(DEEMED TO BE UNIVERSITY)

MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS

APPLICABLE FOR B.TECH. STUDENTS
ADMITTED IN A.Y. 2020-21

Course Structure										
Sl No	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**S**	**Cr**	**CH**	**Pre-requisite**
1	20UC1101	Integrated Professional English	HSS	0	0	4	0	2	4	Nil
2	20UC1202	English Proficiency	HSS	0	0	4	0	2	4	Nil
3	20UC2103	Professional Communication Skills	HSS	0	0	4	0	2	4	Nil
4	20UC2204	Corporate Communication Skills	HSS	0	0	4	0	2	4	Nil
5	20UC3005	Aptitude Builder	HSS	0	0	4	0	2	4	Nil
6		Foreign Language Elective	HSS	2	0	0	0	2	2	Nil
7	20UC0007	Indian Heritage and Culture	HSS	2	0	0	0	0	2	Nil
8	20UC0008	Indian Constitution	HSS	2	0	0	0	0	2	Nil
9	20UC0009	Ecology & Environment	HSS	2	0	0	0	0	2	Nil
10	20UC0010	Universal Human Values & Professional Ethics	HSS	2	0	0	0	0	2	Nil
11	20UC0011	Entrepreneurship	HSS	2	0	0	0	0	2	Nil
12	20MT1101	Mathematics for Computing	BS	2	2	0	2	4.5	6	Nil
13	20SC1102	Introduction to Design	BS	1	0	0	4	2	5	Nil
14	19MT2102	Mathematics for Engineers	BS	2	1	0	0	3	3	Nil
15	20PH1010	Science Elective - 1 (Mechanics)	BS	3	1	0	0	4	4	Nil
16	20SC1203	User centric Design Techniques	BS	1	0	0	4	2	5	Nil

17	20SC2104	Design Thinking and Innovation	BS	1	0	0	4	2	5	Nil
18	20PH2007	Science Elective - 2 (Materials for Mechanical Engineering Applications)	BS	3	0	2	0	4	5	Nil
19	19BT1001	Biology for Engineers	BS	2	0	0	0	2	2	Nil
20	20SC1101	Computational Thinking for Design	ES	3	0	2	6	5.5	11	Nil
21	20ME1103	Design Tools Workshop – I	ES	0	0	4	0	2	4	Nil
22	19SC1202	Data Structures	ES	3	0	2	3	4.75	8	20SC1101
23	19SC1209	Design Tools Workshop – II	ES	0	0	4	0	2	4	Nil
24	20ME1203	Computational Thinking and Data Sciences	ES	3	0	2	3	4.75	8	20SC1101
25	20ME1002	2D Modeling of Physical Systems using CAD tools	ES	1	0	2	0	2	3	Nil
26	20ME2104	3D Modeling and Physical Prototyping of Mechanical components	ES	0	0	4	0	2	4	20ME1002
27	20ME2209	Numerical Computation for Mechanical Engineers	ES	2	0	2	0	3	4	Nil
28	20EE2205	Circuits and Electronics	ES	3	0	2	0	4	5	Nil
29	20ME2105	Thermodynamics	ES	3	0	0	0	3	3	Nil
30	20ME2101	Mechanics of Solids	PC	3	0	2	0	4	5	20PH1010
31	20ME2106	Fluid Mechanics & Hydraulic Machines	PC	3	0	2	0	4	5	Nil
32	20ME2107	Manufacturing Techniques	PC	3	0	2	0	4	5	Nil
33	20ME2208	Mechanical Engineering Design	PC	3	0	2	4	5	9	20ME2101
34	20ME2210	Analysis of Thermal Systems	PC	3	1	0	4	5	8	20ME2105

35	20ME2211	Analysis of Mechanisms and Machines	PC	3	0	2	0	4	5	20PH1010
36	20ME2212	Engineering in the Physical World	PC	1	0	0	4	2	5	20ME2105
37	20ME3113	Machine Design & Innovation	PC	3	1	0	4	5	8	20ME2208
38	20ME3114	Industry 4.0 & Design of Cyber Physical Systems	PC	3	0	0	4	4	7	Nil
39	20ME3115	Heat Transfer	PC	3	0	2	0	4	5	Nil
40	20ME3216	Artificial Intelligence and Data Analytics	PC	3	0	2	0	4	5	Nil
41	PE-1	Professional Elective – 1	PE	2	0	2	0	3	4	-
42	PE-2	Professional Elective – 2	PE	2	0	2	0	3	4	-
43	PE-3	Professional Elective – 3	PE	2	0	2	0	3	4	-
44	PE-4	Professional Elective – 4	PE	2	0	2	0	3	4	-
45	PE-5	Professional Elective – 5	PE	2	0	2	0	3	4	-
46	FC-1	Flexi Core -1	FC	3	0	2	0	4	5	Nil
47	OE	Open Elective – 1	OE	3	0	0	0	3	3	Nil
48	OE	Open Elective – 2	OE	3	0	0	0	3	3	Nil
49	20MB4051	Open Elective - 3 (Modeling Business Systems)	OE	2	0	0	0	2	2	Nil
50	20MB4052	Open Elective - 4 (Entrepreneurship Essentials)	OE	2	0	0	0	2	2	Nil
51	20IE2050	Social internship	PR	0	0	0	8	2	8	Nil
52	20IE3050	Technical Internship	PR	0	0	0	8	2	8	Nil

53		Design Studio elective	PR	0	0	0	10	2.5	10	-
54	20IE3150	Mid Grad Capstone Project – I	PR	0	0	0	8	2	8	Nil
55	20IE3250	Mid Grad Capstone Project – II	PR	0	0	0	8	2	8	Nil
56	20IE4150	Capstone Project – I	PR	0	0	0	24	6	24	Nil
57	20IE4250	Capstone Project – II	PR	0	0	0	24	6	24	Nil
58	19IE4050	Practice School	PR	0	0	0	24	6	24	Nil
59	19IE4051	Internship	PR	0	0	0	24	6	24	Nil
60	20TS3101	Technical Proficiency - 1 / Entrepreneurial Incubation	PTA	0	0	0	12	3	12	Nil
61	20TS3202	Technical Proficiency - 2 / Technopreneurship	PTA	0	0	0	12	3	12	Nil
62	20TS4103	Technical Proficiency - 3 / Entrepreneural Skilling	PTA	0	0	0	12	0	12	Nil
63	20TS4204	Technical Proficiency - 4 / Entrepreneural Skilling	PTA	0	0	0	12	0	12	Nil
		Total Credits						**171**		

Program Articulation Matrix (Mapping of Courses with POs)

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	20UC1101	Integrated Professional English	HSS	0	0	4	0	2									1	1				
2	20UC1202	English Proficiency	HSS	0	0	4	0	2								1	1			2		
3	20UC2103	Professional Communication Skills	HSS	0	0	4	0	2		1			1							1		
4	20UC2204	Corporate Communication Skills	HSS	0	0	4	0	2		1			1							1		
5	20UC3005	Aptitude Builder	HSS	0	0	4	0	2		1			1							1		
6	20UC0007	Indian Heritage and Culture	HSS	2	0	0	0	0	1													
7	20UC0008	Indian Constitution	HSS	2	0	0	0	0												1		
8	20UC0009	Ecology & Environment	HSS	2	0	0	0	0						2						1		
9	20UC0010	Universal Human Values & Professional Ethics	HSS	2	0	0	0	0								2						
10	20UC0011	Entrepreneurship	HSS	2	0	0	0	0											2	2		
11	20MT1101	Mathematics for Computing	BS	2	2	0	2	4.5	2													
12	20SC1102	Introduction to design	BS	1	0	0	4	2			2						2					
13	19MT2102	Mathematics for Engineers	BS	2	1	0	0	3	2													

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
14	20PH1010	Science Elective-1 (Mechanics)	BS	3	1	0	0	4	2				2									
15	20SC1203	User centric Design Techniques	BS	1	0	0	4	2			2						2					
16	20SC2104	Design Thinking and Innovation	BS	1	0	0	4	2	1	2	3	2	2				3		2			
17	20PH2007	Science Elective - 2 (Materials for Mechanical Engineering Applications)	BS	3	0	2	0	4	1			1							1			
18	19BT1001	Biology for Engineers	BS	2	0	0	0	2						1	1							
19	20SC1101	Computational Thinking for Design	ES	3	0	2	6	5.5	2	2		2										
20	20ME1103	Design Tools Workshop –I	ES	0	0	4	0	2			2		2									
21	19SC1202	Data Structures	ES	3	0	2	3	4.75	2		2											
22	20ME1203	Computational Thinking and Data Sciences	ES	3	0	2	3	4.75	2	2												
23	19SC1209	Design Tools Workshop –II	ES	0	0	4	0	2			1	2	2									
24	20ME1002	2D Modeling of Physical Systems using CAD tools	ES	1	0	2	0	2		1	1	1	1								1	
25	20ME2104	3D Modeling and Physical Prototyping of Mechanical components	ES	0	0	4	0	2	2	2	2	2	2								2	2

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
26	20ME2209	Numerical Computation for Mechanical Engineers	ES	2	0	2	0	3	2													
27	20EE2205	Circuits and Electronics	ES	3	0	2	0	4	2				2									
28	20ME2105	Thermodynamics	ES	3	0	0	0	4	2	2		2										
29	20ME2101	Mechanics of Solids	PC	3	0	2	0	4		2	2										2	2
30	20ME2106	Fluid mechanics and Hydraulic machines	PC	3	0	2	0	4	2	2		2										
31	20ME2107	Manufacturing Techniques	PC	3	0	2	0	4	1	2	2										2	2
32	20ME2208	Mechanical Engineering Design	PC	3	0	2	4	5	1	2	1										2	1
33	20ME2210	Analysis of Thermal systems	PC	3	1	0	4	5	2	2		2										
34	20ME2211	Analysis of Mechanisms and Machines	PC	3	0	2	0	4		2	2	2										
35	20ME2212	Engineering in the physical world	PC	1	0	0	4	2		2												
36	20ME3113	Machine Design & Innovation	PC	3	1	0	4	5		2	2	2	3								2	3
37	20ME3114	Industry 4.0 & Design of Cyber Physical Systems	PC	3	0	0	4	4			2	2									2	
38	20ME3115	Heat transfer	PC	3	0	2	0	4	2												2	2
39	20ME3216	Artificial Intelligence and Data Analytics	PC	3	0	2	0	4	2				2									

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
40	20ME3221	Oops through Java	FC	3	0	2	0	4	1				2									
41	20ME3222	R Programming	FC	3	0	2	0	4	1				2									
42	20ME3223	Python Programming	FC	3	0	2	0	4	1				2									
43	20ME3224	Machine Learning	FC	3	0	2	0	4		1	2											
44	20ME4051	Theory of Elasticity and Plasticity	Engineering design	3	0	0	0	3	2	2												
45	20ME4052	Dynamics of Multi Body Systems		2	0	2	0	3	1	2											2	
46	20ME4053	Modeling Analysis and Design of Robotic Systems		2	0	2	0	3	2	2												
47	20ME4054	Creep, Fatigue and Fracture Mechanics		3	0	0	0	3		2		2										
48	20ME4055	Advanced Strength of Materials		2	0	2	0	3	2	2		2										
49	20ME4056	Mechanics of Composites		2	0	2	0	3	2													
50	20ME4057	Sustainable Design & Social Innovation in Engineering Design		1	0	4	0	3	1			3	2		2						3	3
51	20ME4061	Modern Manufacturing Processes	Smart manufacturing	2	0	2	0	3		1												
52	20ME4062	Additive Manufacturing		2	0	2	0	3		1												
53	20ME4063	Advanced Materials		3	0	0	0	3		1												

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
54	20ME4064	Flexible Manufacturing Systems		2	0	2	0	3		1		2										
55	20ME4065	Robotics & Industrial Automation		2	0	2	0	3			1											
56	20ME4066	Reverse Engineering		3	0	0	0	3	1		1											
57	20ME4067	Sustainable Design & Social Innovation in Smart Manufacturing		1	0	4	0	3	1			3	2		2						3	3
58	20ME4071	Automobile Engineering	Automobile Engineering	2	0	2	0	3		2												
59	20ME4072	Hybrid & Electric Vehicle Design		2	0	2	0	3	1			2										
60	20ME4073	Autotronics & Safety		2	0	2	0	3	1	1		2										
61	20ME4074	Robotics & Industrial Automation		2	0	2	0	3			1											
62	20ME4075	Automotive Electrical and Electronics System		2	0	2	0	3	1	1	1											
63	20ME4076	Automobile Engine System and Performance		2	0	2	0	3	2	2		1										
64	20ME4077	Sustainable Design & Social Innovation in Automobile Engineering		1	0	4	0	3	1			3	2		2						3	3
65	20ME4081	Autotronics	Autotronics	2	0	2	0	3	1	2	2	2										
66	20ME4082	Automotive Sensor and Applications		2	0	2	0	3	1		2	2										

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
67	20ME4083	Electronic Engine Management System		2	0	2	0	3	1		2	2										
68	20ME4084	Instrumentation in Automotive Industries		2	0	2	0	3	1		2	2										
69	20ME4085	Autotronics and Vehicle Intelligence		2	0	2	0	3	2	1			2									
70	20ME4086	Autonomous Vehicle Design		2	0	2	0	3	1	1												
71	20ME4087	Sustainable Design & Social Innovation in Autotronics		1	0	4	0	3	1			3	2		2						3	3
72	20ME4091	Design for Quality and Reliability	Product Design	3	0	0	0	3	1		1											
73	20ME4092	Design of Agricultural Products & Machinery		3	0	0	0	3			2				2							
74	20ME4093	Designing Intelligence Systems		3	0	0	0	3	1		1											
75	20ME4094	Sustainable Design		3	0	0	0	3	1		1											
76	20ME4095	Systems Thinking for Design		3	0	0	0	3	1		1											
77	20ME4096	Design with Advanced Engineering Materials		3	0	0	0	3	1		1											
78	20ME4097	Sustainable Design & Social Innovation in Product Design		1	0	4	0	3	1			3	2		2						3	3
79	20IE2050	Social internship	PR	0	0	0	8	2		2			2				2				2	2
80	20IE3050	Technical Internship	PR	0	0	0	8	2		2			2				2				2	2

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
81		Design Studio elective	PR	0	0	0	10	2.5		2			2				2				2	2
82	20IE3150	Mid Grad Capstone Project – I	PR	0	0	0	8	2		3		3									2	2
83	20IE3250	Mid Grad Capstone Project – II	PR	0	0	0	8	2		3			3				3				2	2
84	20IE4150	Capstone Project – I	PR	0	0	0	24	6		3			3				3				2	2
85	20IE4250	Capstone Project – II	PR	0	0	0	24	6		3			3				3				2	2
86	19IE4050	Practice School	PR	0	0	0	24	6		3			3				3				2	2
87	19IE4051	Internship	PR	0	0	0	24	6		3			3				3				2	2
88	20TS3101	Technical Proficiency - 1 / Entrepreneurial Incubation	PTA	0	0	0	12	3									2		2			
89	20TS3202	Technical Proficiency - 2 / Technopreneurship	PTA	0	0	0	12	3									2		2			
90	20TS4103	Technical Proficiency - 3 / Entrepreneural Skilling	PTA	0	0	0	12	0									2		2			
91	20TS4204	Technical Proficiency - 4 / Entrepreneural Skilling	PTA	0	0	0	12	0									2		2			
92	19ME40B4	Robotics	OE	3	0	0	0	3			2		2									
93	19ME40B5	Mechatronics	OE	3	0	0	0	3		2												

S. No	Course Code	Course Name	Category	L	T	P	S	Cr	PO												PSO	
									1	2	3	4	5	6	7	8	9	10	11	12	1	2
94	19ME40B6	Operations Research	OE	3	0	0	0	3					2									
95	19ME40B7	Hybrid Electric vehicles	OE	3	0	0	0	3	1			2										
96	19ME40B8	Industry 4.0	OE	3	0	0	0	3			1	1										
97	19ME40B9	Industrial Automation	OE	3	0	0	0	3			1											
98	19ME40C1	Logistics & Supply chain management	OE	3	0	0	0	3											1			
99	19ME40C2	Total Quality Management	OE	3	0	0	0	3											1			
100	19ME40C3	Smart Mobility	OE	3	0	0	0	3			1											
101	19ME40C4	Managerial Economics for Engineers	OE	3	0	0	0	3											1			

HUMANITIES AND SOCIAL SCIENCES

20UC1101 – INTEGRATED PROFESSIONAL ENGLISH

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the concepts of grammar to improve communication, reading, and writing skills	PO10	2
CO2	Demonstrate required knowledge over Dos and Don'ts of speaking in the corporate context. Demonstrate ability to face formal situations / interactions.	PO9	2
CO3	Understand the varieties of reading and comprehend the tone and style of the author. Skim and scan effectively and appreciate rhetorical devices	PO9	2
CO4	Apply the concepts of writing to draft corporate letters, emails, and memos	PO10	3

Course Objective:

- To express themselves in English with greater fluency, accuracy and confidence
- To communicate with others in practical, business-oriented situations
- To handle variety of business contexts, from negotiating, to using telephone, making presentation.

