: 3 - Strong 2 - Medium 1 - Weak

19UME903 APPLIED HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

OBJECTIVES :

- To impart knowledge on the applications of fluid power engineering and power transmission system.
- To familiarize the fluid power system in automation of machine tools and others equipment's.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power- Advantages of fluid power- Application of fluid power system-Types of fluid power systems-Properties of hydraulic fluids – types of fluids – Fluid power symbols-Basics of hydraulics – Applications of Pascal's Law- Darcy's equation - Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Sources of Hydraulic Power: - Pumping theory – Pump classification – Gear, Vane and piston pumps- construction and working of pumps – pump performance – Variable displacement pumps-Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, double acting special cylinders like tandem, Rod less, Telescopic - Cushioning mechanism - Construction of double acting cylinder - Rotary actuators –Fluid motors, Gear, Vane and Piston motors.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Pressure, Flow and Directional control valves-Types, Construction and Operation-Reciprocating- sequencing – synchronizing – regenerative – Pump unloading circuit –Safety circuit – Accumulators, Types - Sizing of Accumulator -Accumulators circuits – Intensifier - Intensifier circuits - Fail-safe circuits - Speed control Circuits.

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Properties of air - Compressors - Filter, Regulator, and Lubricator Unit - Air control valves, Quick exhaust valves, and pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems - Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuit, failure and troubleshooting.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the operating principle of control element and selection procedure of hydraulic, Pneumatic system. (Understand)
2. Organize the parameters of the pump for the given application (Apply)
3. Apply the PLC knowledge to design the circuit for given application. (Apply)
4. Identify various servo system & trouble shooting of the pneumatic and hydraulic System. (Analyze)
5. Design the hydraulic circuit for the given application (Create)
6. Design the pneumatic circuit for the given application (Create)

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with Applications”, 7th Edition Pearson Education 2019.
2. Srinivasan.R, “Hydraulic and Pneumatic controls”, Vijay Nicole, 2019.

REFERENCE BOOKS:

1. Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, S.Chand& Co, 2018.
2. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 2019.
3. Majumdar S.R., “Oil Hydraulic Systems – Principles and Maintenance”, Tata McGraw Hill, 2018.
4. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall, 1989.
5. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1															3
CO.2	3												3		3
CO.3	3	3											3		3
CO.4		3	3										3		3
CO.5			3		3							2	3		3
CO.6			3		3							2	3		3
19UME903	**3**	**3**	**3**		**3**							**2**	**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME904	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart the knowledge on the functions and design principles of Jigs, fixtures and press tools
- To expose the students 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 ELEMENTSOF 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 FORMING AND DRAWING DIES 9

Difference between bending, forming 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 re-drawing and combination dies – Blank development for ax- symmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V MISCELLANEOUS TOPICS 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 - Course should be supplemented with visits to industries.

TOTAL : 45 PERIODS

Note :Use of Approved design Data Book permitted

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the objectives of tool design.
2. Design the jigs and fixtures for given component.
3. Summarize the press working terminologies, Types of presses and its operations.
4. Explain the blank development operations for bending, forming and drawing.
5. Illustrate the recent trends in tool design.

TEXT BOOKS:

1. Joshi.P.H, “Jigs and Fixtures”, Tata Mcgraw Hill, II Edition, New Delhi, 2004.
2. Donaldson, Lecain,Goold “Tool Design”, Tata McGraw Hill, 3rd Edition, 2000.

REFERENCE BOOKS:

1. Venkataraman.K, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.
2. Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton, 3rd Edition, 1974.
3. Joshi. P.H, “Press Tools-Design and Construction”, Wheels publishing, 1996.
4. Hoffman, “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore,2004.

19UME905	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To familiarize the various discretization methods, solution procedures and turbulence modeling.
- To impart knowledge to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

PREREQUISITE:

Fundamental Knowledge of partial differential equations, Heat Transfer and Fluid Mechanics.

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 behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE METHOD 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION 9

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Bounded, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT V CALCULATION FLOW FIELD BY FVM 9

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. Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain mathematical characteristics of partial differential equations. (Understand)
2. Apply Euler and Navier-Stokes equations concept to solve computational problems. (Understand)
3. Make use of the concepts like accuracy, stability, consistency of numerical methods for solving governing equations. (Apply)
4. Identify and implement numerical techniques for space and time integration of partial differential equations. (Apply)
5. Apply basic skills on programming of numerical methods to solve the Governing equations. (Apply)
6. Analyze data by conducting numerical experiments by using ANSYS Software.(Analyse)

TEXT BOOKS:

1. Chung.T.J, “Computational Fluid Dynamics”, Cambridge University, 2002.
2. Versteeg.H.K, Malalasekera.W, “An Introduction to Computational Fluid Dynamics: The finite volume Method”, Longman, 1998.

REFERENCE BOOKS:

1. Ghoshdastidar. P.S, “Computer Simulation of flow and heat transfer”, Tata McGraw Hill Publishing Company Ltd, 1998.
2. Ghoshdastidar. P.S, “Heat Transfer”, Oxford University Press, 2005.
3. ProdipNiyogi, Chakrabarty .S.K,Laha .M.K, “Introduction to Computational Fluid Dynamics ”, Pearson Education, 2005.
4. Patankar, S.V, “Numerical Heat Transfer and Fluid Flow”, Hemisphere Publishing Corporation, 2004.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1														3	
CO.2	3	2												3	
CO.3	3	2												3	
CO.4	3	2												3	
CO.5	3	2												3	
CO.6	3				3								3	3	3
19UME905	**3**	**2**			**3**								**3**	**3**	**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME906	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To familiarize the students toapply process control and acceptance sampling procedure to their application.
- To impart the knowledge on the concept of quality and reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process-causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and chart -process capability – process capability studies and simple problems. Six sigma concepts.

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

TOTAL : 45 PERIODS

Note: Use of approved statistical table permitted in the examination.

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain various process control techniques to improve quality.
2. Apply process control attributes to attain quality in industries.
3. Compare various sampling methods for selecting samples.
4. Illustrate various failure testing methods for reliability.
5. Apply various quality improvement techniques for product development in industries.

TEXT BOOKS:

1. Douglas. C.Montgomery, “Introduction to Statistical quality control”, John wiley, IV Edition, 2001.
2. Srinath.L.S, “Reliability Engineering”, Affiliated East west press, 1991.

REFERENCE BOOKS:

1. John.S. Oakland, “Statistical process control”, Elsevier, 5th Edition, 2005.
2. MonoharMahaja, “Statistical Quality Control”, DhanpatRai& Sons, 2001.
3. Gupta.R.C, “Statistical Quality control”, Khanna Publishers, 1997.
4. Grant Eugene .L, “Statistical Quality Control”, McGraw-Hill, 1996.

19UME907 RENEWABLE SOURCES OF ENERGY

L	T	P	C
3	0	0	3

OBJECTIVES :

- To familiarize the main renewable sources of energy and their primary applications in the world.
- To impart knowledge on the technological concepts of renewable energy sources.

UNIT I SOLAR ENERGY 9

Solar energy, Solar Radiation, Solar Cells, Solar Thermal energy conversion, Solar Collectors, Fundamentals of photo Voltaic Conversion.

UNIT II WIND ENERGY 9

Wind Data and Energy Estimation –Wind mills– Wind Energy Storage – Applications.

UNIT III BIO – ENERGY 9

Biomass, Biogas, Biomass gasifier, Biogas plant, Digesters, Ethanol production, Bio diesel production

UNIT IV OTEC, TODAL, GEOTHERMAL AND HYDEL ENERGY 9

Tidal energy – Wave energy – Open and closed OTEC Cycles, Geothermal energy sources.

UNIT V HYDROGEN AND FUEL CELL 9

Hydrogen generation, storage, transport and utilization, Fuel cells – technologies, types and the power generation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Apply the knowledge of solar energy systems for various applications. (Apply)
2. Apply the knowledge of wind mills and estimate the energy from wind data (Apply)
3. Analyze the production of Biogas, Ethanol and Bio diesel for the society. (Analysis)
4. Explain the function of Tidal energy; wave energy, Ocean Thermal Energy and Geothermal energy systems. (Understand)
5. Apply the knowledge of hydrogen generation and fuel cell technologies for power generation. (Apply)

TEXT BOOKS:

1. Rai.G.D, “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 1999.
2. Sukhatme .S.P, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd, New Delhi 1997.

REFERENCE BOOKS:

1. Godfrey Boyle, “Renewable Energy Power for a Sustainable Future”, OxfordUniversityPress, UK, 1996.
2. Twidell. J.W, Weir.A“Renewable Energy Sources”, EFN Spon Ltd, UK, 1986.
3. Tiwari.G.N , “solar Energy – Fundamentals Design Modeling and applications”, Narosa Publishing House, New Delhi,2002.
4. Freris.L.L, “Wind Energy Conversion systems”, Prentice Hall, UK, 1990.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3					2	3						2		3
CO.2	3	2				2	2					3	3		
CO.3	3	3				3	3	3					3		3
CO.4						3	3								
CO.5	3					3	3	3				3		3	3
19UME907	**3**	**3**				**3**	**3**	**3**				**3**	**3**	**3**	**3**

Ref: 3 - Strong 2 - Medium 1 - Weak

19UME908	INDUSTRIAL TRIBOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To familiarize the importance of friction and wear.
- To impart knowledge in surface engineering.

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 nonmetals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

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.

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.

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.

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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the surface topography of engineering surfaces.
2. Illustrate the theory of Sliding Wear Mechanism.
3. Choose the suitable lubricant for different applications.
4. Explain the viscous flow between the plates.
5. Discuss the concept of viscous flow between very close parallel plates.
6. Choose the materials for rolling element bearings, fluid film bearings, marginally lubricated and dry bearings.

TEXT BOOKS:

1. Harnoy.A, “Bearing Design in Machinery”, Marcel Dekker Inc, New York, 2003.
2. Khonsari.M.M, Booser .E.R, “Applied Tribology”, John Willey&Sons, New York, 2001.

REFERENCE BOOKS:

1. Bowden.E.P, Tabor.D, “Friction and Lubrication”, Heinemann EducationalBooks Ltd, 1974.
2. Cameron.A, “Basic Lubrication theory”, Longman, U.K, 1981.
3. Bhushan, “Nanotribology and Nanomechanics ”, Springer, 2011.
4. Ramsey Gohar, “Fundamentals of Tribology”, Imperical college press, 2010.

19UME909	POWER PLANT TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES :

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I BASICS OF THERMAL POWER PLANTS 9

Layout of Hydel power plant, - steam power plant -Fuel and ash handling, coal handling, choice of handling equipment, coal storage, Ash handling systems., MHD power plant - open and closed cycle

UNIT II STEAM POWER PLANT 9

Components of steam power plant, Combustion Equipment for burning coal - Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types. FBC boiler, Steam turbines, types, Surface condenser types, Cooling Towers.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering and Indian Nuclear Program me, Nuclear fission and Fusion Reaction, Layout of Nuclear Power Plants, Types of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Fast Breeder reactors (FBR) - Biological effects of Radiation, Safety & Security measures for Nuclear Power plants. Nuclear waste management.

UNIT IV DIESEL AND GAS TURBINE POWER PLANT 9

Types of diesel plants, components, Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material – open and closed cycles, Combined Power plant cycles.