Syllabus:

COMPETENCY: 1

A)Basic Grammar - Countable and uncountable nouns, present simple and continuous, past simple and continuous – classroom practice – Understand and interpret Texts and work place situations B)Structural Pattern - Present continuous for future arrangements State verbs, Regular and irregular verbs, Voice, Modal verbs – Reporting on going tasks in the corporate world C)Descriptive and Qualitative Patterns: Adjectives and Adverbs classroom practice) Time Expressions, Comparatives and superlatives, Pronouns, Conditionals, Phrases and clauses (Including Relative)

COMPETENCY: 2

a) Formal contexts: Being a PA, describing changes in a company Taking orders over the phone
b) Listening & Speaking: Participate in conversation with proper contextual language markers and turn taking. Classroom practice - Presenting context, reason, problem – Case analysis (short).

c) Body Language: Dos and Don'ts of one to one interaction, Telephone interaction Video/ web conferencing. Culture specific practices.
d) Work Etiquette- situation, ambience, team skills, time management and leadership ability.

COMPETENCY: 3

a) Understand and assimilate main ideas and specific details. (250-300 words text of moderate difficulty)
b) Read for general understanding, interpreting, factual or specific information, for grammatical accuracy and information transfer.
c) Understand the general meaning of corporate context and office correspondence.
d) Understand short reports of predictable nature.

COMPETENCY: **4**

a) Internal Correspondence. Making notes on routine matters, such as, taking/ placing orders
b) Emails: Types of emails, salutations, vocabulary used in formal and informal (Including beginnings and endings)
c) Writing straight-forward, routine letters of factual nature

Reference Books:

1. Business Benchmark Book- Preliminary- 2nd edition Cambridge Press 2019.
2. Business Benchmark Book- Pre Intermediate to Intermediate- 2nd edition Cambridge Press 2019

Web Links:

1. https://www.cambridgeenglish.org/
2. https://learnenglish.britishcouncil.org,https://apps.apple.com/in/app/bec-from-cambridge/id1351207688https://play.google.com/store/apps/details?id=com.liqvid.bec

20UC1202 – ENGLISH PROFICIENCY

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Demonstrating different interpersonal skills for employability	PO 8	2
CO2	Distinguishing business essential skills	PO9	2
CO3	Classifying social media and corporate communication skills	PO 12	2
CO4	Applying analytical thinking skills	PO 12	3

Course Objective:

- To communicate with others in practical, business-oriented situations
- To express themselves in English with greater fluency, accuracy, and confidence
- To handle themselves in English in a variety of business contexts, from negotiating, to using the telephone, to making presentations, to socializing

Syllabus:

COMPETENCY 1:
Job description- Advice on job applications – getting the right job- importance of doing a job interview -Launching and promoting a new product-Persuasive and negotiation skills -Types of emails: giving information, making an enquiry, answering enquiries -Marketing Report

COMPETENCY 2:
Becoming an entrepreneur- buying a franchise- franchising start -up -presenting business idea-signaling parts of presentation - arranging business travel- business conferences and meetings-spending sales budget

COMPETENCY 3:
Social media and business- introducing company using social media- staff survey- survey report-off-shoring and outsourcing- customer satisfaction and loyalty- communication with customers-corresponding with customers- business across cultures

COMPETENCY 4:
Underlying assumptions, finding the conclusions, Argument strengthening, Argument weakening, finding the fallacies

Reference Books:

1. Business Benchmark Book- Upper Intermediate - 2nd edition Cambridge Press 2019.
2. Business Benchmark Book- Pre-Intermediate to Intermediate- 2nd edition Cambridge Press 2019.
3. Business Benchmark Book-Upper Intermediate: 2nd Edition Cambridge Press, 2019
4. Pillai, Sabina, et.al, Soft Skills and Employability Skills, New Delhi: CUP. 2018. Print.
5. Peterson, Reading Skill, New York: Peterson. 2007
6. Verbal and Non-Verbal Reasoning, R. S. Aggarwal, S Chand Publications.

7. R S Agarwal, S Chand, 'A modern approach to Logical reasoning'
8. GRE Barron's, Mc Graw Hills
9. Logical Reasoning, Edgar Thorpe, Pearson Publications

Web Links:

1. https://www.cambridgeenglish.org/
2. https://learnenglish.britishcouncil.org,
3. https://apps.apple.com/in/app/bec-from-cambridge/id1351207688
4. https://play.google.com/store/apps/details?id=com.liqvid.bec
5. https://www.cambridgeenglish.org/exams-and-tests/business-preliminary/exam-format/
6. https://www.cambridgeenglish.org/exams-and-tests/business-preliminary/preparation/
7. www.bbclearningenglish.com
8. www.indiabix.com
9. www.freshersworld.com
10. www.managementparadise.com
11. www.coolavenues.com
12. www.indiaedu.com/entrance-exams/cat.../books.html
13. www.mycatprep.com

20UC2103 – PROFESSIONAL COMMUNICATION SKILLS

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Developing critical and analytical reading skills	PO12	2
CO2	Discovering different interpersonal skills to develop people skills	PO12	2
CO3	To enhance the problem-solving skills of the students through the concepts of Simple Equations, Ratio, Proportion &Variation, Percentages, Profit & Loss, Averages, Allegations, Simple & Compound Interest.	PO5	2
CO4	Apply diagrammatic representation of the given data to find the possible outcomes in the topics of Deductions, Cubes, Venn Diagrams and Arrangements	PO2	2

Course Objective:

- To develop comprehending skills
- To discover core thinking skills for problem solving
- To interpret logical thinking skills for better thinking ability

Syllabus:

COMPETENCY-1: Verbal Ability

- Reading for Gist & Summarizing
- Reading for Information & Inference
- Critical Reading
- Analytical Reading
- Logical Reading

COMPETENCY-2: Critical Thinking Skills

- Core Thinking Skills
- Categories of Thinking
- Problem Solving
- Decision Making

COMPETENCY -3: Quantitative Aptitude:

- Simple Equations, Ratio
- Proportion &Variation
- Percentages
- Profit & Loss

- Averages
- Alligations
- Simple & Compound Interest

COMPETENCY -4: Reasoning

- Deductions
- Cubes
- Venn Diagrams
- Linear arrangements
- Circular arrangements
- Ordering and Sequencing
- Selections

Reference Books:

1. Soft Skills by Dr. Alex S CHAND Publications
2. Objective English by Showarick Thrope, Pearson
3. Quantitative Aptitude by R S Agarwal, S CHAND Publications.
4. Quantitative Aptitude by Abhijit Guha, Mc Graw Hills.
5. Verbal and Non-Verbal Reasoning, R. S. Aggarwal, Schand Publications.
6. R S Agarwal, S.Chand , 'A modern approach to Logical reasoning' GL Barrons, McGraw Hills

Web References / MOOCs:

1. Online resource: cssklu.bolgspot.com
2. www.indiabix.com
3. www.freshersworld.com
4. www.managementparadise.com
5. www.coolavenues.com
6. www.indiaedu.com/entrance-exams/cat.../books.html
7. www.mycatprep.com

20UC2204 – CORPORATE COMMUNICATION SKILLS

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To distinguish product and process and quote them in speaking and writing activities	PO12	2
CO2	To apply interpersonal skills	PO12	2
CO3	To enhance the problem-solving skills of the students through the concepts of Numbers, Time & Work, Time & Distance, Permutations & Combinations, Probability which will enable them to improve their problem solving abilities which in turn improve their programming skills.	PO 5	2
CO4	To apply known facts to find the unknowns in the topics Clocks, Calendars, Binary Logic. Identify the rule set by analyzing the given observations in the topics Series, Analogy, Odd Man, Coding-Decoding	PO2	2

Course Objective:

- To demonstrate speaking, and writing skills
- To apply interpersonal skills
- To develop logical thinking skills for better thinking ability

Syllabus:

COMPETENCY-1: Verbal Ability

Speaking from the script, Product & Process Description, Presenting Arguments, Paragraph writing.

COMPETENCY-2: Soft Skills

Goal Setting, Team Building, Leadership, Time Management, Managing Stress

COMPETENCY -3: Quantitative Aptitude:

Numbers, Time & Work, Time & Distance, Permutations & Combinations, Probability

COMPETENCY -4: Reasoning

Clocks, Calendars, Binary logic, Number and letter series, Number and letter analogy, Finding the odd man, Coding-Decoding, Direction sense

Reference Books:

1. Soft Skills by Dr. Alex S CHAND Publications
2. Objective English by Showarick Thrope, Pearson
3. Quantitative Aptitude by R S Agarwal, S CHAND Publications.
4. Quantitative Aptitude by Abhijit Guha, Mc Graw Hills.

5. Verbal and Non-Verbal Reasoning, R. S. Aggarwal, Schand Publications.
6. R S Agarwal, S.Chand , 'A modern approach to Logical reasoning' GL Barrons, McGraw Hills.

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3. www.freshersworld.com
4. www.managementparadise.com
5. www.coolavenues.com
6. www.indiaedu.com/entrance-exams/cat.../books.html
7. www.mycatprep.com

20UC3005 – APTITUDE BUILDER

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To discuss and interpret English language skills necessary for placements	PO12	2
CO2	To demonstrate skills to get selected in interviews and retain job	PO12	2
CO3	To enhance the problem-solving skills of the students through the concepts of Mensuration, Quadratic Equations & Inequalities, Progressions, Logarithms, Data Interpretation, Data Sufficiency which will enable them to improve their problem-solving abilities which in turn improve their programming skills.	PO5	2
CO4	To apply deductive logic to solve questions in Connectives, Blood relations, Ranking and time sequence, Symbols and notations. Apply principles of reflection and rotation to solve picture puzzles.	PO2	2

Course Objective:

- To identify different components of verbal ability and interview skills
- To apply the skills acquired in the placement tests to succeed.
- To develop logical reasoning for better thinking ability

Syllabus:

COMPETENCY-1:

a) Verbal Ability: Sentence Completion, Idioms & Phrases, One Word Substitutes, Sentence Improvement, Sentence Equivalence, Analogies

b) Life Skills: Attitude for Success, Connecting with People, Employment Communication (CV & Interview), Workplace Etiquette

COMPETENCY-2:

a) Attitude for Success: Stimulus and Response, Choosing the Response, Determinisms, Changing the attitude for success, Proactive and reactive Attitude

b) Connecting with People: Empathy, Assertiveness, Saying what you want to say, Saying what you do not want to say – saying 'No'

COMPETENCY-3: Quantitative Aptitude

Mensuration, Quadratic Equations & Inequalities, Progressions, Logarithms, Data Interpretation, Data Sufficiency

COMPETENCY-4: Reasoning

Connectives, Blood relations, Ranking and time sequence, Symbols and notations, Non-verbal reasoning (Picture puzzles), Data sufficiency

Reference Books:

1. Soft Skills by Dr. Alex S CHAND Publications
2. Objective English by Showarick Thrope, Pearson
3. Quantitative Aptitude by R S Agarwal, S CHAND Publications.
4. Quantitative Aptitude by Abhijit Guha, Mc Graw Hills.
5. Verbal and Non-Verbal Reasoning, R. S. Aggarwal, Schand Publications.
6. R S Agarwal, S.Chand , 'A modern approach to Logical reasoning' GL Barrons, McGraw Hills.

Web References / MOOCs:

1. Online resource: cssklu.bolgspot.com
2. www.indiabix.com
3. www.freshersworld.com
4. www.managementparadise.com
5. www.coolavenues.com
6. www.indiaedu.com/entrance-exams/cat.../books.html
7. www.mycatprep.com

20UC0007 – INDIAN HERITAGE AND CULTURE

L-T-P-S : 2-0-0-0
Credits : NIL
Contact Hours : 2
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To familiarize with various aspects of the culture and heritage of India through ages.	PO1	1
CO2	To acquaint with the contributions of Indians in the areas of languages and literature, religion and philosophy	PO1	1
CO3	To understand the Social structure and the spread of Indian culture abroad	PO1	1
CO4	To know the development of Science and Technology in India through ages and to appreciate the contributions of some of the great Indian scientists	PO1	1

Syllabus:

Introduction-Concept of Culture-Culture and Civilization-General Characteristics of Indian Culture-Importance of Culture-Unity in Diversity

History and Culture through the Ages – Fundamental Unity of Harappan and Vedic Culture – Jainism and Buddhism-Mauryan Period-Post-Mauryan Period-Gupta Period-Pallavas and Cholas

Advent of Islam in India-Islam and Sufism-Islamic Art and Architecture-Bhakti Movement-Vijayanagar Period-Art and Architecture and Literature

Rise of the West and its impact on India-Social and Religious reformers in the 18^{th} and 19^{th} centuries-Press and growth of modern Indian literature-Rise of Indian Cinema-Indian Independence

Reference Books:

1. Facets of Indian Culture- Spectrum Publications
2. Ancient India: National Council of Educational Research and Training
3. Medieval India: Part I & Part II: National Council of Educational Research and Training.
4. Modern India: National Council of Educational Research and Training.
5. An Advance History of India: R.C. Majumdar, H.C. Raychaudhuri&KalikinkarDatt: Macmillan India Ltd.
6. The Wonder that was India : A.L.Bhasham

20UC0008 – INDIAN CONSTITUTION

L-T-P-S : 2-0-0-0
Credits : NIL
Contact Hours : 2
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To understand Constitutional development after Independence	PO12	2
CO2	To learn the fundamental features of the Indian Constitution	PO12	2
CO3	To get a brief idea of the powers and functions of Union and State Governments	PO12	2
CO4	To understand the basics of working of Indian Judiciary and the Election Commission	PO12	2

Syllabus:

Making of the Constitution: A brief analysis of National Movement. Constitutional development with reference to Government of India Act-1909,1919,1935 and Indian Independence Act-1947. The Constituent Assembly of India.

Basic features of the Indian Constitution: the Preamble, Fundamental Rights, Directive Principles of State Policy – Fundamental Duties

Government of the Union : The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions, The Union legislature – The Parliament – The LokSabha and the RajyaSabha, Composition, powers and functions – the role of the Speaker.

Government of the State: The Governor – the Council of Ministers and the Chief Minister – Powers and Functions, The State Legislature – composition, powers and functions.

The Indian Judicial System: the Supreme Court and the High Courts – composition, Jurisdiction and functions, Judicial review, Judicial activism, Independence of Judiciary In India.

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners.

Reference Books:

1. Indian Polity' by Laxmikanth
2. Indian Administration' by SubhashKashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti
5. 'Constitutional Law of India' by Seervai H.M.

20UC0009 – ECOLOGY AND ENVIRONMENT

L-T-P-S : 2-0-0-0
Credits : NIL
Contact Hours : 2
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the importance of Environmental education and conservation of natural resources.	PO6	1
CO2	Understand the importance of ecosystems and biodiversity.	PO12	1
CO3	Apply the environmental science knowledge on solid waste management, disaster management and EIA process.	PO6	3
CO4	Understand the importance of Environmental education and conservation of natural resources.	PO6	1

Syllabus:

The Multidisciplinary nature of Environmental Studies, Natural Resources, Forest resources, Mining and its impact on environment

Water resources, Mineral resources, Energy resources, Land resources, Soil erosion, Ecosystems, Biodiversity and its ConservationEnvironnemental Pollution

Soil waste management, Electronic waste management, biomedical waste management

Disaster management, Environmental Legislation Environmental Impact Assessment Process.

Text Books:

1. AnubhaKaushik, C.P.Kaushik, “Environmental Studies”, New Age International, (2007).
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill companies, New Delhi, (2009).

20UC0010 – UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS

L-T-P-S : 2-0-0-0
Credits : 2
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand and identify the basic aspiration of human beings	PO8	2
CO2	Envisage the roadmap to fulfill the basic aspiration of human beings.	PO8	4
CO3	Analyze the profession and his role in this existence.	PO8	4

Syllabus:

Introduction to Value Education: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - The Basic Human Aspirations, Right Understanding, Relationship and Physical Facilities, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations.

Harmony in the Human Being: Understanding the Human Being as Co-existence of Self ('I') and Body, Discriminating between the Needs of the Self and the Body, The Body as an Instrument of 'I', Understand Harmony in the Self ('I'), Harmony of the Self ('I') with the Body, Program to Ensure Sanyam and Svasthya.

Harmony in the Family and Society: Harmony in the Family - the Basic Unit of Human Interaction, Values in Human-to-Human Relationships, 'Trust' – the Foundational Value in Relationships, 'Respect' – as the Right Evaluation, Understand Harmony in the Society, Vision for the Universal Human Order.

Harmony in the Nature (Existence): Understand Harmony in the Nature, Interconnectedness, Self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing 'Existence is Co-existence' at All Levels, The Holistic Perception of Harmony in Existence.

Implications of the Right Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models - Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Text Books:

1. R R Gaur, R Sangal and G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excel Books.

20UC0011 – ENTREPRENEURSHIP

L-T-P-S : 2-0-0-0
Credits : 2
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Analyze the business environment in order to identify business opportunities,	PO11, PO12	4
CO2	Identify the elements of success of entrepreneurial ventures	PO11, PO12	2
CO3	Consider the legal and financial conditions for starting a business venture	PO11, PO12	2
CO4	Evaluate the effectiveness of different entrepreneurial strategies	PO11, PO12	4

Syllabus:

Conceptual definition of entrepreneurs and entrepreneurship, Entrepreneurship in economic theory, Historical development of entrepreneurship, Entrepreneurial practice, The importance of small business, Entrepreneurial economy, Entrepreneurship and Economic Development, Type of Entrepreneurship, Entrepreneur and small business, Features and types of businesses and entrepreneurs, Sources of business ideas, The role of entrepreneurship in economic development, Terms of entrepreneurship, Innovation and entrepreneurship, Entrepreneurship and small business, The life cycle of a small company, Small business sector in Croatia, Forms of entrepreneurial organization, Sources of capital, Entrepreneurial process, Entrepreneurial strategies. Starting a new company, Buying an existing business, Franchising, Family business. Entrepreneurial project: an entrepreneurial venture and entrepreneurial development chain.

Text Books:

1. “How to think like an Entrepreneur” by Philip Delves Broughton
2. “Teaching Entrepreneurship: A Practice-Based Approach” by Heidi M. Neck

BASIC SCIENCES

20MT1101 –MATHEMATICS FOR COMPUTING

L-T-P-S : 2-2-0-2
Credits : 4.5
Contact hours : 6
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Model a system of equations for real world applications in engineering, physical and biological sciences, computer science, finance, economics and solve them through matrix algebra	PO1	3
CO2	Model basic and computational techniques on discrete structures like relations, orders, functions & FSM, Lattices, and propositional &predicate logic	PO1	3
CO3	Model real world structures and their related applications using advanced discrete structures like graphs and trees.	PO1	3
CO4	Model the given Statistical data for real world applications in Engineering science, Economics and Management.	PO1	3
CO5	Demonstrate the Aptitude and Reasoning skills (Tests in skilling hours)	PO1	2

Syllabus:

Linear Algebra:
Matrix Algebra: Introduction, Types of Matrices, Rank of matrix, Solutions of linear, Equations by Gauss elimination and Gauss Seidel methods, Eigen values, Eigen vectors. Quadratic forms

Introduction to Discrete Structures & Discrete Computation:
Relations: Closures of relations. Orders, Equivalence Relations, Functions, Finite-State Machines

Lattices: Partial order relation, Hesse Diagrams, Properties of Lattices and applications.

Logic and Proofs: Propositional Logic, Rules of Inferences, Applications of Propositional, Propositional Equivalences, Predicates and Quantifiers, Predicate logic, Consequences, Introduction to proofs, Proof methods and strategy.

Counting Techniques: Permutations and Combinations Fibonacci series, Divide-and-Conquer Algorithms, Recursive definitions, Generating Functions. Solving Linear Recurrence Relations.

Advanced Discrete Structures & Computation:
Graphs & Trees: Terminology, Types of Graphs, Bipartite graphs, Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path, Planar Graphs, Trees, Tree Traversal Applications of trees, spanning trees and Minimal spanning trees

Modeling Statistical data for real world applications:
Axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Correlation, Regression and Curve fitting.

Skilling: {Tests in skilling hours}

Arithmetic:

Foundations in Arithmetic: Numbers, Ratio, Proportion, Variation, Averages, Percentages, Profit & loss, Time & Distance, Time & Work.

Applications of Number theory: Fermat's theorem, Euclidean Algorithm. Geometry: Lines, Triangles, Quadrilaterals, Polygons, Practical applications of common solids, irregular solids and their application in various engineering problems.

Logic & Reasoning:

Sets and Venn diagrams Deductions, Logical Connectives, Linear and circular arrangements. Clocks, Calendars, Blood Relations, Cubes, Number and letter series,

Coding and Decoding, Symbolic representations of given data, Binary Logic, Non-Verbal reasoning.

Textbooks:

1. John Bird, Basic Engineering Mathematics**,** Sixth edition, Taylor & Francis Ltd., 2017, UK.
2. Kenneth H Rosen, Discrete Mathematics and its Applications, Seventh edition, McGraw Hill, 2007, USA.
3. Linear Algebra and Its Applications, Gilbert Strang, Fourth Edition

Reference Books:

1. Advanced Engineering Mathematics 10th Edition, Erwin Kreyszig
2. R.E. Walpole, R.H. Myers, S.L. Myes, Keying Ye, Probability and Statistics for engineers and scientist, Ninth edition, Pearson publications, 2012, USA.
3. Mott, J.L., Kandel, A. and Baker, T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Second edition, Prentice Hall India Pvt Ltd, 1986, India.
4. Tremblay J P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", First edition, Tata McGraw Hill, 1975, India.
5. R. S. Agarwal, A Modern Approach to Verbal and Non-verbal Reasoning, S Chand Publications, 2018, New Delhi, India.

20SC1102-INTRODUCTION TO DESIGN

L-T-P-S : 1-0-0-4
Credits : 2
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Be able to understand elements and principles of design	PO3, PO9	2
CO2	Able to grasp stage model of action cycle	PO3, PO9	3
CO3	Be able to understand design laws and their importance in design field	PO3, PO9	2
CO4	To comprehend various rules of composition of design	PO3, PO9	3
CO5	To gain hands-on experience of fundamentals of design	PO3, PO9	4

Course Objectives:

- To gain the conceptual understanding of key concepts of Design.
- To understand the elements and principles of Design.
- To understand Design laws and their importance in design field.
- To comprehend various rules of composition of design

Syllabus:

Unit 1: What is Design? (6 Hours)

- Definition and key concepts – Difference between Art and Design
- Misconceptions or myths related to Design as a subject
- Broad scope of Design and related disciplines reflecting multidisciplinary characteristic of Design –Emotional Design, Positive Design, Service Design, Digital Design, UI/UX Design, Product Design, Space Design
- Evolution of Design

Unit 2: Elements and Principles of Design (6 hours)

- Color and its theories, shape and form, types of lines, texture, movement
- Unity, harmony, Contrast, balance, emphasis, Proportion, Hierarchy, Rhythm, Pattern
- 7 stage model of action cycle by Don Norman

Unit 3: Design Laws (9 hours)

- Gestalt's psychology and principles – Proximity, Similarity, continuity, closure
- Aesthetic usability effect, Doherty Threshold, Fitts Law, Hick's law, Jakob's Law, Law of common region, Law of Pragnanz, Law of uniform connectedness, Miller's Law, Occam's Razor, Parkinson's law, Peak end rule, Postel's Law, Serial Position effect, Tesler's Law, Von Restorff effect, Zeigarnik Effect
- What is a good Design and bad design, Best practices of Good Design with examples

Unit 4: Designing for people (9 hours)

- Understanding human psychology and behavior
- Difference between human centric and user Centric Design with the help of case studies

Unit 5: Minor Project (30 Hours)

- Project – Pick any problem, small or big and apply fundamentals and laws of design and come up with possible five solutions.

Reference Books:

1. A Designer's Art – Paul Rand
2. Universal principles of Design - William Lidwell, Kritina Holden, Jill Butler
3. Design of Everyday life – Don Norman
4. Universal methods of design – Brus hanignton
5. Hundred things every designer needs to know about people – Susan Weins Chenk

19MT2102 – MATHEMATICS FOR ENGINEERS

Course code : 19MT2102
L-T-P-S : 2-1-0-0
Credits : 2
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply differential and integral calculus to find maxima & minima of functions, evaluate the integrals and solve the differential equations.	PO1	3
CO2	Demonstrate the Fourier series and Laplace transforms.	PO1	2
CO3	Describe probability, Random Variables	PO1	2
CO4	Explain complex variables, analytic functions and introduction to stochastic process and Algebraic structures.	PO1	2

Syllabus:

***(A) Calculus*:**
(a) Differential and Integral Calculus: Taylor's series for function of two variables, Maxima and Minima for functions of two variables, Evaluation of double and triple integrals, Change of order of Integration, Change of Variables, in polar, cylindrical and spherical coordinates.
(b) Vector Calculus: Scalar and vector point functions, Gradient, Directional Derivative, Divergence and Curl, Evaluation of line integrals , Introduction to Greens and Stoke's theorems and their applications.
(c) Ordinary Differential Equations: Solution of first order equations and their applications, Newton law of cooling, Growth and Decay, Solution of second and higher order Differential Equations.
(d) Partial Differential Equations: Formation of PDE, Solution of first order linear equations – Lagrange's method, solution of second order PDE by separation of variables. Laplace's equation in two dimensions.

(B)Introduction to Advanced Matrix Algebra: Decomposition, Complex Matrices

(C) Laplace Transforms: Laplace and Inverse Laplace transforms and their properties.

(D) Fourier Series: Definition, Dirchelt conditions, Fourier series for simple functions.

(E) Complex Variables: Complex functions- Exponential, Logarithmic and Trigonometric functions, Analytic function, Cauchy - Riemann equations, Introduction to Milne Thomson method .

(F) Probability and Random Variables: Probability , Addition, Multiplication and Baye's theorems. Random variables, Probability Distributions – Binomial, Poisson and Gaussian distributions, Introduction to Markov process.

(G) Algebraic Structures: Introduction to Structure of Algebras, Semi groups, Monoids and Groups, Homomorphism's, Normal subgroups and congruence Relations, Rings**.**

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Willey & Sons, 10th edition, 2010, New Delhi, India.

Reference Books:

1. R.E.Walpole, R.H.Myers, S.L.Myes, Keying Ye, Probability and Statistics for Engineers
   and Scientists, , Pearson's Publications , 9th edition, 2012, USA.
2. Mott, J.L., Kandel, A. and Baker, T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India Private Ltd, 1986, India.
3. Tremblay J P and Manohar R, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill publishers, 1st edition, 2001, India.

20PH1010 – MECHANICS

L-T-P-S : 3-1-0
Credits : 4
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the concept of forces, governing static equations and analyze planer system of forces.	PO1	3
CO2	Use analytical techniques for analyzing forces in statically determinate structures.	PO1	4
CO3	Understanding the concepts of planar and non-planar system of parallel forces and analyzing them. Estimate moment of inertia of lamina and material bodies	PO5	3
CO4	Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems	PO5	4

Course Objective:

- To give students practice in applying their knowledge of mathematics, science, and engineering and to expand this knowledge into the vast area of "rigid body Mechanics".
- To enhance students' ability to design by requiring the solution of open-ended problems.
- To prepare the students for higher level courses such as courses in Mechanics of Solids, Mechanical Design / Structural Analysis.

Syllabus:

Two-Dimensional Force Systems: Introduction, Basic concepts, Laws of motion, Principle of Transmissibility of forces, Resultant of a force system, force laws, Resultant of two dimensional concurrent and Non-Concurrent Force systems, Free body diagrams, Applications**.**Equilibrium of Rigid bodies– Equilibrium and Equations of Equilibrium, Lame's theorem, Type of supports and their reactions, Moments and couples, Varignon's theorem, Resultant moment and applications.

Spacial Force System & Trusses: Spatial force systems – Forces in space, resultant and equilibrium of spatial force system**.**Truss Analysis-Trusses -Assumptions involved in the Method of joints and sections.

Friction and Properties of Areas: Friction**:** Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Applications-ladder friction, wedge friction. **Centriod and Moment of Inertia:** Centroids, center of gravity, Moment of inertia - Area and Mass- polar moment of inertia, Parallel axis theorem**.**

Kinematics of Rigid Body: Introduction, Plane Motion of Rigid Body, Velocity and Acceleration under Translation and Rotational motion**.**

Kinetics of Rigid Body: Introduction, Force, Mass and Acceleration, Work and Energy, Impulse and Momentum, D-Alembert's Principles and Dynamic Equilibrium.