UNIT V RENEWABLE ENERGY AND ECONOMICS OF POWER PLANT 9

Geo thermal, OTEC, Biomass, Tidal, Pumped storage, Solar Photovoltaic - Solar central receiver system - Wind Power plants - Environmental hazards of all power plants, Power tarrif types, Load distribution parameter, Load curve, Capital and operating cost different power plant

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the layout, construction and working of the components of various power plant. Understand
2. Apply the power plant engineering concepts to Identify various equipment required for power generation in different power plants. Apply
3. Apply the power plant engineering concepts to Select the nuclear reactors and waste disposal methods to improve Nuclear power plant performance. Apply
4. Apply the power plant engineering concepts to Identify the ways to extract power from renewable/non-conventional energy sources. Apply
5. Analysis on the Economic Feasibility of Power Generation from Renewable/ nonrenewable Energy Systems. Analyze
7. Apply principles of preventive engineering to analyze the environmental aspects and Safety measures of various power plant. Analyze

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Fourth Edition, Tata McGraw – Hill Publishing Company Ltd., 2017.
2. Arora S.C, Domkundwar S, “A Course in Power Plant Engineering”, DhanpatRai, 2001.

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. Ramalingam.K.K, “Power Plant Engineering”, Scitech Publications, 2015.
5. Nagpal.G.R, “Power Plant Engineering”, Khanna Publishers, 1998.
6. Rai.G.D, “Introduction to Power Plant technology”, Khanna Publishers, 1995.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3	3				2	2					3	2		
CO.2	3	3				2	2					3			3
CO.3	3	3				3	3	3							
CO.4	3	3				3	3	3				3		3	3
CO.5	3	3				3	3								3
CO.6	3	3						3							
19UME909	**3**	**3**				**3**	**3**	**3**				**3**	**2**	**3**	3

Ref: 3 - Strong 2 - Medium 1 - Weak

19UME910	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To familiarize the student the various unconventional machining processes, parameters and their influence on performance and their applications.
- To describe thermo-electric energy based processes
- To explain nano finishing processes.
- To impart knowledge on modern unconventional machining processes.

UNIT I INTRODUCTION & MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – Brief overview. – Abrasive Water Jet Machining - Ultrasonic Machining. (AWJM and USM). Principles, equipment used, Process parameters, advantages and limitations, Applications.

UNIT II ELECTRICAL ENERGY BASED PROCESSES 9

Principles, Equipment, effect of process parameters, advantages and limitations, Applications of Electric Discharge Machining (EDM) and Wire cut EDM.

UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipment used, effect of process parameters, applications, advantages and limitations of Chemical machining, (CHM), Shaped tube electrolytic machining (STEM), Electro chemical grinding (ECG), Electro chemical honing (ECH).

UNIT IV THERMAL ENERGY BASED PROCESSES 9

Principles, Equipment, effect of process parameters, advantages and limitations, Applications of Laser engineered net shaping (LENS), Plasma Arc Welding (PAW) and Electron Beam Machining (EBM).

UNIT V NANO AND MICRO FINISHING PROCESS 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipments, effect of process parameters, applications, advantages and limitations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Summarize the unconventional machining processes to machine new materials (Understand)
2. Interpret the Mechanical and Electrical energy based processes in manufacturing field. (Understand)
3. Identify the nano and micro finishing processes to be imparted on the given work specimens. (Apply)
4. Select the best process out of the available various advanced manufacturing processes for the given job that helpful for the society. (Apply)
5. Apply the knowledge of Unconventional Machining processes by selecting appropriate process parameters for industrial applications. (Apply)
6. Analyze the role of chemical, electro chemical and thermal processes during machining for various advanced materials. (Analysis)

TEXT BOOKS:

1. Abdel, H. and El-Hofy, G. “Advanced Machining Processes”, McGraw-Hill, USA, 2005.
2. Vijay.K.Jain, “Advanced Machining Processes,” Allied Publishers Pvt.Ltd, New Delhi, 2007.
3. Benedict.G.F, “Nontraditional Manufacturing Processes”, Marcel Dekker Inc, New York, 1987.

REFERENCE BOOKS:

1. Pandey P.C, Shan H.S, “Modern Machining Processes”, Tata McGraw-Hill, 2007.
2. Adithan.M, “Unconventional Machining process”, Atlantic, 2009.
3. Pandey.P.C, “Modern Machining process”, Pearson Education, 1980.
4. Senthil.K, “Unconventional Machining process”, Lakshmi Publications, 2010.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3														3
CO.2	3														3
CO.3	3														3
CO.4	3	3													3
CO.5	3														3
CO.6	3	3					2								3
19UME910	**3**	**3**					**2**								**3**

Ref: 3 - Strong 2 - Medium 1 - Weak

19UME911	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge on polymer, metal, ceramic matrix composites. To expose the different fabrication techniques of composites.
- To provide knowledge on Non-destructive testing methods for composite materials.

UNIT I INTRODUCTION TO COMPOSITES 9

Fundamental concepts of composites - metals vs composites - Classification of Composite materials – need for composites - Reinforcements - glass fibers, boron fibers, silicon carbide fibers, metal fibers, aramid fibers, ceramic fibers, alumina fibers, Matrix materials - Polymers - Thermosetting resins - thermoplastic resins.

UNIT II POLYMER MATRIX COMPOSITES 9

Processing of polymer matrix composites- hand lay-up, Spray lay-up processes, Compression molding - SMC Reinforced reaction injection molding, Resin transfer molding, Pultrusion, Filament winding, Applications of polymer matrix composites.

UNIT III METAL MATRIX COMPOSITES 10

Characteristics of MMCs, Various types of Metal matrix composites, Advantages and limitations of MMCs, Effect of reinforcements on properties - Volume fraction - Rule of mixtures, Processing of MMCs - Liquid state processing- stir casting, squeeze casting, infiltration, solid state processing - Powder metallurgy, Diffusion bonding, In-situ processes, applications of MMCs.

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, high temperature synthesis properties and applications in aerospace and space fields.

UNIT V NON-DESTRUCTIVE TESTING METHODS FOR COMPOSITE MATERIALS 8

Visual Inspection - Ultrasonic testing – Acoustography – Radiographic testing – shearography testing – Acoustic Emission (AE) – Acoustic Ultrasonic testing - Thermography – Tap test

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Understand the classification of Composite materials.(Understand)
2. Apply the knowledge to Select appropriate fabrication technique for specific application of polymer matrix composite. (Apply)
3. Apply the knowledge to Select suitable processing method for the fabrication of metal matrix composites (Apply)
4. Apply the knowledge to select suitable fabrication method for specific application of ceramic matrix composite. (Apply)
5. Apply the knowledge to select the appropriate Non-destructive testing methods for composite materials. (Apply)
6. Apply the knowledge to select appropriate composite material for particular engineering application. (Apply)

REFERENCE BOOKS:

1. Issac M. Daniel, OriIshai, “Engineering Mechanics of Composite Materials ”, OxfordUniversity Press,-2006, First Indian edition: 2007.
2. MallicK.P.K, “Fiber Reinforced Composites Materials, Manufacturing and Design ”, Maneel Dekker Inc, 2003.
3. Halpin. J.C, “Primer on Composite Materials Analysis ”, Techomic Publishing Co, 1984.
4. K. Autar Kaw, Mechanics of Composite Materials, CRC Press, 2006.
5. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, JohWiley and Sons, New York, 2000.
6. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, 2004.
7. 5. K.K. Chawla, Composite materials, Springer Verlag, 2007.
8. Krishnan K. Chawla, "Composite Material-Science and Engineering", Springer, 3rd edition , 2012
9. Koch C, “Nanostructured materials: Processing, properties and applications’, William Andrew Publication, 2008.
10. Mallick P.K., "Fiber-Reinforced Composites: Materials, Manufacturing, and Design", CRC Press, 3rd Edition, 2007
11. John C. Halpin “Primer on composite materials analysis”, Techomic Publishing Co., 2017.
12. Brent Strong. A “Fundamentals of Composites manufacturing: materials, methods, and applications”, Society of Manufacturing Engineers, 2007.
13. Jack R. Vinson and R. L. Sierakowski, “The Behavior of Structures composed of composite materials”, Kluwer, 2008.

19UME912	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge on the detailed process planning concepts.
- To familiarize the students to estimate the cost for various products after process planning.

UNIT I WORK STUDY AND ERGONOMICS 10

Method study – Definition – Objectives-Motion economy- Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

UNIT II PROCESS PLANNING 9

Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection – material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

UNIT III INTRODUCTION TO COST ESTIMATION 8

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost.

UNIT IV COST ESTIMATION 8

Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation.

UNIT V PRODUCTION COST ESTIMATION 10

Estimation of material cost, labour cost and over heads, allocation of overheads – Estimation for different types of jobs.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the work study and ergonomic principles for various industrial applications. (Understand)
2. Demonstrate the manufacturing processes to select appropriate optimized sequence of operations for manufacturing a product. (Understand)
3. Explain about the cost estimation and cost accounting. (Understand)
4. Outline the method of costing and objectives of cost estimation. (Understand)
5. Analyze the material cost, labour cost and the overhead cost for different manufacturing process. (Analyze)

6. Analyze the role of chemical, Electrochemical and Thermal process during machining for various advanced materials. (Analyze)

TEXT BOOKS:

1. Sinha.B.P, “Mechanical Estimating and Costing”, Tata McGraw-Hill, 1995.
2. Phillip.F, Ostwalal,JairoMunez, “Manufacturing Processes and systems ”, John Wiley, 9th edition, 1998.

REFERENCE BOOKS:

1. Russell.R.S, Tailor.B.W, “Operations Management”, PHI, 4th Edition,2003.
2. Chitale.A.V, Gupta.R.C, “Product Design and Manufacturing”, PHI, 2nd Edition,2002.
3. Kesavan. R, “Process Planning & Cost Estimation”, new age International, 2009.
4. Adithan.M, “Process Planning & Cost Estimation”, New Age International,2007.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2					2		3	3	3		3	3		
CO.2	2					2			2				3		
CO.3	2										3	3			
CO.4	2										3				
CO.5	2	3						2	2		3	3			
CO.6	3	3													3
19UME912	**3**	**3**				**2**		**3**	**3**	**3**	**3**	**3**	**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME913	NANOSCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To demonstrate a working knowledge of nanotechnology principles
- To familiarize various nano devices and their applications.

UNIT I INTRODUCTION AND CLASSIFICATION 9

Classification of nanostructures, nano scale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nano crystals, dislocations in nano crystals – Effect of nano scale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems.

UNIT II NANOMATERIALS AND CHARACTERIZATION 9

Fabrication methods – Top down processes – Milling, lithographic, machining process – Bottom-up process – Vapour phase deposition methods, plasma-assisted deposition process, MBE and MOVPE, liquid phase methods, colloidal and sol gel methods – Methods for templating the growth of nano materials – Ordering of nano systems, self-assembly and self-organization – Preparation, safety and storage issues.

UNIT III GENERIC METHODOLOGIES FOR NANOTECHNOLOGY 9

Characterization - General classification of characterization methods – Analytical and imaging techniques – Microscopy techniques - Electron microscopy, scanning electron microscopy, transmission electron microscopy, STM, field ion microscopy, scanning tunneling microscopy, atomic force microscopy – Diffraction techniques – Spectroscopy techniques – Raman spectroscopy – Surface analysis and depth profiling – Mechanical properties, electron transport properties, magnetic and thermal properties.

UNIT IV SELF ASSEMBLING NANOSTRUCTURED MOLECULAR MATERIALS AND DEVICES 9

Introduction – Building blocks – Principles of self-assembly, non-covalent interactions, intermolecular packing, nano motors – Self-assembly methods to prepare and pattern nanoparticles – Nanopartcles from micellar and vesicular polymerization, functionalized nano particles, colloidal nanoparticles crystals, self-organizing inorganic nano particles, bio-nanoparticles – nanoobjects.