Text books:

1. Engineering Mechanics-Statics and Dynamics by R. C. Hibbler / Pearson
2. Engineering Mechanics (in SI Units) / S. Timoshenko, D. H. Young, J.V. Rao/ Tata McGraw Hill.
3. Vector Mechanics for Engineers -Statics &Dynamics / F.P. Beer and E.R. Johnston/ Tata McGraw Hill. (http://kisi.deu.edu.tr//mehmet.cevik/Dynamics/Slides/CHAP11_Kinematics_of_particles.pdf)
4. Engineering Mechanics staticsand Dynamics /MeriamandKraige

Reference books:

1. Engineering Mechanics / S. S. Bhavikatti/ New Age.
2. Engineering Mechanics- NH Dubey/ Tata McGrawHill.

20SC1203 - USER CENTRIC DESIGN TECHNIQUES

L-T-P-S : 1-0-0-4
Credits : 2
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the different roles and responsibilities in phases of User centered Design	PO3, PO9	2
CO2	Identify user pain points and opportunity areas through empathy and collaborative design	PO3, PO9	2
CO3	To be able to design a better User Experience using UCD and 6D process	PO3, PO9	4

Course Objectives:

1. To understand the concept of User-centric design as a method of problem solving
2. To understand and practically apply principles, methodologies and tool of User Centric Design
3. To understand the importance of UCD in User Experience Design

Syllabus:

Unit 1: Introduction to User Centered Design (3 Hours)

- What is User Centered Design?
- History of User Centered Design
- User Centered Design and Human Centered Design, Good and Bad design
- Importance and principles of User Centered Design
- Concept of Discoverability and Understanding, 7 stages of action
- Empathy and Collaborative design as a powerful tool for effective User Experience

Unit 2: User centered Design for UX (9 hours)

- Introduction to 4 stage iterative process of UCD- Understanding user context, Identifying user needs, Design phase, Evaluation phase
- Process of UX Design by Interaction Design Foundation
- Introduction to Imagin6D UX framework- Discover, Define, Dream, Design, Develop, Deliver
- Elements of UX/UI Design- 5S model by Jesse James Garrett

Unit 3: Tools and techniques (12 Hours)

- Investigative methods and tools- User Research, interviews, surveys, focused group discussions etc…
- Analytical tools and methods- affinity mapping, Persona Maps, Empathy maps, Experience journey maps etc.,

- Ideation and Design techniques- Brainstorming, mind mapping, Rapid ideation, Information architecture and task flows, Wireframes etc…
- Heuristic evaluation for digital evaluation

Unit 4: Visual Design Tools for Design (18 Hours)

- Adobe Illustrator and Photoshop- for illustrations, Wireframes and Visual/graphic Design
- Introduction to Adobe XD- Creating wireframes
- Azure UX- wire framing and Prototyping tool

Unit 5: Minor Project (18 Hours)

- Minor Project on a real-time design challenges and design efficient solutions through User centered and User Experience Design

Reference Books:

1. The Design of everyday things - Don Norman
2. The Elements of user experience - Jesse James Garrett
3. 100 things every designer need to know about -Susan Weinschenk
4. Designing for Digital Age: How to create human-centered products and services - Kim Goodwin
5. Sketching the User experiences - Bill Buxton

20SC2104 - DESIGN THINKING AND INNOVATION

L-T-P-S : 1-0-0-4
Credits : 2
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the basics of design thinking and its implications in product or service development	PO1	2
CO2	Understand and Analyze the requirements of a typical problem	PO2	4
CO3	Plan the necessary activities towards solving the problem through ideation and prototyping	PO4, PO5, PO11	4
CO4	evaluate the solution and refine them based on the customer feedback	PO3, PO9	5

Syllabus:

Overview of Design Thinking: Define Design Thinking, Differentiate Design Thinking from Design, Get an Overview of the Design Thinking Process.
Empathize and Understand: Explain how empathy influences the outcomes of Design Thinking, List Different Empathy Research Techniques, Define the Guidelines for an Empathetic Research,
Defining Needs: Explain how PoV can be used in defining the design problem, Use a structured approach to arrive at a PoV,
Ideation for Solutions: List the best practices for conducting a successful ideating session, Describe the techniques for evaluating and prioritizing ideas, **Prototyping**: Define prototyping, Explain how prototyping aids in communicating ideas effectively, List various tools for prototyping,
Testing the Solution: Define the steps of a successful testing approach, Demonstrate the process of gathering and responding to user feedback.

Text Books:

1. Design Thinking for Innovation: Research and Practice – Walter Brenner and Falk Uebernickel
2. Different Thinking: Creative Strategies for developing the innovative business 01 – Peter Kreuz and Anja Foerster
3. Design Thinking: Integrating Innovation, Customer Experience and Brand Value – Thomas Lockwood
4. Building Smart Cities: Analytics, ICT, and Design Thinking – Carol L. Stimmel

Reference Books:

1. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems

20PH2007 - MATERIALS FOR MECHANICAL ENGINEERING APPLICATIONS

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand crystal structures and also to find lattice parameters using different XRD techniques	PO1, PO4, PO11	2
CO2	Understand different heat treatment processes and also understand the properties of smart materials	PO1, PO4, PO11	2
CO3	Understand different types of semiconducting materials and ceramic materials	PO1, PO4, PO11	2
CO4	Understand different types of composite materials and nano materials and its applications	PO1, PO4, PO11	2

Syllabus:

Crystallography: Potential energy vs Inter atomic distance, difference between crystalline and amorphous materials, basic definitions, seven crystal system, bravais lattice, Inter planar spacing and problems, production and characteristics of X-rays, Bragg's law and problems, different XRD Techniques -transmission and back reflection methods using by Laue XRD technique, rotating crystal method, calculation of lattice parameters by Powder XRD method,

Heat treatments: Constitutions of alloys, cooling curves: pure metal, solid solution, electric system electric alloy. Phase diagrams and classifications, Iron Carbon Cycle, Introduction of heat treatments, definitions and Steps involved in Heat treatments and its significance, *conventional heat treatments:* annealing, normalizing, hardening, tempering. *Special heat treatments:* superfast heat treatments - flame hardening and induction hardening, case hardening methods - carburizing, nitriding, cyaniding, and carbonitriding.

Smart Materials: Introduction, shape memory effect, classification of shape memory alloys, compositions, properties applications of shape memory alloys.

Semiconducting Materials: Classification of semiconducting materials**,** bond and energy band diagrams for intrinsic and extrinsic semiconductors, role of temperature and doping effect on conductivity, influence of temperature on mobility, factors effecting on carrier concentration, conductivity mechanism, applications.

Ceramics: Introduction, classification, electrical and thermal conductivity, abrasive and refractory materials, applications.

Composites: Introduction, classification, polymer matrix composites, metal matrix composites, ceramics matrix composites, carbon-carbon composites, fiber-reinforced composites and natural and made composites, applications.

Nano materials: Introduction, properties at nano scale, advantages and disadvantages, application s of bulk materials (nano structure, nano wires, nano tubes and nano composites), preparation of nano materials and different methods, applications.

Text books:

1. Daniel. C., Yesudian, Harris. D.G., Samuel, Materials science and engineering, Willey India, ISBN-10: 8188429449.
2. Bandyopadyay. A. K. , Nano Materials, New Age Publishers, ISBN-10: 1906574278.
3. Callister William D., Material Science and Engineering - An Intoduction,. 6th edition, 2007, Wiley India Pvt.Ltd, ISBN-13: 978-0470556733.
4. Kodgire. V. D., Material Science and Metallurgy, ISBN-10: 8186314008.

19BT1001 – BIOLOGY FOR ENGINEERS

L-T-P-S : 2-0-0-0
Credits : 2
Contact Hours : 2
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Acquire the Knowledge of basic biology	PO6, PO7	2
CO2	Acquire the Knowledge of Human Biological Systems	PO6, PO7	2
CO3	Acquire Knowledge on Microorganisms and Biosensors	PO6, PO7	2

Syllabus:

Basic Biology: Introduction, Living organisms, Cell structure and Organelles, Organogenesis, Human Anatomy.

Systems of Life: Digestion, Respiration, Circulation, Excretion, Reproduction, Thinking and coordination and Defense,

Diet and Nutrition: Macro (Carbohydrates, proteins, lipids) - and Micronutrients (vitamins), Essential minerals and their role; deficiency symptoms; and their role; deficiency symptoms. **Micro-organisms:** Classification of Microorganisms, beneficial and harmful effects of Bacteria, Fungi and Viruses.

Biosensors, biomechanics and Medical Imaging technology, Applications of Biosensor in Food and Agriculture.

Text Books:

1. Dr RC Dubey ,"Advanced Biotechnology", S Chand Publications.
2. P K Gupta ,"Elements of Biotechnology", RASTOGI Publications.

ENGINEERING SCIENCES

20SC1101 – COMPUTATIONAL THINKING FOR DESIGN

L-T-P-S : 3-0-2-6
Credits : 5.5
Contact Hours : 11
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Design Basic and Complex Building Blocks for real world problems using structured programming paradigm.	PO1,PO2	3
CO2	Translate computational thinking into Logic Design for Solving real world problems.	PO1,PO2	3
CO3	Apply and Analyse CRUD operations on Basic Data Structures using Asymptotic Notations.	PO1,PO2	4
CO4	Apply and Analyse CRUD operations on Linear Data Structures using Asymptotic Notations.	PO4	4
CO5	Apply the structured programming paradigm with logic building skills on Basic and Linear Data Structures for solving real world problems.	PO1,PO2, PO4	3

Syllabus:

Structured Programming Paradigm: Problem Solving Approach, Algorithms and Algorithm Analysis, Program Development Steps, Structure of C Program, Pre-Processor Directives,
Design of Building Blocks for solving real world problems: Modularization: Functions, Scope of Variables and Storage classes.
Data Types: Primitive, Extended and Derived Including Pointers,
Operators: Types of operators, Precedence, Associativity.
User I/O: Formatted I/O, Command line arguments, Redirecting I/O: Files and File Operations.
Logic Design for Computational Thinking:
Control Flow Statements:
Decision making using conditional statements, Definite and indefinite Iterative statements.
Recursion, logic building using complex building blocks.
CRUD operations on Basic Data Structures:
Basic Data Structure: Arrays, 2-D Arrays, Dynamic Memory Allocation
Searching: Linear Search and Binary Search
Sorting: Bubble Sort
CRUD operations on Linear Data Structures: Stacks, Queues and Single Linked List. Introduction to Trees.

Text Books:

1. Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language: ANSI C Version", 2/e, Prentice-Hall/Pearson Education-2005.
2. E. Balagurusamy, "Programming in ANSI C" 4th ed.,Tata McGraw-Hill Education, 2008.

3. R. F. Gilberg, B. A. Forouzan, "Data Structures", 2nd Edition, Thomson India Edition-2005.

Reference Books:

1. Mark Allen weiss, Data Structures and Algorithm Analysis in C, 2008, Third Edition, Pearson Education.
2. Horowitz, Sahni, Anderson Freed, "Fundamentals of Data structures in C", 2nd Edition-2007.
3. Robert Kruse, C. L. Tondo, Bruce Leung, Shashi Mogalla, "Data structures and Program Design in C", 4th Edition-2007.
4. C for Engineers and Scientists – An Interpretive Approach by Harry H. Cheng, Mc Graw Hill International Edition-2010.
5. Jeri R. Hanly, Elliot B. Koffman, "Problem Solving and Program Design in C", 7/e, Pearson Education-2004.
6. Jean Paul Trembly Paul G.Sorenson, "An Introduction to Data Structures with applications", 2nd Edition.

Web References / MOOCS:

- www.hackerrank.com
- www.codechef.com
- www.spoj.com

Independent Learning:

1. Computational Thinking with Beginning C Programming
https://www.coursera.org/specializations/computational-thinking-c-programming
2. CISCO NetAcad Course
https://www.netacad.com/courses/programming/cla-programming-c

20ME1103 - DESIGN TOOLS WORKSHOP -I

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Practice design thinking by developing artistic skills, Visualize and complete his/her innovative design by final drafting using 3D modeling	PO-3	3
CO2	Understand the concept of web page, web browser, web server, and able to create Static webpages	PO-5	3
CO3	Understand the concept of report writing using a markup language Latex	PO-5	3
CO4	Understand the concept of data visualization and creating data visualization dashboards, Understand the basic concept of VR/AR.	PO-5	3

Course Objectives:

The primary objective of this course is to immerse students into the world of innovation as a systematic process of tackling relevant business and/or social problems. To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions. An innovation new ventures, value propositions, new products or services.

Syllabus:

Introduction to Design tools: Introduction to design tools course, its objective, advantages
3D Modeling: - Conceptual Design, 2D Sketches to 3D Solid Model using AUTODESK FUSION 360.
HTML: Introduction to web browser and URL, Introduction to HTML, Creating a simple HTML page, HTML documents, Concept of tags, Basic structure of HTML document, Head, Body, Paragraph creation, line breaks, text, list, tables, Hyperlinks and images.
HTML5: Basic of HTML5, Special features of HTML5, Canvas, audio, video, Geo location, drag and drop.
CSS: Concept of CSS, Need of CSS, Creating style sheet, CSS properties, CSS styling (Background, text, format, controlling fonts), Styling with lists and tables, CSS Ids and class, CSS color, Creating page layouts and site design.
Data Visualization: Introduction to data visualization, Data, types, Importance of data visualization, Different tools for visualization and comparisons in brief. Excel data explanation, Creation of column Chart, stacked bar chart and Heat map, Creation of excel dashboard. Creation of Dashboards in Power BI. Creation of bar charts, date tables and pie charts in Power BI, creating slicers and maps in power BI.

Latex Report Writing: Understanding Latex compilation, Basic syntax, Writing equations, Tables, Figures handling, List of figures, List of tables, Generating index. Applications: Writing resume, Writing project reports.

Virtual Reality & Augmented Reality: Introduction to Virtual reality, Virtual 360 Environments, Creating basic 360 Virtual frame. Introduction to Augmented reality, Different types of AR, Platforms to create AR interfaces.

Text Books:

1. "Complete Design Thinking Guide for Successful Professionals" by Daniel Ling
2. "Rapid Prototyping: Principles and Applications by Chua C.K., Leong and Lim. C.S, 2nd Edition, World Scientific.
3. Learn HTML & CSS by John Duckett.
4. HTML5 and CSS3 All-in-One for Dummies
5. Mastering Microsoft Power BI Expert techniques for effective data analytics and business intelligence by Brett Powell
6. LaTeX Tutorials: A Primer by Indian TeX Users Group by Indian TeX Users Group (https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf)

Web Links:

1. https://www.coursera.org/learn/3d-model-creation-fusion-360
2. https://www.coursera.org/learn/html/home/welcome
3. https://www.udemy.com/course/become-a-good-latex-user-to-create-professional-documents/
4. https://www.udemy.com/course/microsoft-power-bi-latest-2020-beginner-to-expert-modules

19SC1202 - DATA STRUCTURES

L-T-P-S : 3-0-2-3
Credits : 4.75
Contact Hours : 8
Pre-requisite : 20SC1101

Mapping of Course Outcomes with PO/PSO:

CO#.	Course Outcome	PO/PSO	BTL
CO1	Apply measures of efficiency to algorithms and Compare various linear data structures like Stack ADT, Queue ADT, Linked lists.	PO1, PO3	3
CO2	Analyze and compare linear data structures and analyze different searching and hashing techniques	PO1, PO3	4
CO3	Analyze and compare various non – linear data structures like Trees and Graphs	PO1, PO3	4
CO4	Analyze and compare various sorting algorithms, to select from a range of possible options, to provide justification for that selection, and to implement the algorithm in a particular context.	PO1, PO3	4
CO5	Execute lab experiments and develop a small project along with his/her team members.	PO1, PO3	4

Syllabus:

Algorithm Analysis: Mathematical Background, Model, Analyze, Running Time Calculations, Lists**. Stacks and Queues:** Abstract Data Types (ADTs), The List ADT, The Stack ADT, The Queue ADT.

Trees: Preliminaries, Binary Trees, The Search Tree ADT—Binary Search Trees, AVL Trees, Splay Trees, Tree Traversals (Revisited), B-Trees, Red black trees

Hashing: General Idea, Hash Function, Separate Chaining, Hash Tables without Linked Lists, Rehashing, Hash Tables in the Standard Library, Extendible Hashing.

Priority Queues (Heaps): Model, Simple Implementations, Binary Heap, Applications of Priority Queues.

Sorting: Preliminaries, Insertion Sort, A Lower Bound for Simple Sorting Algorithms, Shell sort, Heap sort, Merge sort, Quick sort, Indirect Sorting, A General Lower Bound for Sorting, Bucket Sort, External Sorting.

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2010 , Second Edition, Pearson Education.
2. Ellis Horowitz, Fundamentals of Data Structures in C: Second Edition, 2015

Reference Books:

1. A.V.Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures And Algorithms”, Pearson Education, First Edition Reprint 2003.
2. Horowitz, Sahni, Anderson Freed, “Fundamentals of datastructures in C” , Second Edition-2007.

19SC1209 - DESIGN TOOLS WORKSHOP -II

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Practice the design ideology by artistic skill	PO3	2
CO2	Visualize the design ideology by using VR technology	PO4	3
CO3	Visualize the design ideology by incorporating VR technique	PO5	3
CO4	Visualize and present his design idea by applying AR technique	PO4	3

Syllabus:

Design Thinking in Modern Art & Ideas: Modern Art & Ideas, Transforming everyday objects, Abstract painting, clay modeling, poetry and literary.

Virtual Reality: Hardware and History, VR Applications, Psychology of VR: the three illusions, challenges in virtual reality, Future of Embodiment in VR, Realism, Graphics, Real-Time 3D Graphics in Games, Basic Concepts in 3D Computer Graphics, Realism Animation, Navigation, Nausea.

Room Scale VR, Holography, Mirror Reality: Setting up room scale VR, Simulation of virtual environment, Stereoscopic Vision, Perspective, Interference and Diffraction, Laser Viewable Holograms, Real and Virtual Images, Introduction to mirror reality.

Augmented Reality: Augmented Reality, characteristics of AR systems and main components of an AR architecture, Augmented Reality with Geolocation,Customizing an augmented reality game.

Text Books:

1. "Complete Design Thinking Guide for Successful Professionals" by Daniel Ling
2. "Project Management" by K. Nagarajan, 7th Edition, New Age International Publishers.
3. "Augmented Reality and Virtual reality" by Timothy Jung, M.ClaudiaTomDieck, Springer.
4. "Rapid Prototyping: Principles and Applications"by Chua C.K., Leong and Lim. C.S, 2nd Edition, World Scientific.
5. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, 3rd Edition, Prentice Hall.

Web References:

1. https://www.coursera.org/learn/uva-darden-design-thinking-innovation?
2. https://www.coursera.org/learn/uva-darden-design-thinking-innovation?
3. https://www.coursera.org/learn/modern-art-ideas?

20ME1203 – COMPUTATIONAL THINKING AND DATA SCIENCES

L-T-P-S : 3-0-2-3
Credits : 4.75
Contact Hours : 8
Pre-requisite : 20SC1101

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Perform basic computations in Python, including working with tabular data.	PO1	2
CO2	Understand basic probabilistic simulations, statistical thinking and Stochastic Programs.	PO1	2
CO3	Use good practices in Python programming using Computational Simulations.	PO1	3
CO4	Implement Computational data modeling and clustering using Python programming.	PO1, PO2	3
CO5	Apply the theoretical concepts to develop Python Programs to solve Optimization Problems and Computational Simulations with the applications of Solid and Fluid Mechanics concepts.	PO1, PO2	3

Syllabus:

Introduction to Python and Optimization: Python Introduction, Installation, Print Function and Strings, Math with Python, Variables, If Statement, If Else, If Elseif Else, While Loop, For Loop, Functions, Function Parameters, Function Parameter Defaults, Global and Local Variables, writing to a File, Appending Files, Reading from Files, Classes, Introduction to Optimization Problems.

Data Reading and Manipulation using Python: Getting User Input, Statistics Module, Module import Syntax, making your own Modules, Lists and Tuples, List Manipulation, Multi-Dimensional Lists, Reading CSV files, Stochastic Programs, Probability and Statistics.

Data Analysis with 2D Plotting: Matplotlib Introduction, Matplotlib Basics, 2D graphs in Matplotlib, 2D Scatter Plot with Python and Matplotlib, More 2D Scatter-Plotting with custom colors, 2D Bar Charts, Random Walks, Monte Carlo Simulations.**Data Analysis with 3D Plotting:** 3D graphs in Matplotlib, 3D Scatter Plot with Python and Matplotlib, More 3D Scatter-Plotting with custom colors, 3D Bar Charts, 3D Plane Wireframe Graph, Live Updating Graphs with Matplotlib, Pandas Introduction, Pandas Basics, Modeling Data.

Note: The above designed syllabus is intending to use Python Programming to solve Optimization Problems and Computational Simulations with the applications of Solid and Fluid Mechanics concepts.

Text Books:

1. Guttag, John. Introduction to Computation and Programming Using Python: With Application to Understanding Data. 2nd edition, MIT Press, 2016. ISBN: 978-0262529624.

2. Jake VanderPlas. Python Data Science Handbook: Essential Tools for Working with Data 1st Edition, O'Reilly Media, 2016. ISBN: 978-1491912058.

Reference Books:

1. Oliver Knill. Probability and Stochastic Processes with Applications.Overseas Press. 2009. ISBN : 978 – 8189938406.
2. Singiresu S. Rao. Engineering Optimization Theory and Practice. 2009. John Wiley & Sons, Inc.

20ME1002 – 2D MODELING OF PHYSICAL SYSTEMS USING CAD TOOLS

L-T-P-S : 1-0-2-0
Credits : 2
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Construct and Interpret drawing scale to visualize the geometries of Engineering objects using points, lines both manually and by AutoCAD / Fusion 360	PO2	2
CO2	Draw projection of planes, solids and Generate the sectional views of solids both manually and by AutoCAD / Fusion 360	PO3, PO4	2
CO3	Draw Engineering curves and develop the lateral surface of solids both manually and by AutoCAD / Fusion 360	PO3, PO5	2
CO4	Build orthographic projections, create isometric sketches and identify standard features both manually and by AutoCAD / Fusion 360	PO3, PSO1	2

Syllabus:

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance – Drawing Instruments and their Use- Conventions in Drawing – Lettering – Geometric Constructions – Scales: Plain and Vernier scales.

Orthographic Projection in First Angle Projection: Principles of Orthographic Projections-conventions - First and Third Angle, Projections of Points and Lines inclined to both planes, True lengths, traces.
(Note: Drafting of the same in CAD)

Projections of Planes & Solids: Projections of regular planes inclined to both planes. Projections of Regular solids inclined to one plane.**Sections and Sectional Views**: Right Regular Solids - Prism, Cylinder, Pyramid, Cone.

Engineering Curves used in Engineering Practice & their Constructions:
Conic Sections: Ellipse, Parabola, Hyperbola and Rectangular Hyperbola – oblong, concentric method
Special Curves: Cycloid, Epicycloid, Hypocycloid and Involute
Developments of solids: Development of surfaces of right regular solids – Prisms, Cylinder, Pyramid cone and their parts

Isometric Projections: Principles of Isometric Projection- Isometric Scale- Isometric view conventions- Isometric View of Lines, Plane Figures, simple problems
Transformation of Projections: Conversion of Isometric Views to Orthographic Views – Conventions.

Text Books:

1. Engineering Drawing, N.D.Bhat/ Charotar
2. Engineering Drawing , N.S.Parthasarathy, VelaMurali
3. Machine drawing- N.D.Bhatt., published by R.C. Patel Charotar Book Stall TulshiSadan, Station Road, Anand, India

Reference Books:

1. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
2. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing,Scitech Publishers(Corresponding set of) CAD Software Theory and User Manuals
4. Machine Drawing by / Bhattacharyya / Oxford
5. Machine Drawing with Auto CAD / GouthamPohit, GoutamGhosh / Pearson

Web References:

1. https://nptel.ac.in/courses/112103019/
2. https://academy.autodesk.com/authenticated-home-user
3. https://www.youtube.com/channel/UCamtopKcVk176djUP_rbA-A
4. https://web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf
5. https://opac.vimaru.edu.vn/edata/EBook/Engineering%20drawing%20third%20edition.pdf.
6. https://www.sciencedirect.com/book/9780080108391/engineering-drawing-from-thebeginning.
7. https://gptcadoor.org/assets/downloads/3ckcwmvwfu0hyqq.ppt
8. https://www.ucvts.tec.nj.us/cms/lib/NJ03001805/Centricity/Domain/611/Lesson%201%20Intro%20to%20Drawing.pdf

20ME2104 – 3D MODELING AND PHYSICAL PROTOTYPING OF MECHANICAL COMPONENTS

L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : 20ME1002

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Draft various parts of machine components and their assemblies. Conversion of part drawings to assembly drawing and vice versa in conventional form, Draw different line types and various dimensioning, conventional representation of materials and machine components, sectioning, limits, fits and tolerances.	PO1, PSO1	3
CO2	Develop and interpret production drawing for various machine elements, Implement Computer Aided Drafting for various machine components using software.	PO1, PO3, PO5, PSO2	3
CO3	Understand different manufacturing techniques and their relative advantages / disadvantages with respect to different applications and Fabricate components physically using various tools and machines	PO2, PO4, PSO1, PSO2	4
CO4	Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes, Assemble different components and produce small devices of their interest	PO2, PO4, PSO1, PSO2	4

Course Objective:

This course focuses on both traditional drafting techniques and computer aided drafting. Further, the course aims at enabling the students to understand and apply national and international standards while drawing machine component, and familiarize them in drawing various machine components, drafting the assembly and part drawings of machine components

To familiarize with the procedures of basic manufacturing processes through hands on practice on the use of various hand tools and equipment. The course will be taught and implemented with the aim to achieve the course outcomes (COs) so that the student can demonstrate the following competency needed by industry: “Prepare simple jobs on the shop floor of the engineering workshop”, “Develop skills related to the mechanical operations needed for the industry.”

Syllabus:

Review: Orthographic projection, missing lines, Interpolation of views and sectioning
Part and assembly drawing: Introduction, assembly drawing of stuffing box, steam engine cross head, air valve, Lathe tailstock, gate valve, screw jack, connecting rods, spark plug, tool post, safety Valves etc. Drawing exercises.
Symbols of Machine, elements and welded joints.

Specification of materials: Engineering materials, code designation of steels, copper, and aluminium and its alloys.
Limits, tolerances and fits: Introduction, limit systems, tolerance, fits drawing exercises.
Surface roughness: Introduction, surface roughness, machining symbols, identification of surface roughness drawing exercises.
Production drawing: Introduction to developing and reading of production drawing of simple machine elements like helical gear, bevel gear, flange, pinion shaft, connecting rod, crank shaft, belt pulley, piston details etc, idea about tool drawing.
Computer aided drawing: Introduction, input, output devices, introduction to drafting software like Creo/ Solidworks, basic commands and development of simple 2D and 3D drawings.
Carpentry (simple exercise in wood working, pattern making)
Fitting operations & power tools.
Electrical &Electronics
Sheet metal working, Welding (arc welding & gas welding and gas cutting), brazing, Plastic moulding, glass cutting.
Manufacturing Methods: casting, forming, machining, joining, advanced manufacturing Methods.
CNC machining, Additive manufacturing.

Reference Books:

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.
6. Narayana "Machine drawing", New Age International
7. K.L.Narayana and P.Kannaiah "Production drawing", New Age International
8. Bhatt N.D "Machine drawing", Charotar

20ME2209 – NUMERICAL COMPUTATION FOR MECHANICAL ENGINEERS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand elementary programming concepts, and the basics in MATLAB	PO1	3
CO2	Understand linear algebra, probability and statistics for solving engineering problems	PO1	2
CO3	Solve a system through linear and nonlinear equations, and ordinary differential equations in Mechanical Engineering	PO1	3
CO4	Select an appropriate numerical approach for solving engineering problems	PO1	3
CO5	Ability to select bench marks to confirm the computational approach	PO1	3

Course Objective:

The main objective of this course is to enable the students to improve their programming skills using the MATLAB environment to implement algorithms and to use MATLAB as a tool in solving problems in Engineering.

Syllabus:

Covers elementary programming concepts, including variable types, data structures, and flow control.Provides an introduction to linear algebra and probability.
Numerical methods relevant to Mechanical Engineering, including approximation (interpolation, least squares, and statistical regression), integration, solution of linear and nonlinear equations, and ordinary differential equations.
Presents deterministic and probabilistic approaches.Uses examples from Mech.Engg, particularly from robotics, dynamics, and structural analysis.
Assignments require MATLAB programming

Text Books:

1. Guttag, John. Introduction to Computation and Programming Using Python: With Application to Understanding Data. 2nd ed. MIT Press, 2016. ISBN: 978-0262529624.
2. Jake VanderPlas. Python Data Science Handbook: Essential Tools for Working with Data 1st Edition, O'Reilly Media, 2016. ISBN: 978-1491912058.

Reference Books:

1. Oliver Knill. Probability and Stochastic Processes with Applications.Overseas Press. 2009. ISBN : 978 – 8189938406.

20EE2205 – CIRCUITS AND ELECTRONICS

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the Basic of Electrical network elements	PO1, PO5	2
CO2	Understand the behavior of semiconductor switches and its applications	PO1, PO5	2
CO3	Apply Time & frequency domain analysis of first & second order networks	PO1, PO5	3
CO4	Understand the Applications of Analog & Digital circuits	PO1, PO5	2

Syllabus:

Fundamentals of the lumped circuit abstraction.Resistive elements and networks, independent and dependent sources.

Switches and MOS devices, digital abstraction, amplifiers, and energy storage elements.

Dynamics of first- and second-order networks; design in the time and frequency domains;

Analog and digital circuits and applications.

Text Books:

1. John Bird, Electrical Circuit Theory and Technology, Sixth edition, Newnes (Elsevier) publications, 2017.
2. Electric Circuits – J. Edminister and M.Nahvi – Schaum's Outlines,

Reference Books:

1. Network Analysis by ME Van Valkenburg, Prentice Hall of India, 3rd Edition, 2000.
2. Jacob Millman, Christor. C W. H. Hayt, J.E. Kimmerly, "Engineering circuit analysis", 8th Edition, Tata Mc-Graw Hill, 2014.

20ME2105 - THERMODYNAMICS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the fundamentals of thermodynamic systems and processes.	PO1	2
CO2	Apply first law of thermodynamics to various flow and non-flow processes.	PO1, PO2	3
CO3	Apply second law of thermodynamics and principle of entropy to Engineering Devices.	PO1	3
CO4	Apply principles of combustion for gravimetric and volumetric analysis of fuels.	PO1, PO2	3
CO5	Plan and conduct simple experiments to demonstrate thermodynamic principles.	PO4	4

Syllabus:

Fundamental Concepts and Definitions: Thermodynamic system and control volume, macroscopic and microscopic points of view, thermodynamic properties, processes, state, path, cycle, thermodynamic equilibrium and quasi-static process. Reversible and irreversible processes, zeroth law, concept of temperature.
Work and Heat: Definition of work, units, work done at the moving boundary of system, work done in various non-flow processes, definition of heat, units, comparison of heat and work.
First Law of Thermodynamics for Non-Flow Systems: First law of thermodynamics for a closed system undergoing a cycle and for a change of state; energy - a property of system, internal energy and enthalpy. Specific heat at constant volume and constant pressure.
First Law of Thermodynamics for Flow Systems: Control mass, control volume, first law of thermodynamics for a control volume, steady flow energy equation and applications to engineering equipment andPMM-1.
Second Law of Thermodynamics: Thermal reservoirs, Kelvin-Plank and Clausius statements of second law of thermodynamics; Equivalence of Kelvin-Plank and Clausius statements, PMM-2; Carnot cycle, Carnot engine, corollary of Carnot‘s theorem, absolute thermodynamic temperature scale.
Entropy: Definition of entropy, Clausius theorem, entropy change in reversible process temperature-entropy plot, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, applications of entropy principle, entropy change of an ideal gas; availability and irreversibility.
Fuels and Combustion: Types of fuels, exothermic and endothermic combustion equations, stoichiometry. Conversion of gravimetric to volumetric analysis and vice versa; excess air, exhaust gas analysis.

Text Books:

1. Thermodynamics, an Engineering Approach - Yunus A. Cengel& Michael Boles, 6th Edition, Tata McGraw Hill, NewDelhi.
2. Engineering Thermodynamics - P. K. Nag, 5th Edition, Tata McGraw Hill, NewDelhi.

Reference Books:

1. Fundamentals of Thermodynamics - G. J. VanWyle
2. Engineering Thermodynamics - Cohen and Rogers, 5th Edition, Pearson Education India limited.
3. Heat and Thermodynamics - Zemansky, McGraw Hill, 5thEdition.

PROFESSIONAL CORE

20ME2101 – MECHANICS OF SOLIDS

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 20PH1010

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Analyze stresses in members with 1D axial loading or torsion	PO2, PSO1	4
CO2	Analyze shear force and bending moment diagrams	PO2, PSO1	4
CO3	Analyze deflections and stresses in beams	PO2, PSO1	4
CO4	Design Columns and pressure vessels	PO3, PSO1	4
CO5	Apply the theoretical concepts to conduct various experiments of strength of materials practically and analyze the data	PO3, PSO2	4

Course Objective:

The objective of this course is to make the learner be able to identify stresses, strains and deflections in members that are loaded either axially or with torsion, or flexural loadings. Identify principal stresses, maximum shearing stress of two dimensional loaded structural members. Analyse beams with different Cross Sections and analyse columns and thin-walled pressure vessels

Syllabus:

Introduction: Types of Stress, Strains, Stress Strain Diagram, Hooke's Law.