UNIT V NANO DEVICES AND THEIR VARIOUS APPLICATIONS 9

Nanomagnetic materials – Particulate nanomagnets and geometrical nanomagnets – Magneto resistance – Probing nano magnetic materials – Nano magnetism in technology – Carbon nano tubes – fabrication- applications – Organic FET, organic LED‟s – Organic photovoltaic – Injection lasers, quantum cascade lasers, optical memories, electronic applications, coulomb blockade devices.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the effects of nano scale dimensions on various properties.
2. Summarize the bottom up and top down processes and various synthesis techniques.
3. Compare the different types of characterization and their significance.
4. Apply key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology.
5. Explain the concept of nano magnetism Technology and CNT fabrication techniques.

TEXT BOOKS:

1. Charles P Poole, Frank J Owens “Introduction to Nanotechnology”, John Wiley and Sons, 2007.
2. Kelsall Robert W,IanHamley,MarkGeoghegan “Nanoscale Science and Technology”, Wiley Eastern, 2005.

REFERENCE BOOKS:

1. Gregory Timp, “Nanotechnology”, Springer-Verlag,2005.
2. Michael Kohler, Wolfgang,Fritzsche, “Nanotechnology: Introduction to Nanostructuring Techniques ”, 2004.
3. Bharat Bhushan, “Springer Handbook of Nanotechnology”, 2004.
4. Muralidharan.V.S, “Nanoscience and Technology”, CRC,2008.

19UME914	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge on the sources of vibration and noise in automobiles.
- To familiarize on control techniques for vibration and noise.

UNIT I BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and nonlinear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsion vibration, determination of natural frequencies.

UNIT II BASICS OF 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 environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV CONTROL TECHNIQUES 9

Vibration isolation, tuned absorbers, unturned 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 SOURCE OF NOISE AND CONTROL 9

Methods for control 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 : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the basic principles of vibration isolation and absorption.
2. Compare the various noise characteristic in engineering environment.
3. Explain the Noise Characteristics of engines.
4. Analyze the vibration and design the vibration control system.
5. Choose the methods for control of engine noise, combustion noise and mechanical noise.

TEXT BOOKS:

1. SingiresuS.Rao, “Mechanical Vibrations”, Pearson Education, 2004.
2. KewalPujara, “Vibrations and Noise for Engineers”, DhanpatRai& Sons, 1992.

REFERENCE BOOKS:

1. Bernard Challen, RodicaBaranescu, “Diesel Engine Reference Book”, SAE International, 1999.
2. Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann, 2004.
3. John Fenton, “Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing”, ISBN 1-86058-073, 1998.
4. Leo L. Beranek, “Noise and Vibration Control”, McGraw Hill Higher Education; Revised edition,2000.

19UME915	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge on various refrigeration cycles, system components and refrigerants.
- To impart knowledge on Psychrometry and Air conditioning Systems.

UNIT I REFRIGERATION CYCLE 9

Thermodynamic principles of refrigeration – Vapour compression systems – Types of Vapour Compression Cycles, Use of ph charts, Cascade system, Basic air Refrigeration cycles.

UNIT II REFRIGERANTS AND SYSTEM COMPONENTS 9

Compressors – reciprocating and rotary (elementary treatment), Types of condensers, evaporators, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

UNIT III PSYCHROMETRY 9

Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor, requirements of comfort air conditioning, summer and Winter Air conditioning.

UNIT IV AIR CONDITIONING SYSTEMS 9

Air Conditioning Systems – Summer Air Conditioning System, Winter Air Conditioning System – Factors affecting Air Conditioning Systems – Working principles of Comfort Air Conditioning System, Centralized Air conditioning systems, SplitAir conditioning systems. Indoor Air quality concepts.

UNIT V UNCONVENTIONAL REFRIGERATION CYCLES 9

Vapour Absorption system – Ejector jet, Steam jet refrigeration, Thermo electric refrigeration. Applications – ice plant – food storage plants – milk – chilling plants.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the working principle of refrigeration systems and cycle.
2. Summarize the system components and properties of refrigerants.
3. Apply the Psychrometric principles to solve problems.
4. Explain the working principles of Air conditioning systems.
5. Summarize the applications of Unconventional refrigeration cycles.

TEXT BOOKS:

1. Arora C.P, “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 2013.
2. Er. R.K. Rajput, “Refrigeration and Air Conditioning”, S.K. Kataria& Sons, 2012.

REFERENCE BOOKS:

1. Roy. J. Dossat, “Principles of Refrigeration”, Pearson Education, 2013.
2. Khurmi RS, “Refrigeration and Air Conditioning”, McGraw Hill Higher Education, 2010.
3. Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd, 2005.
4. Stoecker N.F, Jones, “Refrigeration and Air Conditioning”, TMH,New Delhi, 2001.

19UME916 **NUCLEARENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.
- Demonstrate an understanding of nuclear processes, and the application of general natural science and engineering principles to the analysis and design of nuclear and related systems of current and/or future importance to society.
- Familiarize analytical and problem solving skills, with special emphasis on design of nuclear reactors.
- Demonstrate an understanding of the broad social, ethical, safety and environmental context within which nuclear engineering is practiced.

UNIT I NUCLEARPHYSICS 9

Nuclear model of an atom– Equivalence of mass and energy– binding– radioactivity-half life– neutron interactions – cross sections.

UNIT II NUCLEARREACTIONSANDREACTIONMATERIALS 9

Mechanism of nuclear fission and fusion– radioactivity – chain reactions– critical mass and composition-nuclear fuel cycles and its characteristics– uranium production and purification- Zirconium, thorium, beryllium.

UNIT III REPROCESSING 9

Reprocessing: nuclear fuelcycles – spent fuel characteristics– role of solven text raction in reprocessing– solvent extraction equipment.

UNIT IV NUCLEARREACTOR 9

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding Reactors– heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

UNIT V SAFETY ANDDISPOSAL 9

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the basic nuclear structure, the nuclear decay process and interaction of radiation with matter.
2. Classify the fission and the fusion reaction processes.
3. Outline the nuclear reprocessing techniques.
4. Illustrate the design and construction of reactors.
5. Explain the nuclear plant safety and nuclear waste disposal methods.

TEXT BOOKS:

1. ThomasJ.Cannoly, “Fundamentals of nuclear Engineering” JohnWiley1978.
2. John.R.Lamarsh, Anthony.J.Baratta, “Introduction to nuclear engineering”, 3rd Edition.

REFERENCE BOOKS:

1. Collier J.G, HewittG.F, “Introduction to Nuclear ower”, Hemisphere publishing, NewYork. 1987
2. WakilM.M.El., “Power Plant Technology” –McGraw-Hill International,1984.
3. Lipschutz R.D “Radioactive Waste-Politics, Technology and Risk”, Ballingor, Cambridge, 1980
4. ThomasJ.Cannoly, “Fundamentals of nuclear Engineering” John Wiley1978

19UME917	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To expose the students to an entrepreneur.
- To familiarize the students in financing and accounting.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrepreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

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.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Interpret the concept of entrepreneurship in economic growth. (Understand)
2. Understand the profile of the entrepreneur, classify their types and describe the role of entrepreneurship in economic growth. (Understand)
3. Identify various national and state level institutes offering entrepreneurship development program and to assess participants for the possibility of becoming successful entrepreneur. (Apply)
4. Apply suitable business opportunities for their enterprise and to prepare a project report for obtaining financial aid for their venture. (Apply)
5. Identify various sources of finance for their proposed company and to carryout break even analysis. (Apply)
6. Illustrate the reasons for sickness in small business establishments, its consequences and corrective measures and to explain suitable growth strategies for any small scale industry. (Analyze)

TEXT BOOKS:

1. S.S.Khanka “Entrepreneurial Development”, S.Chand& Company. Ltd. Ram Nagar New Delhi, 4th edition, 2012

REFERENCE BOOKS:

1. Hisrich.R.D, Peters M P and Dean A.Shepherd, “Entrepreneurship”, 10th Edition, Tata McGraw-Hill, 2018.
2. C.B.Gupta&N.P.Srinivasan, “Entrepreneurial Development”, Sultan Chand & Sons New Delhi, Revised edition, 2015.
3. Mathew J Manimala, “Entrepreneurship Theory at the Crossroads: Paradigms and Praxis”, Dreamtech Press, 2nd edition, 2005.
4. Rabindra N. Kanungo, “Entrepreneurship and innovation”, Sage Publications, New Delhi, 1998.
5. P.C Jain,EDII, “Hand Book for New Entrepreneurs”, Oxford University Press, 2003.
6. Donald F Kuratko, “Entrepreneurship – Theory, Process and Practice”, Cengage Learning, Custom Publications, 10th edition, 2016.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1							2		2						
CO.2							2		2						
CO.3							2		2						
CO.4							2		2						
CO.5							2		2		3			3	
CO.6							2		2						
19UME917							**2**		**2**		**3**			**3**	

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME918	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge on 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.

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.

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.

UNIT III CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 10

Repair methods for beds, sideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 8

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the knowledge on the principles, functions and practices for the successful management of maintenance activities in industry. (Understand)
2. Apply the concept of maintenance planning in industrial maintenance system (Apply)
3. Analyze the preventive maintenance concept by applying the knowledge of maintenance categories (Analyze)
4. Analyze the temperature, vibration and wear debris of machine tool condition monitoring for safety maintenance. (Analyze)
5. Analyze the various failures in machine elements and identify the suitable safety precautions and repair methods (Analyze)
6. Analyze the various failures in material handling system and identify the suitable safety precautions and repair methods (Analyze)

TEXT BOOKS:

1. Srivastava S.K, “Industrial Maintenance Management”, S. Chand and Co, 1981.
2. Bhattacharya S.N, “Installation, Servicing and Maintenance”, S. Chand and Co, 1995

REFERENCE BOOKS:

1. White E.N, “Maintenance Planning”, Gower Press, 1979.
2. Garg M.R, “Industrial Maintenance”, S. Chand & Co, 1986.
3. Higgins L.R, “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition,1988.
4. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1996.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	3								2	2	2		3		
CO.2	3	3									2	2	3		
CO.3	3	3					3				2	2	3		
CO.4	3	3					3				2	2	3		
CO.5	3	3					3				3	2	3		
CO.6	3	3					3				3		3		
19UME918	**3**	**3**					**3**		**2**	**2**	**3**	**2**	**3**		

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME919	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory control.
- To impart knowledge on the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch 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.

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.

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-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi-product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Production Forecasting and anticipated production-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 – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates. Integrated production planning and control: A multi-objective optimization model.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of just in time systems - fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, and Inventory control in an engineering Industry.(Understand)
2. Apply the concepts of production planning and control in complex problems. (Apply)
3. Apply the Manufacturing knowledge and utilization of computers to control the production in shop floor. (Apply)
4. Choose the recent trends like Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP), Profit consideration, Economics of a new design to enhance productivity. (Apply)
5. Utilize the knowledge of Production Engineering to the contemporary topics relevant to business of all functional disciplines and inventory control. (Apply)
6. Examine various problems with production planning control to identify the optimal work schedule. (Analysis)

TEXT BOOKS:

1. Mart and Telsang, “Industrial Engineering and Production Management”, S. Chand and Company, 1st edition, 2000.
2. James.B.Dilworth, “Operations management – Design, Planning and Control for manufacturing and services”, Mcgraw Hill International edition, 1992.

REFERENCE BOOKS:

1. Samson Eilon, “Elements of production planning and control”, Universal Book Corpn, 1984.
2. Elwood S.Buffa, RakeshK.Sarin, “Modern Production / Operations Management”, Ed. John Wiley and Sons8th Edition, 2000.
3. KanishkaBedi, “Production and Operations management”, Oxford university press, 2nd Edition2007.
4. Melynk, Denzler, “Operations management – A value driven approach”, Irwin Mcgrawhill.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1															
CO.2	3		3												3
CO.3	3	3			2								2		3
CO.4		3									2				3
CO.5	3												3		
CO.6	3	3										2			3
19UME919	**3**	**3**	**3**		**2**						**2**	**2**	**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME920	DESIGN OF HEAT EXCHANGERS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications.
- To familiarize the function of evaporative condenser

UNIT I CLASIFICATION OF HEAT EXCHANGERS 9

Parallel flow, Counter flow and cross flow; shell and tube and plate type; single pass and multipass - once through stream generators etc.