Axially Loaded Members: Deflection of an Axially Loaded Member, Force-deformation Relationships and Static Indeterminacy; Uniaxial Loading and Material Properties, Trusses and their Deformations - Statically Determinate and Indeterminate Trusses, Stress-strain-temperature Relationships

Torsion: Introduction, Torsion of a Circular Bar, Non-Uniform Torsion, Transmission of Power by Circular Shafts, Strain Energy in Pure Shear and Torsion.

Multi axial stresses and strains: Introduction to Multiaxial Stress, Multiaxial Stress and Strain Multiaxial Strain and Multiaxial Stress-strain Relationships Stress and Strain Transformations Stress Transformations and Principal Stress Failure of Materials and Examples.

Shearing Forces and Bending Moments: Shear Force and Bending Moment, Relationship Between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams

Stresses in Beams: Introduction, Normal Strains in Beams, Normal Stresses in Beams, Cross Section Shapes of Beams, Shear Stresses in Rectangular Beams, Shear Stresses in The Webs of Beams with Flanges.

Thin walled Pressure Vessels: Concepts of Hoop and Longitudinal Stresses, Simple Problems for Cylinders and Shells.

Columns: Buckling and Stability

Text Books:

1. Gere &Goodno "Mechanics of Materials" Cengage Publishers
2. RC Hibbeler, "Mechanics of Materials" 10th edition, Pearson.

Reference Books:

1. Pytel A H and Singer F L, Harper Collins "Strength of Materials", New Delhi.
2. Shames, I. H., Pitarresi, J. M "Introduction to Solid Mechanics", Prentice-Hall, NJ.

20ME2106 - FLUID MECHANICS & HYDRAULIC MACHINES

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand physical laws related to fluid statics and buoyancy.	PO1, PO2	2
CO2	Apply continuity, Euler and Bernoulli equations in various fluid flow situations.	PO1, PO2	3
CO3	Understand and apply momentum equation and boundary layer concepts to flow through pipes and to impact of jets.	PO1, PO2	3
CO4	Apply fluid dynamical principles to hydraulic machines.	PO1, PO2	3
CO5	Conduct experiments to verify and apply various fluid flow principles and performance evaluation of various hydraulic machines like turbines and pumps	PO4	4

Syllabus:

Fluid Properties: Definition of fluid, properties of fluids - density, specific weight, specific gravity, viscosity, classification of fluids, surface tension, capillarity, vapor pressure.
Fluid Statics: Introduction, pressure, Pascal law, hydrostatic law, measurement of pressure, simple and differential manometers; total pressure and center of pressure on vertical, horizontal, inclined and curved surfaces.
Buoyancy: Buoyancy, forces on submerged bodies, stability of submerged and floating bodes.
Fluid kinematics: Introduction, types of fluid flow, discharge, continuity equation, potential function and stream function.
Fluid dynamics: Introduction, Euler‘s equation of motion, Bernoulli‘s equation and applications, venturi meter, orifice meter.
Flow through pipes: Introduction, major and minor energy losses, friction coefficient in laminar and turbulent flow, Hagen-Poiseuille law, Hydraulic gradient and total energy line, pipes in series and parallel, power transmission through pipes, Reynold‘s experiment and water hammer.
Dimensional analysis and model similitude
Boundary layer theory: Introduction, laminar and turbulent boundary layers, boundary layerthickness, displacement thickness, momentum thickness, energy thickness, boundary layer separation, methods of preventing separation.
Impact of Jets: Introduction to impulse-momentum equation and its applications, force exerted by jet on fixed target, moving target, and series of curved vanes.

Hydraulic Machines - Turbines: Introduction, types and classification Pelton wheel, Francis turbine, Kaplan turbine-theory, work done and efficiency, design parameters, problems.
Hydraulic Machines - Centrifugal pumps: Definition of pump, classification, description and

general principle of working; priming, work done and efficiency of a centrifugal pump, minimum starting speed, cavitation in centrifugal pumps, multi-stage pumps, problems on centrifugal pumps.

Text Books:

1. Fluid Mechanics by S. K. Som and G. Biswas, Tata McGraw Hill publications.
2. Fluid Mechanics by Yunus A. Cengel, McGraw Hill publications.
3. Fluid Mechanics and Hydraulic Machines, D. S. Kumar, Narosa Publishing House Private Limited.

Reference Books:

1. Fluid Mechanics by Frank M. White, Seventh Edition, McGraw Hill.
2. Fluid Mechanics & Hydraulics, K. R. Arora, Standard Book House, New Delhi.
3. Fluid Mechanics & Hydraulics, Modi & Seth, Standard Book House, New Delhi.

20ME2107 – MANUFACTURING TECHNIQUES

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand and apply the casting processes	PO1, PSO2	2
CO2	Apply the welding processes and identify the faults in welding processes	PO3, PSO1	2
CO3	Apply principles of cold/hot forming processes	PO3, PSO2	4
CO4	Apply sheet metal processes and design sheet metal dies.	PO3, PSO1	3
CO5	Fabricate the parts using machine tools	PO2, PSO2	3

Course Objective:

The objective of this course is to make the learner able to identify manufacturing processes in mechanical industries to prepare the physical product and apply manufacturing processes to produce a product used in industries, houses, automobiles, and agriculture purposes.

Syllabus:

Primary Manufacturing Processes

Patterns and Pattern making, Moulding methods and processes, sand preparation and control, testing, cores and core making. Design considerations in casting, gating and Riser - directional solidification in castings, Metallurgical aspects of Casting, Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell Moulding, continuous casting-squeeze casting, electro slag casting, Fettling and finishing, casting defects and Inspection of castings.

Basic Joining Processes

Types of welding-gas welding, -arc welding,-shielded metal arc welding, GTAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermit welding, Flame cutting - Use of Oxyacetylene, modern cutting processes, arc cutting, Soldering, brazing and braze welding and their application., welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys. Introduction to Electron beam and Laser welding, weld stress-calculations, design of weld size, estimation of weld dilution, heat input, effect of welding parameters preheating, and post heating temperature: Selection of electrodes, flux etc. Inspection of welds, Defects in welding, causes and remedies.

Metal Forming : cold/hot forming processes, Metallurgical aspects of metal forming, yield criteria and their significance, Forging and rolling processes: Forging principle, parameters and calculation of forces and power requirements during forging, Rolling processes, calculation of forces and geometrical relationship in rolling, analysis of rolling load, torque and power. Form rolling, rolling defects, causes and remedies.

Extrusion and Drawing Processes: Extrusion force calculation-defects and analysis

Sheet metal forming processes: conventional and HERF processes-presses-types and selection of presses, formability of sheet metals, electro hydraulic forming, magnetic pulse forming. Press work – coining, embossing etc., Design of sheet metal dies.

Text books:

1. Lindberg, "Processes and Materials of Manufacture", Prentice hall India (p) Ltd.
2. Serope Kalpakjian, Steven R. Schmid "Manufacturing Engineering and Technology" (4th Edition) Prentice Hall 2000-06-15 ISBN: 0201361310
3. P.N.Rao "Manufacturing Technology", TMH Ltd 1998(Revised edition)
4. Dieter "Mechanical Metallurgy", Revised edition 1992, McGraw hill
5. Amitabha Ghosh and Asok Kumar Mallik " Manufacturing science TMH publisher

20ME2208 – MECHANICAL ENGINEERING DESIGN

L-T-P-S : 3-0-2-4
Credits : 5
Contact Hours : 9
Pre-requisite : 20ME2101

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Selection of appropriate materials in mechanical design	PO1, PO3, PSO2	2
CO2	Emphasize the fundamentals of mechanical behavior of materials	PO2, PSO2	2
CO3	Design of machine components for static strength	PO2, PSO1	3
CO4	Design of machine components for fatigue strength	PO2, PSO1	3
CO5	To perform static and dynamic analysis in various structures and to solve complex engineering problems	PO2, PSO1	3

Course Objective:

The objective of this course is to make the learner able to understand the fundamentals of mechanical behavior of materials, determine the mechanical properties of materials to design and solve the problems related to mechanical behavior of engineering materials.

Syllabus:

Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes Mechanical behavior of engineering materials, Selection of Materials, Selection of Shapes.

Fundamentals of mechanical behavior of materials, as well as design with materials: elasticity, plasticity, fatigue, fracture, and creep

Design Philosophy, General considerations and procedure in machine design, preferred numbers, Codes & Standards, Reliability Design for Static Strength: Simple Stresses - Combined stresses - Torsional and Bending stresses - Factor of safety and theories of failure.

Design for Fatigue Strength: Stress concentration – Methods of reducing stress concentration factor, Design for fluctuating stresses- Endurance limit, Estimation of Endurance strength – Notch sensitivity– Goodman's line and Soderberg's line, Combined fluctuating stresses

Skilling Syllabus:

Introduction to Design, FEM and Problem Solving Methods.
Static Analysis: Static loads, Eigen Value Buckling Analysis.

Dynamic Analysis: Modal Analysis, Harmonic Analysis, Fatigue analysis, Random Analysis.
Analysis of metals and composites: Linear and non-linear, Static structural and dynamic analysis of

- Beams (Statically Determinate and indeterminate),
- Pressure Vessels (Thick and Thin),
- Torsion of Shafts,
- Plates (Finite Width and Infinite Width)
- Stress concentration Factors for geometrical imperfections.
- Shafts subjected to combined loading,
- Analysis of metals and composites: Linear and non-linear, Static structural and dynamic analysis of
- Effect of chamfers and fillets.
- Pretension of bolts,
- Fatigue (Low cycle and high cycle),
- Generation of S-N curve from Low cycle fatigue.
- Analysis of fracture modes.

Text Books:

1. Gere &Goodno "Mechanics of Materials" Cenage Learning India Pvt Ltd
2. Engineering Design by George E.Dieter, 4th Edition, McGraw-Hill International Editions.
3. Engineering Design Process by Haik&Shahin, Cengage learning.

Reference Books:

1. S.S. Rattan "Strength of Materials" Tata McGraw Hill
2. E.P.Papov "Mechanics of Materials" Prentice Hall Publications
3. B.C.Punmia, Ashok Kr. Jain ArunkumarJain"Mechanics of Materials" Laxmi Publications
4. Finite Element method by R.Chandrapatla
5. Pytel A H and Singer F L, Harper Collins "Strength of Materials", New Delhi.

20ME2210 - ANALYSIS OF THERMAL SYSTEMS

L-T-P-S : 3-1-0-4
Credits : 5
Contact Hours : 8
Pre-requisite : 20ME2105

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand phase equilibrium of a pure substance, Determine efficiency of Rankine vapor power cycle	PO1, PO2	2
CO2	Estimate dimensional parameters of various steam nozzles including convergent and divergent nozzles and efficiency of condensers	PO1, PO2	3
CO3	Understand the fundamentals of internal combustion engines	PO1, PO2	2
CO4	Compare various methods of refrigeration by understanding working principles, Understand principle of psychrometry and air-conditioning process	PO4	3
CO5	Analyze internal & external fluid flows and Analyze steady and transient heat transfer through various systems	PO4	4

Syllabus:

Pure Substance: Vapour-liquid-solid phase equilibrium, independent properties, Equations of state, Tables of thermodynamic properties.
Vapour Power Cycles: Rankine cycle, Effect of pressure and temperature, Regenerative cycle, Binary vapour cycle.
Steam Nozzles & Condensers: Types of nozzles, isentropic flow through nozzles, effect of friction, nozzle efficiency, critical pressure ratio and maximum discharge, throat and exit areas using Mollier diagram, Condensers - Jet and surface condensers, condenser vacuum and vacuum efficiency, condenser efficiency, thermodynamic analysis.
IC Engines: Engine nomenclature, classification of I.C. Engines, working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke) - valve and port timing diagrams - Differences between SI & CI and 2 stroke & 4 stroke engines and combustion in S.I and CI engines.
Refrigeration & Air conditioning: Methods of refrigeration, Refrigerator & heatpump, Reversed carnot and bell-colemancycles, Refrigerating effect, COP, Vapour compression and vapour absorption refrigeration systems, Psychrometric properties, psychrometric chart and air-conditioning process.

Skilling Syllabus:

Introduction to CFD (Computational Fluid Dynamics) – Ansys FLUENT
Internal fluid flows, External fluid flows

Steady and transient heat transfer
Combined study on fluid flow and heat transfer

Text Books:

1. Cengel & Boles “Engineering Thermodynamics”,Mc Graw Hill Publishers.
2. P.K.Nag “Basic and Applied Thermodynamics”,TMH, New Delhi.
3. V.Ganesan “I.C. Engines”,T.M.H.
4. ANSYS Fluent Tutorial Guide by ANSYS, Inc. Release 17.0 Southpoi.
5. “Computational fluid dynamics, the basics with applications” by john D Anderson.
6. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
7. Mechanical Measurements by Thomas G. Beckwith, Addison-Wesley Publications

20ME2211 – ANALYSIS OF MECHANISMS AND MACHINES

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 20PH1010

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Identify, select and analyze kinematically suitable mechanisms for required motion of machinery	PO4	2
CO2	Develop velocity and acceleration diagrams and analyze the data	PO2	4
CO3	Develop cam profiles and Analyze gears and gear trains kinematically	PO4	4
CO4	Analyze mechanisms dynamically	PO3	4
CO5	Apply the theoretical concepts to design mechanisms by using the simulation software and analyzing the data.	PO2	4

Course Objective:

To enable the learners to analyze various mechanisms kinematically and analyze the dynamics of machine components.

Syllabus:

Mechanisms and Machines: Introduction to Plane and Space Mechanisms, Kinematic Pairs, Kinematic Chains and their Inversions, Mobility and range of movement - Kutzbach and Grubler's criterion, Grashof'scriterion. Velocity analysis: Velocity analysis using IC and relative velocity method. Acceleration analysis.

Cams: cam profiles of knife edge, roller and offset followers of reciprocating motion.
Gears and Gear trains: Gears – terminology, fundamental law of gearing, involute profile. Interference and undercutting. Gear Trains – simple, compound and epicyclic gear trains.
Balancing: Introduction, Static balancing, dynamic balancing, transferring of a Force from one plane to another, Balancing of Several Masses in Different planes, Balancing of Reciprocating Mass, Secondary Balancing.
Dynamic force analysis: Force analysis of Slider crank mechanism.

Gyroscopes: Gyroscopic Effect on Naval Ships, Stability of an Automobile, Stability of a Two-Wheel vehicle, Four-Wheeler

Text Books:

1. David H. Myszka "Machines and Mechanisms-Applied Kinematic Analysis", 4th Edition, Prentice Hall
2. Robert Norton "Kinematics and Dynamics of Machinery" 1st Edition, Tata McGraw - Hill Education, (2009)

3. Shigley J.E., and Uicker J.J "Theory of Machines and Mechanisms", McGraw Hill, (1995).

Reference Books:

1. Thomas Bevan "Theory of Machine" CBS Publications.
2. Rao, J. S "The Theory of Machines through Solved Problems", New Age International.
3. A.Ghosh and A.K.Mallik "Mechanisms and Machine Theory", 3rd edition, EWP Pvt.Ltd.

20ME2212 - ENGINEERING IN THE PHYSICAL WORLD

L-T-P-S : 1-0-0-4
Credits : 2
Contact Hours : 5
Pre-requisite : 20ME2105

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Recalling the Laws and fundamentals related to thermal energy and electrical energy.	PO2	2
CO2	Applying the laws in thermal and electrical systems.	PO2	3
CO3	Analyzing and designing of thermal systems.	PO2	3
CO4	Analyzing real time energy systems and developing a novel design.	PO2	4
CO5	Modeling and Numerical analysis of thermal systems	PO2	4

Syllabus:

Behaviour at different scales – micro, macro, lumped – in engineering applications; molecular origin of thermal and mechanical phenomena; brief discussion of chemical and electrical domains: statistical mechanics to thermodynamics and macroscopic behaviour; conservations laws for energy, mass, momentum; origin and limits of macroscopic constitutive relations: physical systems: lumped approximations; equilibrium networks; elementary dynamics: and applications to energy and materials.