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, LMTD, sizing of finned tube heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III MECHANICAL DESIGN OF SHELL AND TUBE TYPE 9

Thickness calculations, Tube sheet design using TEMA formula, Concept of equivalent plate for analyzing perforated analysis, flow induced vibration risks including acoustic issue and remedies, tube to tube sheet joint design, buckling of tubes, thermal stresses.

UNIT IV COMPACT AND PLATE HEAT EXCHANGERS 9

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

UNIT V CONDENSORS AND COOLING TOWERS 9

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Classify the various heat exchangers.
2. Summarize the process of a heat exchanger.
3. Explain the design concept of shell and tube type heat exchanger.
4. Outline the types and functions of compact and plate heat exchangers.
5. Explain the design procedure of condensers and cooling towers.

TEXT BOOKS:

1. Taborek.T, Hewitt.G.H,Afgan.N, “Heat Exchangers Theory and practice ”, McGraw-Hill Book Co, 1980.
2. Walkers, “Industrial Heat Exchangers – A Basic Guide”, McGraw Hill Book Co, 1980.

REFERENCE BOOKS:

1. Nicholas Cheremistoff, “Cooling Tower”, Ann Arbor Science Pub, 1981.
2. Arthur P. Frass, “Heat Exchanger Design”, John Wiley and Sons, 1988.
3. Gupta.J.P, “Fundamentals of Heat exchanger and pressure vessels technology”, Hemisphere Publishing Corporaion, 1980.
4. Donald Q Kern, Alban D. Karus “Extended surface heat transfer”, McGraw Hill Book Co, 1972.

19UME921	ADVANCED I.C. ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart knowledge in engine combustion and engine design.
- To familiarize the students to understand the concepts of pollution formation, testing and recent developments in IC Engines.

UNIT I SPARK IGNITION ENGINES 9

Carburetor, Mixture requirements, Design of carburetor –fuel jet size and venture size, Combustion in SI engines, Stages of combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process.

UNIT II COMPRESSION IGNITION ENGINES 9

Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbo charging, Introduction to Thermodynamic Analysis of CI Engine Combustion process.

UNIT III DESIGN OF IC ENGINES 9

IC engine design principles, Design of engine components - Piston, connecting rod, crankshaft, computer aided design of engine components, Combustion chamber designs for SI engine and CI engine.

UNIT IV POLLUTANT FORMATION IN ENGINES 9

Formation of NOX , HC/CO mechanism , Smoke and Particulate emissions, Green House Effect, Methods of controlling emissions , and Particulate Trap, Emission (HC,CO, NO and NOX) measuring equipment's, Smoke and Particulate measurement, Indian Driving Cycles and emission norms.Noise pollution from automobiles, measurement and standards.

UNIT V TESTING OF IC ENGINES AND RECENT TRENDS IN IC ENGINES 9

Torque measurement, Air flow measurement, Fuel flow measurement, Engine friction measurement, Speed measurement, Cylinder pressure measurement, Engine testing

standards. Introduction to simulation tools. Adiabatic engines, Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Surface ignition and Stratified Charge Engine. Engines for special applications-mining, submarine, off road, race car, defense, Selective Catalytic Reduction (*SCR*).

TOTAL :45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain combustion stages and pollution formation in SI and CI engines. (Understand).
2. Apply the concept of combustion process in SI and CI Engine and analyze the thermodynamic performance of an engine. (Apply)
3. Explain the engine testing standards, engine testing parameters measurement and various latest engines. (Understand)
4. Apply the Engine Exhaust emission control techniques to minimize various emissions. (Apply)
5. Design and analyze the I.C.engine components using software. (Analyze)
6. Analyze the performance of carburetor and find the air fuel ratio. (Analyze)

TEXT BOOKS:

1. Ganesan V, “Internal Combustion Engines”, Tata Mcgraw-Hill, 4th edition, 2012.
2. Heywood J. B, “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co. NY, 1989
3. Mathur M. L and Sharma. R. P, “A Course in Internal Combustion Engines”, DharpatRai& Sons, 1993.

REFERENCE BOOKS:

1. John B Heywood, “Internal Combustion Engine Fundamentals”, Tata McGraw-Hill,
2. Gupta H.N, “Fundamentals of Internal Combustion Engines”, Prentice Hall of India, 2013.
3. Heinz Heisler, “Advanced Engine Technology”, SAE International Publications, USA, 2005.
4. Obert E. F, “Internal Combustion Engines and Air Pollution”, Harper and Row Publication Inc. NY, 1973.
5. Heisler H, “Advanced Engine Technology”, Edward Arnold, 1995.
6. Pundir B. P., “IC Engines Combustion and Emissions”, Narosa Publishing House, 2010.

19UME922	FAILURE ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart Knowledge on various multidimensional static failure criteria for different materials.
- To explain most critically stressed point in a machine component.
- To make the student Calculate reliability of the product using FEMA tools.

UNIT I MATERIALS AND DESIGN PROCESS 9

Factors affecting the behavior of materials in components, effect of component geometry and shape factors, design for static strength, stiffness, designing with high strength and low toughness materials, designing for hostile environments, material processing and design, processes and their influence on design, process attributes, systematic process selection, screening, process selection diagrams, ranking, process cost.

UNIT II FRACTURE MECHANICS 9

Ductile fracture, brittle fracture, Cleavage-fractography, ductile-brittle transition-Fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage -Linear Elastic Fracture Mechanics - Griffith theory, Energy release rate, instability and R-curve, stress analysis of cracks-stress intensity factor, K-threshold, crack growth instability analysis, crack tip stress analysis.

UNIT III DYNAMIC AND TIME-DEPENDENT FRACTURE 9

Dynamic fracture, rapid loading of a stationary crack, rapid crack propagation, dynamic contour integral, Creep crack growth-C Integral, Visco elastic fracture mechanics, viscoelastic J integral.

UNIT IV DETERMINATION OF FRACTURE TOUGHNESS VALUES 9

Experimental determination of plane strain fracture toughness, K- R curve testing, J measurement, CTOD testing, effect of temperature, strain rate on fracture toughness.

UNIT V FAILURE ANALYSIS TOOLS 9

Reliability concept and hazard function, life prediction, life extension, application of Poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF,MTTR, FMEA definition-Design FMEA, Process FMEA , analysis causes of failure, modes, ranks of failure modes, fault tree analysis, industrial case studies/projects on FMEA.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the material properties and materials fabrication of producing a component possessing the size, shape and properties
2. Classify the various fracture mechanics, theories and fracture analysis.
3. Outline the dynamic contour integral and analyze system.
4. Explain the experimental determination of fracture toughness values.
5. Summarize the various failure analysis tools.

TEXT BOOKS:

1. John M Barsoom, Stanley T Rolte, “Fracture and Fatigue Control in Structures”, Prentice Hall, New Delhi, 1987.
2. Michael F Ashby, “Material Selection in Mechanical Design”, Butterworth – Heinemann, III Edition, 2005.

REFERENCE BOOKS:

1. Shigley and Mische, “Mechanical Engineering Design ”, McGraw Hill Inc, 1992.
2. Mahmoud M Farag, “Material Selection for Engineering Design”, Prentice Hall, 1997.
3. Faculty of Mechanical Engineering, “Design Data Book”, DPV Printers, 1993.
4. ASM Metals Handbook, “Failure Analysis and Prevention”, ASM MetalsPark, 10th Edition, 1995.

19UME923 COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

OBJECTIVES :

- To explain the fundamentals of CAD.
- To impart knowledge on flexible manufacturing system and CAPP.

UNIT I COMPUTER AIDED DESIGN 9

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD - Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

UNIT II COMPONENTS OF CIM 9

CIM as a concept and a technology, CASA/SME model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM - CIM data transmission methods - serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM - point to point (PTP), star and multiplexing. Computer networking in CIM - the seven layer OSI model, LAN model, MAP model, network topologies - star, ring and bus, advantages of networks in CIM.

UNIT III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9

History Of Group Technology = role of G.T in CAD/CAM Integration - part families - classification and coding - DCLASS and MCLASS and OPTIZ coding systems - facility design using G.T - benefits of G.T - cellular manufacturing. Process planning - role ofprocess planning in CAD/CAM Integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP systems.

UNIT IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS 9

Shop floor control - phases - factory data collection system - automatic identification methods - Bar code technology - automated data collection system. FMS-components of FMS - types - FMS workstation - material handling and storage system - FMS layout- computer control systems - applications and benefits.

UNIT V COMPUTER AIDED PLANNING AND CONTROL ANDCOMPUTER MONITORING 9

Production planning and control - cost planning and control - inventory management - material requirements planning (MRP) - shop floor control. Lean and Agile Manufacturing Types of production monitoring systems - structure model of manufacturing - process control and strategies - direct digital control.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the concepts of CAD, group technology, CAPP, shop floor control and FMS for various applications (Understand)
2. Apply the concepts of CAD, group technology, CAPP, shop floor control and FMS for given scenario. (Apply)
3. Apply the function of various components in computer integrated manufacturing (Apply)
4. Apply the knowledge of group technology and computer aided process planning in CIM (Apply)
5. Apply the knowledge of computer aided planning and control and computer monitoring in CIM (Apply)
6. Analyze the function of shop floor control and flexible manufacturing system for the different applications. (Analyze)

TEXT BOOKS:

1. Mikell. P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, 2001.
2. Ranky, Paul G, “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd 2005.

REFERENCE BOOKS:

1. Rao.P.N, “CAD/CAM Principles and Applications”, TMH Publications, 2007.
2. Mikell. P. Groover, Emory Zimmers, “CAD/CAM”, prentice hall of India Pvt.Ltd, 1998.
3. James A. Regh,Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Education, 2005.
4. Chris McMahon,Jimmie Browne “CAD CAM Principles,Practice and Manufacturing Management”, Pearson Education, 2005.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1													3		
CO.2	3												3		
CO.3		2											3		
CO.4		3											3		
CO.5		3											3		3
CO.6									3	3			3		3
19UME923	**3**	**3**							**3**	**3**			**3**		**3**

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME924	CRYOGENICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the major concepts of and debates surrounding industrial and organizational psychology
- To impart knowledge on psychological research and theory to human interaction in the workplace.

UNIT I INTRODUCTION TO CRYOGENIC SYSTEMS 9

Properties of materials at low temperature, Properties of Cryogenic Fluids, Air and Gas Liquefication Systems: Thermodynamically ideal system, Production of low temperatures Liquefication systems for gases other than Neon, Hydrogen and Helium, liquefaction systems for Neon, Hydrogen and Helium. Cryogenic Refrigeration System

UNIT II GAS SEPARATION AND GAS PURIFICATION SYSTEMS 9

The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods.

UNIT III VACUUM TECHNIQUES 9

System for production of high vacuum such as mechanical, diffusion, ion and cryopumps. Cryogenics measurement systems Temperature pressure, flow rate, liquid level measurement, Introduction to Cryocoolers.

UNIT IV CRYOGENIC FLUID STORAGE SYSTEMS 9

Introduction, Basic Storage vessels, inner vessel, outer vessel design, piping, access man ways, safetydevice. Cryogenic insulations Vacuum insulation, gas filled powders and fibrous materials, solid foam, selection and comparison of insulations. Cryogenic fluid transfer systems. Transfer through uninsulated lines, vacuum insulated lines, porous insulated linesetc.

UNIT V ADVANCES IN CRYOGENICS 9

Vortex tube and applications, Pulse tube refrigerator, Cryogenic Engine for space vehicles.

Cryogenic Applications in gas industry, cryogenic fluids, space research, Cryobiology, food processing, electronics, nuclear and high energy physics, chemical processing, metal manufacturing, cryogenic power generation, medicine, analytical physics and chemistry.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Summarize the properties of cryogenics system.
2. Identify the suitable method for gas separation and purification methods.
3. Demonstrate the various vaccum techniques.
4. Explain the process of cryogenic fluid storage systems.
5. Discuss the various advance applications in cryogenics.

TEXT BOOKS:

1. Mukhopadhyay, Magmata, “Fundamentals of Cryogenic Engineering”, PHI Learning, 2012.
2. Cryogenic Engineering – R.B. Scott – D.VanNostrand Company, 1959.

REFERENCE BOOKS:

1. Cryogenic Process Engineering – K.D. Timmerhaus and T.M. Flynn, Plenum Press, New York,1989.
2. High Vacuum Technology – A. Guthree – New Age International Publication.
3. Experimental Techniques in Low Temperature Physics – G.K. White – Osford University Press,England, 1959.

19UME925	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To familiarize the basic concepts associated with the design and functioning applications of Robots.
- To impart knowledge to analyze robot kinematics and robot programming.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Payload – Robot Parts and Functions – Need for Robots – Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors –Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), 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: Edge detection, Segmentation Feature Extraction and Object Recognition - Algorithms. Applications –Inspection, Identification, Visual Serving and Navigation

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

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 – Pay back Method, EUAC Method, Rate of Return Method.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Illustrate the robot anatomy and various robot applications.
2. Compare the different types of grippers and robot drive systems.
3. Discuss the role of sensors and machine vision system in robot applications.
4. Use the various programming languages for intended robot movement.
5. Explain the robot implementation in industries and its economics.

TEXT BOOKS:

1. Groover.M.P, “Industrial Robotics – Technology, Programming and Applications ”, McGraw-Hill , 2001.
2. Fu.K.S,Gonzalz.R.C, Lee C.S.G, “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co, 1987.

REFERENCE BOOKS:

1. YoramKoren, “Robotics for Engineers”, McGraw-Hill Book Co, 1992.
2. Janakiraman.P.A, “Robotics and Image Processing,” Tata McGraw-Hill, 1995.
3. AshishDutta, “Robotic Systems - Applications, Control and Programming”, 2012.
4. John J. Craig, “Introduction to Robotics”, Pearson Edition, 2008.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1	2		2												
CO.2	2		2												
CO.3	2		2												
CO.4	3	2	3	2											
CO.5	2		3												
19UME925	**3**	**2**	**3**	**2**											

Ref: 3 - Strong 2 - Medium 1 – Weak

19UME926	INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I AIRCRAFT INDUSTRY OVERVIEW 4

Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Industry Supply Chain, Prime contractors, Tier 1 Suppliers, Key challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering/CAD/CAM/CAE Tools and Materials technology, Global and Indian Aircraft Scenario

UNIT II INTRODUCTION TO AIRCRAFTS 6

Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices.Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations.

UNIT III INTRODUCTION TO AIRCRAFT SYSTEMS 16

Types of Aircraft Systems. Mechanical Systems. Electrical and Electronic Systems. Auxiliary systems. Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit, Electrical systems: Avionics, Flight controls, Autopilot and Flight Management Systems, Navigation Systems, Communication, Information systems, Radar System

UNIT IV BASIC PRINCIPLES OF FLIGHT 10

Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects.

Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag.

UNIT V BASICS OF FLIGHT MECHANICS 9

Mach Waves, Mach Angles, Sonic and Supersonic Flight and its effects

Stability and Control

Degree of Stability- Lateral, Longitudinal and Directional Stability and controls of Aircraft. Effects of Flaps and Slats on Lift Coefficients, Control Tabs, Stalling, Landing, Gliding Turning, Speed of Sound, Mach Numbers, Shock Waves

Aircraft Performance and Maneuvers

Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on a Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Get an exposure to the Aerospace Industry.
2. Understand the Basics of Aircraft Systems and Aircraft Structures.
3. Industry Practices on Design of Aircraft Structures.
4. Understand the applicability of Design aspects in Aircraft Design.
5. Relate the theoretical knowledge with the design of Aircraft Structures.

REFERENCE BOOKS:

1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition
2. Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition
3. Fundamentals Of Flight, Shevell, Pearson Education, 2nd Edition
4. Introduction to Flight by Dave Anderson
5. .Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian moir, Allan Seabridge
6. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA education series,6th Edition
7. Airframe Structural Design by Michael Niu, Conmilit Press, 1988,2nd Edition
8. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition
9. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000
10. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2nd Edition, 2006
11. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes&
12. William A. Watkins, Glencoe &McGraw-Hill,6th Edition, 1993
13. An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA by Filippo De Florio, Butterworth-Heinemann.

19UME927 DESIGN OF AIRCRAFT STRUCTURES

L	T	P	C
3	0	0	3

UNIT I OVERVIEW OF THE AIRCRAFT DESIGN PROCESS 6

Introduction

Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies

Fundamentals of Structural Analysis

Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations.

UNIT II AIRCRAFT STRUCTURES AND LOADS 7

Introduction to Aircraft Structures

Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints

Aircraft Loads& Duration

Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads

UNIT III AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES 5

Material selection criteria, Aluminum Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Superplastic Forming And Diffusion Bonding

UNIT IV STRUCTURAL ANALYSIS OF AIRCRAFT STRUCTURES 20

Theory of Plates- Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear. **Sample Exercises.**

Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress, **sample exercises**

Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed

Section Beams, Shear Stresses due to Torsion in Thin Walled Beams. **Sample Exercises**.

Theory of Torsion- Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections, **Sample Exercises.**

UNIT V AIRCRAFT CERTIFICATION AND STRUCTURAL REPAIR 7

Airworthiness and Aircraft Certification

Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements

Aircraft Structural Repair

Types of Structural damage, Nonconformance, Rework,Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Discuss the aircraft design process
2. Explain the various loads act in the aircraft structure.
3. Discuss the aircraft materials and manufacturing process.
4. Analyze the various force in aircraft structure.
5. Discuss the various airworthiness and aircraft certification
6. Illustrate the ADL analysis and aircraft repair.

REFERENCE BOOKS:

1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition
2. Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition
3. Fundamentals Of Flight, Shevell, Pearson Education, 2nd Edition
4. Introduction to Flight by Dave Anderson.
5. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian moir, Allan Seabridge
6. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA education series,6th Edition
7. Airframe Structural Design by Michael Niu, Conmilit Press, 1988,2nd Edition
8. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition
9. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000
10. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2nd Edition, 2006
11. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes&
12. William A. Watkins, Glencoe &McGraw-Hill,6th Edition, 1993
13. An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA by Filippo De Florio, Butterworth-Heinemann

19UME929 **STATISTICAL QUALITY CONTROL**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To know the fundamental and advanced knowledge of the Statistical Quality control.

UNIT I INTRODUCTION 4

Definitions of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; The DMAIC Process, Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

UNIT II STATISTICAL PROCESS CONTROL 10

Mean, Median, Mode, Standard deviation, Calculating area, The Deming funnel experiment, Normal distribution tables, finding the Z score, Central limit theorem. SPC-The Magnificent Seven, Applications of SPC, Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)

UNIT III CONTROL CHARTS FOR VARIABLES 9

Control Charts for X-Bar and R- Charts, Statistical basis of the charts, Development and use of X bar and R charts, Interpretation of charts. Type I and Type II errors, the probability of Type II error, Numerical problems.

UNIT IV PROCESS CAPABILITY 11

The foundation of process capability, Natural Tolerance limits, c p – process capability index, c pk , p p – process performance index, summary of process measures, Numerical problems. Binomial distribution, Poisson distribution (from the point of view of Quality control) Control Chart for Fraction Nonconforming, Control Chart for number Nonconforming, Control Charts for Nonconformities or Defects, Control Chart for Number of non-conformities per unit, Numerical problems.

UNIT V LOT-BY-LOT ACCEPTANCE SAMPLING FOR ATTRIBUTES 11

The acceptance sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, AOQL, LTPD, OC curves, Military Standard 105E, the Dodge-Romig sampling plans, Numerical problems, CUSUM Control Chart (basic principles of the chart for monitoring the process mean); EWMA control chart (EWMA control chart for monitoring process mean), design of an EWMA control chart.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Analyse different statistical methods for statistical process control.
2. Assess general advantages and disadvantages for alternative process control methods.
3. Compare alternative process control methods.
4. Identify the different quality control techniques for varying sampling methods.
5. Formulate an adequate statistical control problem for a production or similar process.
6. Estimate the quality measures in general by means of modern and relevant statistical tools.

TEXT BOOKS:

1. Statistical Quality Control, E.L. Grant & R.S. Leavenworth, 7th Ed., McGraw- Hill.
2. Statistical Quality Control, R C Gupta, Khanna Publishers, New Delhi, 2005
3. Introduction to Statistical Quality Control, Douglas C Montgomery, Publisher: Wiley; 8th Ed.

REFERENCE BOOKS:

1. Statistical Process Control and Quality Improvement, Gerald M. Smith, Pearson Prentice Hall. ISBN 0 – 13-049036-9.
2. Statistical Quality Control for Manufacturing Managers, W S Messina, Wiley & Sons, Inc. New York, 1987
3. Principles of Quality Control, Jerry Banks, Wiley & Sons, Inc. New York.

MOOCS:

1.https://nptel.ac.in/courses/110/105/110105088/

19UME930 **ADDITIVE MANUFACTURING**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To know the fundamental and advanced knowledge of the Additive manufacturing technology and their applications.
- To be familiar with the design for AM and characteristics of the different materials used in Additive Manufacturing technologies.

UNIT I INTRODUCTION **9**

General Overview – Need - Development of Additive Manufacturing Technology -Principle – AM Process Chain- Classification –Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications and Benefits-Virtual Prototyping.

UNIT II REVERSE ENGINEERING AND DESIGN FOR ADDITIVE MANUFACTURING **9**

Introduction to Reverse engineering-Basic concepts- Digitization techniques – Model reconstruction –Design tools: Data Processing - CAD model preparation-Part orientation and support structure generation-Model Slicing- Tool path generation-Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing-Software for AM.

UNIT III LIQUID AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS **9**

Stereolithography(SLA): Principle- pre-build process- part-building and post-build processes- photo polymerization of SL resins- part quality and process planning –materials-advantages, limitations and applications.Solid Ground Curing (SGC): working principle- process-strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle- details of processes- process variables- types, products- materials and applications. Laminated Object Manufacturing (LOM): Working Principles- details of processes- products- materials, advantages, limitations and applications.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS **9**

Selective Laser Sintering (SLS): Principle- process description- Indirect and direct SLS- powder structures- post processing- surface deviation and accuracy- Typical Materials and Application. Laser Engineered Net Shaping (LENS): Processes- materials- products- advantages- limitations and applications–Electron Beam Melting-Shape Deposition Manufacturing (SDM)-Case Studies.

UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS 9

Three dimensional Printing (3DP): Principle- Basic process-Physics of 3DP- types of printing-process capabilities- material system. Solid Liquid based and powder based 3DP systems-strength and weakness- Applications and case studies-Ballastic Particle Manufacturing (BPM)-Introduction to 4D Printing technology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Define the Working principle, methods, design tools and Geometric modeling techniques, possibilities and limitations of Additive Manufacturing technologies.
2. Recall the Reverse engineering, virtual prototyping, construction of Additive Manufacturing technologies with different materials, their potential to support design and manufacturing.
3. Illustrate the different AM technology based on application, material, technique and needs.
4. Compare the Modern development in different Additive manufacturing process.
5. Apply the design tools for AM and Wire frame, surface and solid modeling by Geometric modeling techniques using different software.
6. Analyze the case studies relevant to mass customized manufacturing in AM.