Text Books:

1. Engineering Thermodynamics, Nag, P.K., TMH Publications.
2. Thermoelectric refrigeration. Goldsmid H., Springer; 2013 Dec 14.
3. A Comprehensive Guide to Solar Energy Systems, Trevor Letcher, 1stEdition.
4. Fundamental of Heat Exchanger Design, R.K. Shah, 2003.

Reference Books:

1. Fundamentals of Engineering Thermodynamics, Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisie D.; Bailey, Margaret B., 7th edition, Wiley publishers.
2. Fundamentals of Thermodynamics, G.J. Van Wylen., Sonntag (6E), Wiley India publications.
3. Fluid Mechanics, Frank M. White, 8^{th} edition, McGraw Hill Publications.

20ME3113 – MACHINE DESIGN & INNOVATION

L-T-P-S : 3-1-0-4
Credits : 5
Contact Hours : 8
Pre-requisite : 20ME2208

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Model the machine elements such as bearings, bolts, belts and gears	PO3, PSO1	3
CO2	Analyze the machine elements to design a new component	PO4, PSO1	4
CO3	Characterize the mechanical system to a real world application	PO2, PSO1	4
CO4	Synthesize the modal to design a mechanical system	PO2, PSO1	4
CO5	Design and execute a fully functional prototype, Utilize models and engineering analysis for design, Manage a design project from concept to prototype, Validate design requirements, Complete reliability analyses and risk assessments	PO5, PSO2	5

Course Objectives:

- To Design different types of mechanical drives like flat and V-belt drives, chain drives, Design of brakes and clutches, Select of journal bearings and anti-friction bearings, Design of spur, helical, bevel and worm gears.
- This course prepares for the capstone design course by providing understanding of all necessary steps and project management communication, documentation necessary to successfully execute the capstone design project.

Syllabus:

Shafts: Design of solid and hollow shafts for strength and rigidity, Design of shaft for variable load, Design of shafts for gear and belt drives.
Couplings: Design of Rigid and Flexible Couplings
Design of Helical springs, Torsion springs, Spiral springs, Leaf springs.
Design of Fasteners:
Welded joints: Design of Welded joints, Strength of welded joints, Circular fillet welds-bending and torsion, Welded joint with eccentric loading,
Bolted joints: Design of bolts with pre-stresses - Design for leak Proof Joints – Design of joints under eccentric loading - Bolt of uniform strength.
Power Screws: Types - Mechanics of power screws, Efficiency of Square and Self-locking screw
Belt Drives: Selection of flat and V-belts from manufacturer's catalogue, Belt tensioning methods, Construction and applications of timing belts.
Chain Drives: Polygonal effect, Power rating of roller chains, Construction of sprocket wheels.

Bearings: modes of Lubrication, Sliding contact bearing design, bearing materials, selection of lubricant. Rolling contact bearings- selection of ball, roller bearings- under static load, dynamic load.
Brakes: Analysis and Design of Block brakes, internal shoe Brakes, End shoe Brakes, Pivoted shoe Brakes, Band Brakes, Temperature raise, Friction materials.
Spur Gears: Force analysis, Beam strength (Lewis) equation, Estimation of module based on beam and wear strength.
Helical Gears: Transverse and normal module, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.
Bevel Gears: Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears,
Worm Gears: Design and analysis of worm gear drive
Topics:

- Define and explain phases of a design process
- Complete a functional prototype
- Use models to analyze and improve designs
- Incorporate reliability, risk, and safety in design iterations
- Work efficiently within a team to execute a design process
- Implement appropriate steps to plan and manage an engineering project

Text Books:

1. V.Bhandari “Design of machine elements”, Tata McGraw Hill book Co
2. M.F.Spotts Design of Machine Elements “ Pearson Education
3. The Mechanical Design Process, 5th ed., by D. Ullman, 2015
4. Product Design and Development, 6th ed., by K.T. Ulrich and S.D. Eppinger, 2015
5. Machine Design, 5th ed., by R.L. Norton, 2013.

Reference Books:

1. Shigley J.E, “Mechanical Engineering Design”, McGraw-Hill, 1996
2. Black P.H. and O. Eugene Adams, “Machine Design”, McGraw Hill Book Co. Ltd
3. R.C.Bahl and V K Goel “Mechanical Machine Design” Standard Publishers
4. Machine Design by Dr.N.C.Pandya&Dr.C.S.Shah, Charotar Publishing House

20ME3114 – INDUSTRY 4.0 & DESIGN OF CYBER PHYSICAL SYSTEMS

L-T-P-S : 3-0-0-4
Credits : 4
Contact Hours : 7
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the basic principles of AI in solutions that require problem solving	PO3, PO4, PSO1	3
CO2	Understand the concepts of Robotics and its control	PO3, PO4, PSO1	2
CO3	Understand the concepts of IoT and its applications	PO3, PO4, PSO1	2
CO4	Understand the concepts of Cloud Technology	PO3, PO4, PSO1	2
CO5	Apply the concepts of Cyber security and Control Systems	PO3, PO4, PSO1	3

Syllabus:

Introduction to Industry 4.0:

The Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

Need for AI in Robotics: Thinking and acting humanly, intelligent agents, structure of agents, Turing Test, State space search - Uninformed search.
Problem Solving: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning–knowledge representation – first order logic

Robotics: Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement

IoT: Introduction to IoT, Design Methodology: Purpose and Requirements specifications, process specifications, Domain model specifications, Information Model specifications, Service specifications, IoT level specifications, Functional and operational view specifications, Device and Component Integration, Application Development.

Cloud Technology: Introduction , Differences Between Traditional and Cloud Computing Environments, IT Assets as Provisioned Resources , Global, Available, and Scalable Capacity, Higher-Level Managed Services, Built-in Security ,Architecting for Cost ,Operations on AWS, Design Principles, Scalability ,Disposable Resources Instead of Fixed Servers, Automation,

Loose Coupling, Services, Not Servers, Databases, Managing Increasing Volumes of Data, Removing Single Points of Failure, Optimize for Cost, Caching, Security.

Text books:

1. Artificial Intelligence a Modern Approach by Peter Norvig, Rusell

Reference Books:

2. Internet of Things – A hands-on approach", Arshdeep Bahga and Vijay Madisetti
3. Architecting for the Cloud-AWS Best Practices

20ME3115 – HEAT TRANSFER

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply Fourier law of conduction and combined conduction convection concepts to 1-D heat transfer problems.	PO1, PSO1	3
CO2	Analyze heat transfer using extended surfaces , unsteady state heat transfer and 2-D conduction mode of heat transfer	PO1, PSO2	4
CO3	Understand convection mode of heat transfer and heat transfer during phase change by applying the empirical correlations to solve convection problems	PO1, PSO1	3
CO4	Apply the principles of heat transfer to analyze and design different heat exchangers.	PO1, PSO2	4
CO5	Experimental verification of various heat transfer parameters	PO1, PSO2	3

Course Objective:

To apply the knowledge of material and energy balances, mass transfer and chemical reaction engineering–I for solving problems involving heterogeneous reaction systems and to understand and apply the principles of non-ideal flow in the design of heat exchangers.

Syllabus:

Introduces fundamental processes of heat transfer.Fourier's law. Heat conduction processes including thermal resistance, lumped capacitance,fins

Elementary convection, including laminar and turbulent boundary layers, internal flow, and natural convection.

Heat transfer in boiling and condensation. Thermal radiation, including Stefan-Boltzmann law,

Small object in large enclosure, and parallel plates. Basic concepts of heat exchangers, shape factors

Text Books:

1. Heat Transfer – A practical approach, Yunus A. Cengel, Second Edition, Tata McGraw-Hill.
2. Introduction to Heat Transfer, Incropera. F. P. and Dewitt D. P., John Wiley and Sons.

Reference Books:

1. A Heat Transfer Text Book, Lienhard, J. H., Prentice Hall Inc.
2. Heat Transfer, Holman, J. P., McGraw-Hill Book Co., Inc., New York.
3. Heat Transfer – A Basic Approach, M. NecatiOzisik, McGraw-Hill Pub Co., New York.

20ME3216 – ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand about Artificial Intelligence, techniques of AI and Problem solving by Search, Heuristic Search, Randomized search techniques and Finding Optimal paths	PO1, PO5	2
CO2	Analyze the appropriate methodologies for problem decompositions, planning and constraint data constraint satisfactions.	PO1, PO5	4
CO3	Understand the Basics of Descriptive Statistics, Inferential Statistics.	PO1, PO5	2
CO4	Understand the Basics of Regression & ANOVA and Prescriptive analytics.	PO1, PO5	2
CO5	Apply the theoretical concepts to conduct various experiments on Search Techniques and Language Representation.	PO4	3

Syllabus:

Introduction: Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents. **State Space Search:** Depth First Search, Breadth First Search, DFID. **Heuristic Search:** Best First Search, Hill Climbing, Beam Search, Tabu Search. **Randomized Search:** Simulated Annealing, Genetic Algorithms, Ant Colony optimization. **Finding Optimal Paths:** Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search. **Problem Decomposition:** Goal Trees, AO*, Rule Based Systems, Rete Net. Game Playing: **Planning and Constraint Satisfaction:** Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graph plan, Constraint Propagation.
Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and backward chaining.
Descriptive Statistics: Introduction to the course Descriptive Statistics Probability Distributions
Inferential Statistics: Inferential Statistics through hypothesis tests Permutation & Randomization Test
Regression & ANOVA: Regression, ANOVA (Analysis of Variance)
Prescriptive analytics:
Creating data for analytics through designed experiments, creating data for analytics through active learning, creating data for analytics through Reinforcement learning.

Text books:

1. Deepak Khemani. A First Course in Artificial Intelligence, McGraw (India), 2013. Hill Education

Reference Books:

1. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.
2. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
3. Pamela McCorduck, Machines Who Think:A Personal Inquiry into the History and Prospects ofArtificial Intelligence,A K Peters/CRC Press; 2 edition, 2004.
4. Zbigniew Michalewicz and David B. Fogel. How to Solve It: Modern Heuristics. Springer; 2nd edition, 2004.

FLEXI-CORE COURSES

20ME3221 - OOPS THROUGH JAVA

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the basic concepts of Java Language.	PO1	2
CO2	Understand the basic concepts of Loop Controls and Decision Making through Java Language.	PO1	2
CO3	Understand the basic concepts of Class and Object in Object Oriented Programming through Java Language.	PO1	2
CO4	Understand the basic concepts of Inheritance in Object Oriented Programming through Java Language.	PO1	2
CO5	Apply the concepts of ObjectOriented Programming through Java Language.	PO5	3

Syllabus:

Basic Java Application, Variables and Types, Text Input and Output, Java Objects and Subroutines, Details of Expressions.

Java Blocks, Loops and Branches, Algorithm Development, while and do..while, for Statement, if Statement, switch Statement.

Java Class Fundamentals, Declaring Objects, Introducing Methods, Constructors, this Keyword, Overloading Methods.

Inheritance Basics,Using super, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance.

Text Books:

1. Java - The Complete Reference by Herbert Schildt, McGraw-Hill Education, 2019.
2. Programming in JAVA, Dietel & Dietel, AWL.
3. Introduction to JAVA programs, Y.Danial Liang, PHI.

Reference Books:

1. Java for Dummies by Barry Burd.

20ME3222 - R-PROGRAMMING

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the Basic Concepts of R Language Syntax.	PO1	2
CO2	Understand the Basic Concepts of Objects, Symbols and Environments in R Language.	PO1	2
CO3	Understand the Basic Concepts of Functions in R Language.	PO1	2
CO4	Understand the Basic Concepts of Object-Oriented Programming in R Language.	PO1	2
CO5	Apply the concepts of R Programming, for Statistical Software Development.	PO5	3

Syllabus:

R LANGUAGE INTRODUCTION AND SYNTAX: An Overview of the R Language, Constants, Operators, Expressions, Control Structures, Accessing Data Structures, R Code Style Standards.

R OBJECTS, SYMBOLS AND ENVIRONMENTS: Primitive Object Types, Vectors, Lists, Other Objects, Attributes, Symbols, Working with Environments, The Global Environment, Environments and Functions, Exceptions.

FUNCTIONS: The Function Keyword, Arguments, Return Values, Functions as Arguments, Argument Order and Named Arguments, Side Effects.

OBJECT-ORIENTED PROGRAMMING: Overview of Object-Oriented Programming in R, S3 Classes, S4 Classes, S3 Versus S4, Managing Your Objects.

Text Books:

1. R in a Nutshell by Joseph Alder. O'Reilly Media.
2. The Art of R Programming by Norman Matloff.

Reference Books:

1. R for Dummies by Andrie de Vries, Joris Meys.

20ME3223 - PYTHON PROGRAMMING

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the Basic Concepts of Python.	PO1	2
CO2	Understand the Basic Concepts of Reading, Writing and Organizing Files using Python.	PO1	2
CO3	Understand the Basic Concepts of Working with CSV Files, Excel Spreadsheets, Pdf and Word Documents using Python.	PO1	2
CO4	Understand the Basic Concepts of Scheduling Tasks and Launching Programs using Python.	PO1	2
CO5	Apply the concepts of Python Programming, for Automating the Industrial needs.	PO5	3

Syllabus:

PYTHON BASICS: Arithmetic Operations, Logical Operations, Conditional Statements, Loops, Functions, Object Oriented Programming.

READING, WRITING AND ORGANIZING FILES: Files and File Paths, The os.path Module, The File Reading/Writing Process, Walking a Directory Tree, Compressing Files with the zipfile Module.

WORKING WITH CSV FILES, EXCEL SPREADSHEETS, PDF AND WORD DOCUMENTS: CSV Files, Excel Documents, PDF Documents, Word Documents.

SCHEDULING TASKS AND LAUNCHING PROGRAMS: The time Module, Rounding Numbers, The datetime Module, Review of Python's Time Functions, Launching Other Programs from Python, Sending Email, Sending Text Messages with Twilio.

Text Books:

1. *A Practical Introduction to Python Programming* by Brian Heinold.
2. *Automate the Boring Stuff with Python* by Al Sweigart.

Reference Books:

1. *Python for Dummies*by Stef Maruch, Aahz Maruch.

20ME3224 – MACHINE LEARNING

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the basic Python Programming and basic computations using Python	PO2	2
CO2	Understand and apply the basic Machine Learning and Pre-processing techniques in Machine Learning	PO3	3
CO3	Understand and apply supervised Machine Learning techniques- Regression Techniques	PO3	3
CO4	Understand and apply supervised Machine Learning techniques – Classification Techniques	PO3	3
CO5	Apply Machine Learning algorithms to solve real world problems	PO3	3

Course Objective:

At the end of this course on Machine Learning which is a challenging and highly rewarding subfield of Data science, the learner will be able to learn basic concepts of Machine learning, Algorithms and coding in a simple way. Learner will have hands-on practice in the form of implementing algorithms of Machine learning in Python programming language which are based on real life examples.

Syllabus:

Introduction to Python

Basic operations using python, strings, lists and tuples

Data Pre-processing techniques in Machine Learning

Introduction to machine learning, Data handling, Importing libraries, Data pre-processing using python, Missing data, Categorical Data

Regression algorithms in Machine Learning:

Linear regression, Logistic regression, Polynomial regression, Multivariate regression, Gradient descent method

Classification algorithms in Machine Learning:

Naïve bayes algorithm, Support vector machine (SVM), Support vector machine in regression (SVR).

Text Books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010.

PROFESSIONAL ELECTIVES

20ME4051 - THEORY OF ELASTICITY AND PLASTICITY

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : 20ME2208

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Analyze stresses and strains in planes in elastic or plastic region	PO1, PO2	4
CO2	Solve 2-D problems in rectangular Components	PO1, PO2	4
CO3	Analyze stresses and strains in 3-D problems	PO1, PO2	4
CO4	Analyze Beams and frames in plasticity applications	PO1, PO2	4

Syllabus:

Introduction:

Elasticity: Components of stress and strain: plane stress and plane strain;

Plasticity: Foundations of plasticity, the criterions of yielding, stress-strain relationship, stress resolving postulates, rule of plastic flow.