TEXT BOOKS:

1. Groover M.P, “Automation, Production System and CIM”, Prentice-Hall, India, 1998.
2. Gibson I, Rosen D.W, Choudry A andStucker B, “Additive Manufacturing : Rapid prototyping to direct digital manufacturing”, Springer, 2010.
3. Chua C.K, Leong K.F andLim C.S, “Rapid prototyping: Principles and applications”, second edition World Scientific Publishers, 2010.

REFERENCE BOOKS:

1. Gebhardt A, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardener Publications, 2011.
2. LiouL.W andLiou F.W. “Rapid Prototyping And Engineering Applications: A tool box for prototype development ”, CRC Press, 2011.
3. Kamrani, A.K andNasr E.A, “Rapid Prototyping: Theory and practice”, Springer, 2006.
4. Hilton P.D and Jacobs P.F, “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2005.
5. Tom Page “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012.

19UME933	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Pre-Requisite: Nil

OBJECTIVES:

- To impart knowledge on Mathematical foundations necessary for Machine Learning
- To provide knowledge on Machine Learning Algorithms
- To develop programming skills required for Machine Learning Applications

UNIT: I INTRODUCTION TO MACHINE LEARNING 7

Real life Examples of machine Learning – Data & Machine Learning – Learning Function – Hypothesis - Parametric Machine Learning Algorithm – Non-Parametric Machine Learning Algorithm – Supervised Machine Learning – Unsupervised Machine Learning – Semi Supervised Machine Learning – Classification – Regression – Errors – Bias-Variance – Overfitting – Under fitting

UNIT II LINEAR ALGORITHMS 10

Basics of Linear Regression – Gradient Descent Algorithm – Stochastic Gradient Descent Algorithm – Logistic Regression – Linear Discriminant analysis - Regularization

Basic of Python Programming – Exercises for linear Algorithms using Python Programming

UNIT III NON-LINEAR ALGORITHMS 10

Classification and Regression Trees (CART) – Naïve Bayes Algorithm – K Nearest Neighbors (KNN) – Learning Vector Quantization – Support Vector Machine

Exercises for Non-linear Algorithms using Python Programming

UNIT IV ENSEMBLE ALGORITHMS 8

Bagging – Bootstrap method – Bagging Aggregation – Bagged Decision Trees – Rain Forest Algorithm – Boosting ensemble method – Ada Boost Model

Exercises for ensemble Algorithms using Python Programming

UNIT V ARTIFICIAL NEURAL NETWORK (ANN) 10

Basics of Neural Network– Brain and ANN –Machine learning and ANN - Neurons - Hidden layer – Output layer – Activation function – Forward Propagation – Backward Propagation - Convolutional Neural Networks - Recurrent Neural Networks - Natural Language Processing

Exercises in Artificial Neural Network using Python Programming

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the concepts of machine learning for solving various complex problems of engineering
2. Apply the knowledge machine learning to solve complex engineering problems based on regression and classification
3. Identify the suitable Machine learning algorithm for complex engineering problems for reaching sustained conclusions using the principles of mathematics and programming
4. Design solutions for complex engineering problems to predict or forecast the results for engineering, business, health care and environmental applications
5. Interpret the data and synthesize the information using Machine Learning algorithms and statistical methods to provide valid conclusions
6. Select and apply appropriate IT tools for modelling and prediction of the results of the complex engineering problems, understanding the limitations of the model.

TEXT BOOKS:

1. Jason Brownlee "Master Machine Learning Algorithms", Machine Learning Mastery Pty. Ltd., Australia, 2020
2. Aurélien Géron "Hands-On Machine Learning with Scikit-Learn and TensorFlow" (2nd Edition), O′Reilly Media Inc., USA.,2017.

REFERENCE BOOKS:

1. Patrick Hall & Navdeep Gill, "An Introduction to Machine Learning Interpretability" (2nd Edition) by, O'Reilly Media, Inc., USA, 2018
2. Giuseppe Bonaccorso "Machine Learning Algorithms", PACKT PUBLISHING LIMITED, UK, 2018
3. Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI, 2014
4. Simon O. Haykin,"Neural Networks and Learning Machines", 3d Edition, Pearson, 2009

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1															
CO.2	3											2	2		
CO.3	3											2	2		
CO.4	3				3							2	2		
CO.5	3											2			
CO.6		**3**			**3**										
19UME933	**3**	**3**			**3**							**2**	**2**		

Ref: 3 - Strong 2 - Medium 1 – Weak

OPEN ELECTIVE (Mechanical Department offering course):

Sl. No	Course Category	Course Code	Course Name	L	T	P	C
1.	OE	19UME971	Industrial Psychology and Work Ethics	3	0	0	3
2.	OE	19UME972	Industrial Safety and Engineering	3	0	0	3
3.	OE	19UME973	Synthesis of Nano Materials	3	0	0	3
4.	OE	19UME974	Principles of Management	3	0	0	3
5.	OE	19UME975	Total Quality Management	3	0	0	3

19UME971	INDUSTRIAL PSYCHOLOGY AND WORK ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To explain the major concepts of and debates surrounding industrial and organizational psychology
- To impart knowledge on psychological research and theory to human interaction in the workplace.

UNIT I INTRODUCTION TO INDUSTRIAL PSYCHOLOGY 9

Definitions and Scope. Major influences on industrial Psychology. Performance Management Training and Development.

UNIT II INDIVIDUAL IN WORKPLACE 9

Motivation and Job satisfaction, stress management. Organizational culture, Leadership and group dynamics.

UNIT III ENVIRONMENT AND ENGINEERING PSYCHOLOGY-FATIGUE 9

Boredom, accidents and safety. Job Analysis, Recruitment and Selection – Reliability & Validity of recruitment tests.

UNIT IV SOCIOLOGY 9

A general over view scope of industrial sociology, industry and education, industry and family, industry and social stratification. History and evolution of values and ethics in social work. Team work, communication, organizational skills and time management.

UNIT V ETHICAL PRACTICE AND SOCIETY 9

Professional values and self-awareness about ethical professional behavior, ethical decision making processes and dilemma examples. Considerations for each jurisdiction that registers, certifies or licenses social workers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Summarize the industrial psychology and performance management.
2. Make use theories to explain and predict behavior and mental processes
3. Identify the safety and job analysis for engineering psychology.
4. Illustrate the industrial sociology and evolution the values of industrial activity.
5. Demonstrate the ethical practice in industries and social workers.

TEXT BOOKS:

1. Miner J B, “Industrial/Organizational Psychology ”, McGraw Hill Inc,1992.
2. Reamer F G, “Social Work Values and Ethics”, Columbia University Press, 2nd Edition, 2003.

REFERENCE BOOKS:

1. Aamodt M G, “Industrial/Organizational Psychology: An Applied Approach ”, Belmont, 2007.
2. Aswathappa K, “Human Resource Management”, Tata McGraw Hill, 2008.
3. Edmund G Seebauer, Robert L Barry “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2001.
4. David Ermann, Michele S Shauf “Computers, Ethics and Society”, Oxford University Press, 2003.

19UME972	INDUSTRIAL SAFETY AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To enable the students to learn about various functions and activities of safety department.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

UNIT I CONCEPTS AND TECHNIQUES 10

History of Safety movement –Evolution of modern safety concept-general concepts of management –line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, 52 safety sampling, evaluation of performance of supervisors on safety.

UNIT II SAFETY AUDIT 10

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report –review of inspection, remarks by government agencies, consultants, experts –perusal of accident and safety records, formats –implementation of audit indication -liaison with departments to ensure co-ordination –check list –identification of unsafe acts of workers and unsafe conditions in the shop floor-IS 14489 : 1998 Code of practice on occupational Safety and health audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 10

Concept of an accident, near miss incident, reportable and non-reportable accidents, reporting to statutory authorities –principles of accident prevention –accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee – cost of accident.

UNIT IV SAFETY PERFORMANCE MONITORING 8

ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience-permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate ,Total Injury illness incidence rate, Lost workday cases incidence rate (LWDI), Number of lost workdays rate –problem.

UNIT V SAFETY EDUCATION AND TRAINING 7

Importance of training -identification of training needs - training methods –programmes, seminars, conferences, competitions – method of promoting safe practice -motivation– communication - role of government agencies and private consulting agencies in safety training DGFASLI, NSC, ASSE, HSE, OSHA-NEBOSH–creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. To understand the functions and activities of safety engineering department.
2. To carry out a safety audit and prepare a report for the audit.
3. To prepare an accident investigation report.
4. To estimate the accident cost using supervisors report and data.
5. To evaluate the safety performance of an organization from accident records.
6. To identify various agencies, support institutions and government organizations involved in safety training and promotion.

TEXT BOOKS:

1. Ray Asfahl. C “Industrial Safety and Health Management” Pearson Prentice Hall, 2003.
2. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973.
3. John V.Grimaldi and Rollin H. Simonds, “Safety Management”, Richard D Irwin, 1994.

REFERENCE BOOKS:

1. Lees, F.P & M. Sam Mannan, “Loss Prevention in Process Industries: Hazard Identification, Assessment and Control ”, Butterworth -Heinemann publications, London, 4th edition, 2012.
2. John Ridley, “Safety at Work”, Butterworth and Co., London, 1983.
3. Subramanian.V., “The Factories Act 1948 with Tamilnadu factories rules 1950”, Madras Book Agency, 21 st ed., Chennai, 2000.

19UME973	SYNTHESIS OF NANO MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- This course aims at imparting knowledge on synthesis of nano materials

UNIT I BULK SYNTHESIS 9

Synthesis of bulk nano-structured materials – sol gel processing – Mechanical alloying and mechanical milling- Inert gas condensation technique – Nanopolymers – Bulk and nano composite materials.

UNIT II CHEMICAL APPROACHES 9

Self-assembly, self-assembled monolayers (SAMs). Langmuir-Blodgett (LB) films, clusters, colloids, zeolites, organic block copolymers, emulsion polymerization, template synthesis, and confined nucleation and/or growth. Biomimetic Approaches: polymer matrix isolation, and surface-templated nucleation and/or crystallization. Electrochemical Approaches: anodic oxidation of alumina films, porous silicon, and pulsed electrochemical deposition.

UNIT III PHYSICAL APPROACHES 9

Vapor deposition and different types of epitaxial growth techniques- pulsed laser deposition, Magnetron sputtering - Micro lithography (photolithography, soft lithography, micromachining, e-beam writing, and scanning probe patterning).

UNIT IV NANOPOROUS MATERIALS 9

Nanoporous Materials – Silicon - Zeolites, mesoporous materials – nano membranes and carbon nanotubes - AgX photography, smart sunglasses, and transparent conducting oxides –molecular sieves – nanosponges.

UNIT V CHARACTERIZATION OF NANOPHASE MATERIALS 9

Fundamentals of the techniques – experimental approaches and data interpretation – applications/limitations of x-ray characterization: – x-ray sources – wide angle, extended x-ray absorption technique – Electron microscopy: SEM/TEM – high resolution imaging – defects in nanomaterials – spectroscopy: – electron energy-loss mechanisms – electron filtered imaging – prospects of scanning probe microscopes – optical spectroscopy of metal/semiconductor nanoparticles.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Describe about bulk and nano composite materials.
2. List out the self-assembled monolayers (SAMS).
3. Discus the operation of Magnetron sputtering device.
4. Collect the experimental approaches and data interpretation.
5. Distinguish the nano membranes and carbon nanotubes.

TEXT BOOKS:

1. C. N. R. Rao, A. Muller, A. K. Cheetham, “The Chemistry of Nano materials: Synthesis, Properties and Applications”, Wiley-VCH, Verlag GmbH, Volume 1, Germany, 2004.
2. G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties &Applications ,Imperial College Press”, 2004.
3. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate, “Handbook of NanoScience, Engg. and Technology”, CRC Press,2002.

REFERENCE BOOKS:

1. S.P. Gaponenko, “Optical Properties of semiconductor Nano crystals ”,Cambridge University Press, 1980.
2. K. Barriham, D.D. Vvedensky, “Low dimensional semiconductor structures: fundamental and device applications”, Cambridge University Press, 2001.
3. Guozhong Cao, “Nanostructures & Nanomaterials Synthesis, Properties G;Z: Applications”, World Scientific Publishing Private, Ltd., Singapore, 2004.
4. Zhong Lin Wang, “Characterization Of Nanophase Materials”, Wiley-VCH, Verlag GmbH, Germany, 2004.
5. Carl C. Koch, “Nanostructured Materials: Processing, Properties and Potential Applications”, Noyes Publications, William Andrew Publishing Norwich, New York, U.S.A, 2002.

19UME974	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impart the knowledge on the process of management in organizations and the dynamic world of managers.
- To familiarize the nature of managers contribute to the productivity and performance of their organizations.

UNIT I OVERVIEW OF MANAGEMENT 9

Organization – Management – Role of managers – Evolution of Management thought – Organization and the environmental factors – Managing globally – Strategies for International Business.

UNIT II PLANNING 9

Nature and Purpose planning – Planning process – Types of plans – Objectives – Managing by objective (MBO)- Strategies – Types of strategies – Policies – Decision Making – Types of decision – Decision Making Process - Rational Decision Making Process – Decision Making under different conditions.

UNIT III ORGANISING 9

Nature and purpose of organizing – Organization structure – Formal and informal groups / organization – Line and Staff authority – Departmentation – Span of Control – Centralization and Decentralization – Delegation of authority – Staffing – Selection and Recruitment – Orientation Career Development – Career stages – Training – Performance Appraisal.

UNIT IV DIRECTING 9

Creativity and Innovation – Motivation and Satisfaction – Motivation Theories- Leadership – Leadership theories – Communication – Hurdles to effective communication – Organization Culture – Elements and types of culture – Managing cultural diversity.

UNIT V CONTROLLING 9

Process of controlling – Types of control – Budgetary and non-budgetary control techniques – Managing Productivity – Cost Control – Purchase Control – Maintenance Control – Quality Control – Planning operations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Summarize various management thoughts.
2. Explain planning and decision making processes.
3. Illustrate the purpose of organizing and different organizational structure.
4. Compare various motivational, leadership theories.
5. Discuss different budgetary and non-budgetary control techniques.

TEXT BOOKS:

1. Stephen P. Robbins, Mary Coulter, “Management”, Prentice Hall of India, 2006.
2. Charles W.L Hill, Steven L Mc Shane, “Principles of Management ”, Tata McGraw-Hill Education Pvt. Ltd., 2007

REFERENCE BOOKS:

1. Hellriegel, Slocum & Jackson, “Management – A Competency Based Approach ”, Thomson South Western, 10th Edition,2007.
2. Harold Koontz, Heinz Weihrich, mark V Cannice, “Management – A global & Entrepreneurial Perspective”, Tata Mcgraw Hill, 12th Edition,2007.
3. Parthasarathy. P, “Principle of Management”, Vrinda Publication, 2nd Edition, New Delhi, 2008.
4. Andrew J. Dubrin, “Essentials of Management”, Thomson Southwestern, 2007.

19UME975	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES :

- Give knowledge on the fundamental principles of Total Quality Management;
- To give idea about choose appropriate statistical techniques for improving processes;
- To familiarize the student write reports to management describing processes and recommending ways to improve them;
- To give idea about research skills that will allow them to keep abreast of changes in the field of Total Quality Management;
- To explain the concepts and principles of total quality management.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle,5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking– Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Identify basic concepts of TQM and the role of senior management.
2. Explain the customer satisfaction, retention, employee involvement and the continuous process improvement techniques.
3. List seven tools of quality, new seven management tools and concept of six sigma.
4. Apply the concept of QFD, FMEA and total productive maintenance.
5. Demonstrate the need for ISO 9000, other quality system and auditing.

TEXT BOOKS:

1. Dale H.Besterfiled, “Total Quality Management”, Pearson Education Asia, 2006.
2. James R. Evans, William M. Lindsay “The Management and Control of Quality”, Tata South-Western (Thomson Learning), 2005.

REFERENCE BOOKS:

1. Oakland. J.S, “TQM – Text with Cases”, Butterworth – Heinemann Ltd3rd Edition, 2003.
2. Suganthi.L, Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd, 2006.
3. Janakiraman.B, Gopal. R.K “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd, 2006.
4. Valarmathi .B, Srinivasa Gupta N “Total Quality Management”, Vijay Nicole.

INTER/ MULTI DISCIPLINARY ELECTIVE COURSES:

Sl.No	Course Code	Course Name	L	T	P	C
1.	19UGM951	Automation in Agriculture Engineering (Common to Mech, Agri, IT)	3	0	0	3
2.	19UGM952	Electric Vehicles (Common to EEE & Mech)	3	0	0	3
3.	19UGM953	Bio Fluid Mechanics (Common to Biomedical & Mech)	3	0	0	3

19UGM951	AUTOMATION IN AGRICULTURE	L	T	P	C
	(Common to Mech, IT, Agri)	3	0	0	3

Objective:

- To expose the students to the concept of Agriculture Automation and Farm Mechanization.
- To learn about the different types of primary and secondary tillage implements, farm equipment and ploughing methods.
- To introduce the concepts of Automatic Systems and IoT applications.
- To train the students to explore and use new technologies in Agriculture.

UNIT I INTRODUCTION TO FARM MECHANIZATION & AGRICULTURE AUTOMATION **8**

Sources of farm power- merits& demerits of different farm power- farm mechanization-concept –scope-constraints & scope –selection factors. Mechanization in farm operations. Introduction -agriculture automation.

UNIT II TILLAGE IMPLEMENTS & AUTOMATION IN SOWING, PLANTERS **10**

Tillage-objective- classification- primary tillage - mould board plough working principle – Disc plough working principle -secondary tillage –Disc harrow-single action-double action-off set-cultivator types.

Sowing &fertilizer equipment-sowing methods- Automation in sowing- seed drill-components of seed drill-seed cum fertilizer. Automation in planters-ex: potato planter, sugar cane planter.

UNIT III SYSTEMS OF AUTOMATION **8**

Automated Irrigation – Pneumatic System and its applications – Portable timer system – Timer/Sensor Hybrid/SCADA – Methods of automating Irrigation layout – Machine Learning in Tank Monitoring System.

UNIT IV IoT IN AGRICULTURE **10**

IoT based Automated Irrigation System – IoT based Smart Irrigation – Sensor based Automation – types – operation – Solar based Automatic Irrigation System – components – operation - Automation by sensing soil moisture-– Automation using ANN based controller – operation.

UNIT V AGRICULTURAL ROBOT **9**

Introduction to Agricultural Vehicle Robot - Overview of a Robot Farming System-Agricultural Robot Vehicles - Robot Management System-Multi robot systems -Agricultural robots-types, operations.

Total :45 periods

TEXT BOOKS:

1. Jagdishwarsahay 2006, Elements of Agricultural Engineering, Standard Publishers Distributors, New Delhi.
2. Qin Zhang_ F J Pierce-(2013) Agricultural Automation_ Fundamentals and Practices-CRC Press Taylor & Francis Group.
3. H.R.Haise, E.G.Kruse. et al., 1981. "Automation of Surface Irrigation: 15 years of USDA Research and Development at Fort Collins, Colorado.

REFERENCES:

1. E.L. Barger, R.A. Kepner, Roy Bainer, Principles of Farm Machinery (Third Edition), CBS Publishers & Distributors Pvt. Ltd.
2. Harris Pearson Smith and Lambert Henry Wilkes, Farm machinery and equipment's, 6thedition, Tata McGraw-Hill, New Delhi, 1997.
3. Michael and ojha 2005, Principles of Agricultural Engineering, Jain brothers, New Delhi.
4. Brian Wahlin and DarellZimbelman, Canal Automation for Irrigation Systems, AmericanSociety of Civil Engineers, 2014.

COURSE OUTCOMES:

After completion, the student will be able to

1. The importance of Farm mechanization and concept of Agriculture Automation. (Understand)
2. Classify the various tillage implements, seed drills, automation in sowing and planters (Understand)
3. Apply the knowledge of different systems to automate irrigation. (Apply)
4. Apply the knowledge of IOT to design smart systems for automating Agriculture. (Apply)
5. Classify the various Robots for automation in Agriculture. (Understand)

Beyond the Syllabus

1. Blue River Technology – Weed Control.
2. Harvest CROO Robotics – Crop Harvesting.

CO-PO MAPPING

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	2					2	2							
CO.2	2					2	2							
CO.3	3					3	3				3	3		
CO.4	3					3	3					3		
CO.5	2					2	2							

PROGRAMME ARTICULATION MATRIX

Subject	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
19UGM951	**3**					**3**	**3**				**3**	**3**		

Ref: 3 - Strong 2 - Medium 3 – Weak

19UGM952	ELECTRIC VEHICLES (Interdisciplinary Course: EEE & MECH)	L 3	T 0	P 0	C 3

UNIT I Hybrid and Electric Vehicles (HEV): History Overview and Modern Applications **9**

Ground vehicles with mechanical powertrain and reasons for HEV development - HEV configurations and ground vehicle applications - Advantages and challenges in HEV design

UNIT II Power Flow and Power Management Strategies in HEV **9**

Mechanical power: generation, storage and transmission to the wheels - Electric power: generation, storage and conversion to mechanical power - Hydraulic power: generation, storage and conversion to mechanical power - Energy storage/conversion and thermodynamic relations

UNIT III Electric Drives & Power Electronics in Hybrid Electric Vehicles **9**

DC-Brushed and brushless drives: principles of design, operation, math modeling and control - Shunt Drives - Series Drives - Compound Drives - Thermal analysis of electric drives in various vehicle applications. Rectifiers - Buck convertor - Voltage source inverter - Current source inverter - DC-DC convertor

UNIT IV Vehicle Dynamics Fundamentals for HEV Modeling and Wheel-ElectricDrive,Suspension System Design **9**

Various strategies for improving vehicle energy/fuel efficiency - Vehicle chassis mathematical model in various operation conditions (steady motion, acceleration, regenerating braking, coasting, moving up and down a hill) Gear trains in wheel-electric drives - Mechatronic design of wheel-electric drives - Suspension design for wheel-electric drives Wheel/Tire-terrain interactive dynamics - Inverse dynamics-based control.

UNIT V Batteries and Energy Storages **9**

Battery characterization, math modeling and designs-. Battery sizing for various vehicle applications - Battery monitoring and charging control - Combination of batteries and ultra capacitors - Fuel cells: principles of operation, design, modeling - Fuel cell storage system - Strategy for controlling hybrid fuel cell system- Flywheel energy storage characterization - Hydraulic accumulator characterization. **Total : 45 Periods**

REFERENCE BOOKS:

1. Chris Mi.M, Abdul Mansoor and David WenzhongGao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives” Wiley, Jul 2011.
2. Iqbal Hussain, “Electric & Hybrid Vechicles – Design Fundamentals”, Second Edition, CRCPress, 2011.
3. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
4. MehrdadEhsani, YiminGao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
5. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2001.

19UGM953	BIOFLUID MECHANICS	L	T	P	C
		3	0	0	3

Objective:

- To gain knowledge in the theory and characteristics of fluid mechanics.
- To study the characteristics of flow.
- To familiarize the concept of cardiovascular physiology.
- To understand the biomechanics of the human circulation.

UNIT I BASIC OF FLUID MECHANICS 9

Units and dimensions – Properties of fluids – mass density, specific weight, specific volume, specific gravity, viscosity, Newton law of viscosity, compressibility, vapour pressure, surface tension and capillarity, Types of fluid, Fluid Pressure.

UNIT II FLOW CHARACTERISTICS AND FLUID DYNAMICS 9

Types of flow: Laminar, Turbulent, steady, unsteady, uniform, non uniform flows , stream line, streak line, path line – continuity equation, Reynolds equation of motion, Navier stokes equation.

UNIT III FLOW THROUGH CIRCULAR CONDUITS 9

Boundary layer – Boundary layer thickness – Viscous flow – Hagen poiseuille equation – Major loss – Darcy Weisbach equation – friction factor – Moody diagram – minor losses.

UNIT IV CARDIOVASCULAR PHYSIOLOGY AND RHEOLOGY OF BLOOD 10

Cardiovascular Physiology: Introduction – Heart – Cardiac Valves – Systematic Circulation – Coronary Circular – Pulmonary Circulation and Gas Exchange in the Lungs – Cerebral and Renal circulation – IoT based Automated Irrigation System – IoT based Smart Irrigation – Sensor based Automation – types – operation – Solar based Automatic Irrigation System – components – operation - Automation by sensing soil moisture-– Automation using ANN based controller – operation.

UNIT V AGRICULTURAL ROBOT 9

Introduction to Agricultural Vehicle Robot - Overview of a Robot Farming System-Agricultural Robot Vehicles - Robot Management System-Multi robot systems -Agricultural robots-types, operations.

Total :45 Periods

TEXT BOOKS:

1. Jagdishwarsahay 2006, Elements of Agricultural Engineering, Standard Publishers Distributors, New Delhi.
2. Qin Zhang_ F J Pierce-(2013) Agricultural Automation_ Fundamentals and Practices-CRC Press Taylor & Francis Group.
3. H.R.Haise, E.G.Kruse. et al., 1981. "Automation of Surface Irrigation: 15 years of USDA Research and Development at Fort Collins, Colorado

REFERENCES:

1. E.L. Barger, R.A. Kepner, Roy Bainer, Principles of Farm Machinery (Third Edition), CBS Publishers & Distributors Pvt. Ltd.
2. Harris Pearson Smith and Lambert Henry Wilkes, Farm machinery and equipment's, 6thedition, Tata McGraw-Hill, New Delhi, 1997.
3 Michael and ojha 2005, Principles of Agricultural Engineering, Jain brothers, New Delhi.
4. Brian Wahlin and DarellZimbelman, Canal Automation for Irrigation Systems, AmericanSociety of Civil Engineers, 2014.

COURSE OUTCOMES:

After completion, the student will be able to

1. The importance of Farm mechanization and concept of Agriculture Automation. (Understand)
2. Classify the various tillage implements, seed drills, automation in sowing and planters (Understand)
3. Apply the knowledge of different systems to automate irrigation. (Apply)
4. Apply the knowledge of IOT to design smart systems for automating Agriculture. (Apply)
5. Classify the various Robots for automation in Agriculture. (Understand)

Beyond the Syllabus

1. Blue River Technology – Weed Control
2. Harvest CROO Robotics – Crop Harvesting

CO-PO MAPPING

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	2					2	2							
CO.2	2					2	2							
CO.3	3					3	3				3	3		
CO.4	3					3	3					3		
CO.5	2					2	2							

PROGRAMME ARTICULATION MATRIX

Subject	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
19UGM953	**3**					**3**	**3**				**3**	**3**		

Ref: 3 - Strong 2 - Medium 3 – Weak

ONE CREDIT COURSE:

Sl. No	Course Code	Course Name	L	T	P	C
1.	19UME861	Jigs and Fixtures	1	0	0	1
2.	19UME862	Smart Materials	1	0	0	1
3.	19UME863	Solar energy	1	0	0	1
4.	19UME864	Work Study	1	0	0	1
5.	19UME865	CNC programming	1	0	0	1
6.	19UME866	Limits, Fits and Tolerances	1	0	0	1

19UME861	JIGS & FIXTURES	L	T	P	C
		1	0	0	1

OBJECTIVES :

- To understand the introduction of Jigs and fixtures
- To gain proficiency in the development of required views of the final knowledge.

UNIT I PRINCIPLES JIGS & FIXTURES 5

Objectives of tool - Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Mechanical actuation – pneumatic and hydraulic actuation Standard parts

UNIT II JIGS 5

Introduction of jigs - Types of Jigs – Post, Turn over, Channel, latch, box, pot, angular post jigs – Indexing jigs Drill bushes and Jig buttons – Tolerances and materials used.

UNIT III FIXTURES 5

Introduction of fixtures for given component General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the jigs and fixtures.
2. Compare and development of jigs and fixtures.

REFERENCE BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co.,Ltd., New Delhi, 2010.
2. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, NewDelhi, 2010.
3. Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, 2011.

19UME862	SMART MATERIALS	L	T	P	C
		1	0	0	1

OBJECTIVES :

- The aim of this course is presents the latest on a variety of smart materials, smart structures, and propertiesand recent applications as well as the family grouping of materials.

UNIT I INTRODUCTION TO SMART MATERIALS 5

Smart materials - Definition, Concept and classifications of smart materials - Advanced composite materials, Ceramics, Pure Glass, Gallium arsenide, Superconductors and Intelligent materials.

UNIT II SMART STRUCTURES AND PROPERTIES 7

Components of a Smart Structure.Properties - Optical (optical bandgap engineering, nonlinear optical effects, electrochromic, photochromic and thermochromic effects). Electrical properties (piezoelectric effect). Thermo-mechanical properties (shape memory effect, self-healing).Magnetic properties (magnetoresistance). Active surface properties (photocatalytic effect, biocompatibility).

UNIT III APPLICATIONS OF SMART MATERIALS 3

Sensors (gas, vapors, temperature, strain, stress, adaptive structures). Energy (solar cells, solar absorbers, smart windows).Environment (self-cleaning surfaces).Biomedical (artificial lungs, DNA chips, smart hydrogels).Aerospace and outer space (self-healing protective surfaces, thermal radiators). Electronics and consumer products (displays, illumination, printed electronics).

TOTAL : 15 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Explain the definition and types of smart materials.
2. Utilize the components of smart structures and unique properties of smart materials.
3. Categorize the applications of smart materials in various engineering field.

REFERENCE BOOKS:

1. Mel Schwartz, “Smart Materials”, CRC Press, 2009.
2. A. V. Srinivasan, D. Michael McFarland, “Smart Structures, Analysis and Design”, Cambridge University Press, 2001.
3. M.V. Gandhi, B.D. Thompson, “Smart Materials and Structures”, Springer Science & Business Media, 1992.

19UME863 **SOLAR ENERGY**

L	T	P	C
1	0	0	1

OBJECTIVES :

- To gain knowledge on the various sources of renewable and non-renewable energy.
- To impart various conversion technique to tap the solar energy.

UNIT I INTRODUCTION TO SOLAR ENERGY 5

Energy – Renewable, Non – renewable, Man and Energy – Energy sources – Energy Alternatives – Devices for solar energy collection – Flat Plate Collector and Concentrated Collector.

UNIT II SOLAR ENERGY CONVERSION 5

Solar air heaters – Solar bond – Solar power plant – Solar air conditioning and refrigeration – solar cooker – solar still.

UNIT III DEVELOPMENT IN SOLAR ENERGY 5

Solar energy in agriculture – Advances in solar energy – Economic analysis of solar energy – Future of solar energy – solar Ice maker.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Understand the different sources of availability of energy.
2. Apply the knowledge of thermal concepts for the extraction of solar energy.
3. Analysis the possibilities of getting improvement in the economy of solar energy.

REFERENCE BOOKS:

1. S P Sukhatme, J K Nayak, “Solar Energy: Principles of thermal Collection and Storage”, First Reprint, Tata Mcgraw – Hill, 2008.
2. Soteris A. Kalogirou, “Solar Energy Engineering: processes and Systems”, Second Edition, Academic Press, 2014.

19UME864	WORKSTUDY	L	T	P	C
		1	0	0	1

OBJECTIVES :

- To impart knowledge about work study and dealing with work related issues in the work place.
- To familiarize the usage of standard time and allowances.

UNIT I WORK STUDY, MOTION STUDY & ERGONOMICS 7

Work study definition; Role of work study in improving productivity; Work study procedure: Selection of jobs; Information collection and recording; Recording techniques-charts and diagrams.Motion study; Therbligs; Cycle graph and Chrono Cycle graph; Simo chart and Principles of Motion economy. Ergonomics; Work environment and Human factors.

UNIT II WORK MEASUREMENT & FACILITIES DESIGN 8

Definition; Procedure; Performance rating; Concept of normal time; allowances. Work sampling technique. Introduction to pre - determined motion time system. Computing Standard Time.Site Selection: Factors influencing the selection of rural and urban locations of sites, Optimum decision on choice of site and analysis. Plant Layout: Types of production, Types of layouts, Advantages and Disadvantages of layout, Factors affecting layout. Design of work place layout.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Produce a model using ergonomic principles that suitable for specified work environment.
2. Design of work place plant Layout.

REFERENCE BOOKS:

1. O.P.Khanna,"Industrial Engineering and Management" DhanpatRai& Sons, 2010.
2. Suresh Dalela and SaurabhDalela "Text Book of Work Study and Ergonomics" Standard Publishers Distributors, New Delhi, 2013.

19UME865	CNC PROGRAMMING	L	T	P	C
		1	0	0	1

OBJECTIVES :

- The objective of this course is to programming of computerized numerical control equipment with hands-on practice on operations of a CNC milling and Turning.

UNIT I INTRODUCTION TO CNC **5**

Functions of a machine tool - Concept of numerical control - Historical Development - Evolution of CNC - Limitations of CNC - Features of CNC.

UNIT II CNC MACHINING **10**

Fundamentals of CNC milling& turning - Part programming techniques - examples - Linear interpolation- Circular interpolation- simulation.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Develop part programmes for given components.

REFERENCE BOOKS:

1. S K Sinha, “CNC Programming Using Fanuc”, The McGraw-Hill Companies, Inc,2010.
2. Ashok Kumar Singh, “CNC Programming”, Vayu Education of India; First edition (2015).
3. Hans B. Kief, Helmut A. Roschiwal, “CNC Handbook”, McGraw-Hill Education: New York, 2012.

19UME866	LIMITS, FITS AND TOLERANCES	L	T	P	C
		1	0	0	1

OBJECTIVES :

- To familiarize the fundamentals of Types of fits used, limits and tolerances of dimensions methods which are to be used in industrial drawing.

UNIT I LIMITS AND FITS 7

Limits –- Types of limits – Fits – Shaft and hole terminology – Clearance - Classifications of fits – System of Fits - Selection of fits – Methods of Indicating Fits on drawings - examples.

UNIT II TOLERANCES 8

Tolerances – Allowances – Unilateral and Bilateral tolerances – Methods of tolerances – Indication of tolerances on linear dimension of drawings –Indication of tolerances on angular dimension of drawings -Tolerance of form and position – Geometrical tolerances – Geometric characteristic symbols – Indication of Geometrical tolerances – Indication of Maximum material condition – Interpretation of Indication of Geometrical tolerances.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

1. Apply the different types of limits and fits various types of machine parts
2. Apply the tolerance for various types of machine parts.

REFERENCE BOOKS:

1. Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2003.
2. Sadhu singh, sah.P.L, “Fundamentals of machine drawing”, PHI learning private limited, 2013.

Estd : 1995

SETHU INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

VIRUDHUNAGAR

"A Gateway to Knowledge and success"