2-D Problems in rectangular co-ordinates: solution by polynomials; St.Venants principle; determination of displacements; Bending of a cantilever loaded at the end; Bending of a beam under uniform load.

Stress and strain analysis in 3-D problems: Principle stresses and their determination; Stress invariants; strains at a point. Principal axis of strain; Elementary problems.

Plastic analysis of beams and frames: Limit analysis of beams and frames; Minimum weight design, influence of axial force.

Text Books:

1. Theory of Elasticity by Timeshanko, McGrawhill Publications.
2. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.

Reference Books:

1. Theory of Elasticity by Y.C.Fung.
2. Engineering Plasticity; Slater R.A.C: John Wiley and Son: NY 1977

20ME4052 – DYNAMICS OF MULTI BODY SYSTEMS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 3
Pre-requisite : 20PH1010

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Analyze one DOF free and forced undamped vibration systems	PO1, PSO1	2
CO2	Analyze and control of one DOF forced damped vibration systems	PO2, PSO1	3
CO3	Analyze and control of Two and Multi DOF vibration systems	PO2, PSO1	3
CO4	Analyze continuous systems and vibration measurement.	PO2, PSO1	2

Syllabus:

FUNDAMENTALS OF VIBRATION: Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration.
Single Degree Freedom Systems: Free and Forced vibration of undamped systems.
Forced Vibration of Damped with Harmonic Excitation System, Vibration isolation - Vibrometers and accelerometers - Response to Arbitrary and non - harmonic Excitations – Transient Vibration –Impulse loads-Critical Speed Of Shaft-Rotor systems. Vibration Isolation methods - Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber - Damped Vibration absorbers. Specification of vibration limits –Vibration severity standards - Vibration as condition monitoring tool.
TWO DEGREE FREEDOM SYSTEM: Introduction- –Coordinate Couplings and Principal Coordinates
MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM: Multi Degree Freedom System –Influence Coefficients and stiffness coefficients-Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix-Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method.
Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method.
Continuous System: Vibration of String, Shafts and Beams. Introduction to Active and Semi-active Vibration Control.
Vibration Measurement: Basics, data acquisition, FFT analysis and filters

Text Books:

1. Mechanical Vibrations, S.S. Rao, Pearson Education Inc. (4th Ed.), 2007.
2. Mechanical Vibrations by G. K. Groover. Nem Chand & Bros.
3. Vibration and Control, D. J. Inman, John Willey & Sons Inc, 2002
4. Mechanical Vibrations, S. Tamadonni & Graham S. Kelly, Schaum's Outline Series, Mc-Graw Hill Inc, 1998.

20ME4053 - MODELING ANALYSIS & DESIGN OF ROBOTIC SYSTEMS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the forward and inverse dynamics and different types of dynamic formulation schemes.	PO1, PO2	2
CO2	Modeling of motion of robots and manipulators	PO1, PO2	3
CO3	Kinematic modeling and analysis of mechanical and robotic systems	PO1, PO2	4
CO4	Understand the control of mechanical / robotic systems	PO1, PO2	2

Syllabus:

Introduction to Robot Dynamics and Kinematics: Forward Dynamics and Inverse Dynamics – Importance – Spatial description and transformations – Different types of dynamic formulation schemes – Lagrangian formulation for equation of motion for robots and manipulators.
Dynamic Modeling and Simulation: Modeling of motion of robots and manipulators using Newton – Euler equations – State space representation of equation of motion and system properties – Importance of Simulation and its types – Numeric Integration solvers and their role in numeric simulation - Numeric simulation of robots and manipulators using MATLAB / Simulink module.
Introduction to Robot Control: Introduction – Need and types of control schemes for robots – joint space control schemes with an example – task space control schemes with an example.
Kinematics and Dynamics Modeling: Kinematic modeling and analysis of mechanical and robotic systems – Forward kinematics and inverse kinematics – Jacobian and velocity analysis – Dynamic/ Kinetic modeling and analysis of mechanical and robotic systems – Forward dynamics, statics and performance analysis.
Kinematics and Dynamics Controlling: System control of mechanical / robotic systems using Adams – Inverse dynamics, regulatory control and tracking control.

Text books:

1. Kelly R, Santibanez V and Loria A, ―Conrol of Robot Manipulators in Joint Space‖, Springer, 2005.
2. Devendra K Chaturvedi, ―Modeling and Simulation of Systems using MATLAB and Simulink, CRC press, 2010.

20ME4054 - CREEP FATIQUE AND FRACTURE MECHANICS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 4
Pre-requisites : 20ME2208

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Assess the failure of unflawed structural components	PO2, PO4	4
2	Assess the fatigue life of structural components under the specified load spectrum	PO2, PO4	4
3	Evaluate the fracture toughness and assess the life of flawed structural components	PO2, PO4	4
4	Assess the life of structural components under creep	PO2, PO4	4

Syllabus:

Analysis of stresses and strains in three-dimensions: Principal stresses and strains. Stress / strain invariants, Octahedral stresses, Theories of failure, various yield criteria.

Repeated Stresses and fatigue in metals: Fatigue tests, endurance limit, Fatigue under combined loadings. Fatigue design theory: Goodman, Gerber and Soderberg criteria.

Factors influencing fatigue behavior of metals: Frequency, temperature, size, form, surface conditions, residual stress, etc. influence of stress concentration, notch sensitivity. Various mechanical and metallurgical methods used for improving fatigue strength of metals. Effects of corrosion; Corrosion fatigue and fretting; Cumulative fatigue damage and life estimation of components;

Fracture Mechanics: Basic modes of fracture; Griffith theory of brittle fracture and Orwan modifications;

Linear Elastic Fracture Mechanics (LEFM): Stress field ahead of crack-tip; stress intensity factors; critical SIF; Fracture toughness testing and evaluation of KIC.

Elasto-plastic fracture mechanics: Plane stress and plane strain plastic zone sizes; J-integral method; SERR computation and evaluation of structural integrity.

Creep behaviour of metals: Creep-stress-time-temperature relations; creep testing methods; Mechanics of creep; creep in tension, bending and torsion; strain-hardening effects on creep; creep buckling; members subjected to combined stresses and creep.

Text books:

1. Mechanical Metallurgy – George E. Dieter (McGraw-Hill)
2. Elementary Engineering Fracture Mechanics – David Broek (Springer)

Reference Books:

1. Engineering Fracture Mechanics – S.A. Meguid (Springer)
2. Fracture Mechanics – C.T. Sun and Z.H. Jin (Elsevier)
3. Elements of Fracture Mechanics – Prashant Kumar (Tata McGraw-Hill)
4. Fundamentals of Fracture Mechanics – TribikramKundu (CRC Press)
5. Mechanical Behavior of Materials – Norman E. Dowling (Prentice Hall)

20ME4055 - ADVANCED STRENGTH OF MATERIALS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 20ME2101

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Analyze statically indeterminate beams	PO1, PO2	4
CO2	Analyze stresses in curved beams and Examine the Shear Centre for various cross sections of beams	PO1, PO2	4
CO3	Apply unit load method to find deflections in beams and structures	PO1, PO2	3
CO4	Analyze stresses in rotating members and thick cylinders	PO1, PO2	4
CO5	To simulate the structural members using ANSYS and validate the results with analytical methods	PO1, PO2	4

Syllabus:

Statically Indeterminate Beams: Introduction to Statically indeterminate Beams, apply the Moment Area Method to analyze the fixed beams. Introduction to Continuous beams, apply Clapeyron's theorem of three moments to analyze continuous beams.
Curved Beams: Stresses in Beams of small and large initial curvature, Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections.
Shear Center: Importance of Shear Centre, Locate the shear center for different cross-sections.
Energy Methods: Introduction, Principles of virtual work, Apply Unit load Method to determine displacements and slope in Beams and to analyze simple structures and trusses.
Centrifugal Stresses: Introduction, Stresses in Rotating Ring, Disc of uniform thickness.
Thick Cylinders: Stresses in Thick cylinders, Apply Lame's theory to determine radial and circumferential stresses in thick cylinders. Stresses in compound cylinders.

Text books:

1. Mechanics of Materials by Gere and Timoshenko, CBS publishers, 2nd edition.

Reference Books:

1. Pytel A H and Singer F L, *"Strength of Materials",* Harper Collins, New Delhi.
2. Beer P F and Johston (Jr) E R, *"Mechanics of Materials",* SI Version, McGraw Hill, NY.
3. Popov E P, *"Engineering Mechanics of Solids",* SI Version, Prentice Hall, New Delhi.
4. Advanced Mechanics of Solids by L. S. Srinath, 3rd edition Tata McGraw-Hill, 2009.

List of Experiments:

1. To analyze fixed beam subjected to symmetrical loading
2. To analyze fixed beam subjected to unsymmetrical loading
3. To analyze two span continuous beam subjected to similar loads
4. To analyze three span continuous beam subjected to combination of loads
5. To analyze curved beam with rectangular cross section
6. To analyze curved beam with trapezoidal cross section
7. To validate the simulation of cantilever beam using analytical method
8. To validate the simulation of Truss using analytical method
9. To plot the variation of stresses in rotating disc of uniform thickness
10. To analyze thick cylinder subjected to internal pressure

20ME4056 - MECHANICS OF COMPOSITES

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 20ME2208

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Know the composite materials and manufacturing methods	PO1	2
CO2	Understand the behavior of composite Lamina	PO1	2
CO3	Know the properties of various types composite materials	PO1	2
CO4	Apply Failure theories to calculate stresses in composite materials	PO1	3

Syllabus:

Introduction to composite materials, Geometric definitions, Classification of composites, Types of fibers, Types of the matrix, Hybrid composite, scale of analysis- micro and macro mechanics approaches, Degree of Anisotropy. Manufacturing methods of the composites, Autoclave moulding, Filament winding, Resin transfer moulding.

Elastic behaviour of composite lamina (Micro mechanics),Micro mechanics methods, Geometric aspects and elastic symmetry, Longitudinal elastic properties(Continuous fibers), Transverse elastic properties, In-plane shear properties(Continuous fibers),Longitudinal properties(short fibers)

Elastic behaviour of composite lamina (Macro mechanics approach), stress strain relations: General anisotropic material, Specially orthotropic material, transversely isotropic material, Orthotropic material under plane stress, isotropic material.

Standard sizes of the specimen for tensile and compressive, Fatigue tests, impact test of uni-directional composites. Failure of the composite materials: fibre failures, matrix failure, interface failure. Failure Theories Tsai-Wu, Tsai-hill, Puck criterion, Maximum stress, maximum strain, Hashin.

Text Books:

1. Engineering Mechanics of composite materials by Issac Daniel
2. Mechanics of composite Materials by AutarK.Kaw

Reference Books:

1. Mechanics of composite materials by R.M.Jones
2. Mechanics of Composite Materials Recent Advances by ZviHashin, Carl T.Herakovich
3. Principles of composite material mechanics by Ronald F.Gibson

20ME4057 – SUSTAINABLE DESIGN & SOCIAL INNOVATION IN ENGINEERING DESIGN

L-T-P-S : 1-0-4-0
Credits : 3
Contact Hours : 5
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Able to know all fundamental concepts related to the courses in Engineering Design Specialization	PO1	3
CO2	Able to gain hands-on experience on all relevant software tools	PO5	3
CO3	Able to identify the real-world problem and inculcate problem solving and critical thinking skills	PO7	3
CO4	Design and execute a fully functional prototype	PO4, PSO1, PSO2	5

Course Objective:

- The objective of this course is to design a capstone project by providing understanding of all necessary fundamental concepts learned through the core and elective courses and able to identify the real-world problem and provide the solution.

Syllabus:

Fundamental concepts in Engineering Design Specialization

Hands-on experience on all relevant software tools

Capstone Project:

Step-1: Define the problem and identify the objectives

Step-2: Research must be focused and incorporate new ideas and a thorough exploration of old similar ideas.

Step-3: The build process must take into consideration materials, processes, construction limitations, and cost**.**

Step-4: The entire project must be tested to see if it does the job for which it was designed.

References:

1. Text books
2. E-resources
3. Journals
4. Web resources

20ME4061 - MODERN MANUFACTURING PROCESSES

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 20ME2107

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	To classify and understand the need of Non-Traditional Manufacturing Processes.	PO2	2
CO2	To understand the working principle, mechanism of metal removal and the effect of various process parameters on its performance of various Non-Traditional Machining Processes.	PO2	2
CO3	To understand the working principle and the effect of various process parameters on its performance of various Non-Traditional Welding Processes.	PO2	2
CO4	To understand the working principle of various Non-Traditional Forming Processes.	PO2	2

Syllabus:

Modern Manufacturing Processes: Introduction, Need for modern manufacturing processes. Classification of modern machining processes based on sources of energy.

Mechanical energy-based machining processes: Principle, Equipment, Process parameters, Advantages, limitations and applications of Abrasive jet machining, water jet machining, ultrasonic machining.

Chemical energy-based machining processes: Principle, Equipment, Process parameters, Advantages, limitations and applications of Chemical machining, Electro-chemical machining, Electro-chemical deburring and Electro chemical honing.

Thermoelectric energy-based machining processes: Principle, Equipment, Process parameters, Advantages, limitations and applications of Electric discharge machining, Wire-electric discharge machining, electric discharge grinding, laser beam machining, plasma arc machining, electron beam machining.

Non-traditional welding processes: Principle, Equipment, Process parameters, Advantages, limitations and applications of Laser beam welding, Plasma arc welding, Electron beam welding, Ultrasonic welding, Friction welding, Explosive welding and Under water welding.

Non-traditional Forming processes: Methods, advantages, limitations and applications of Explosion Forming Process, Electro Hydraulic Forming, Magnetic Pulse Forming, Petro-Forge Hammer.

Text Books:

1. Advanced machining processes / Jain V K / Allied Publishers, 2005

2. Welding and Welding Technology, Richard L. Little, McGraw Hill.Inc., U S,Ist Edition.

Reference Books:

1. Modern Machining Processes / Pandey P.C. and Shah H.S./ TMH, 1995
2. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984
3. Production Technology -- H.M.T.
4. High velocity forming of metals -ASTME Prentice Hall
5. Non-Conventional Machining by P K Mishra, Narosa Publications

20ME4062 - ADDITIVE MANUFACTURING

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	To be able to properly distinguish between the hype and realities of additive manufacturing	PO2	2
CO2	To understand the basic AM processes, and the limitations and advantages of each.	PO2	2
CO3	To understand the differences between traditional processes and additive manufacturing production, including the differences in design methodology.	PO2	2
CO4	To use AM terminology properly and understand the role and importance of standards in the additive manufacturing industry.	PO2	2

Syllabus:

Additive Manufacturing Process: Basic Principles of the Additive Manufacturing Process, Generation of Layer Information, Physical Principles for Layer Generation. Elements for Generating the Physical Layer, Classification of Additive Manufacturing Processes, Evaluation of the Theoretical Potentials of Rapid Prototyping Processes.

Machines for Rapid Prototyping:OverviewofPolymerization: Stereolithography (SL), Sintering/Selective Sintering: Melting in the Powder Bed, Layer Laminate Manufacturing (LLM) and Three-Dimensional Printing (3DP).

Rapid Prototyping: Classification and Definition, Strategic Aspects for the Use of Prototypes, Applications of Rapid Prototyping in Industrial Product Development. Rapid Tooling: Classification and Definition of Terms, Properties of Additive Manufactured Tools, Indirect Rapid Tooling Processes: Moulding Processes and Follow-up Processes, Indirect Methods for the Manufacture of Tools for Plastic Components, Indirect Methods for the Manufacture of Metal Components.

Direct Rapid Tooling Processes: Prototype Tooling: Tools Based on Plastic Rapid Prototyping Models and Methods, Metal Tools Based on Multilevel AM Processes, Direct Tooling: Tools Based on Metal Rapid Prototype Processes.

Text Books:

1. Andreas Gebhardt Jan-Steffen Hötter, Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser Publications, 6915 Valley Avenue, Cincinnati, Ohio.

2. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Second Edition, Springer New York Heidelberg Dordrecht London.

Reference Books:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid
3. Tooling: Technologies and Industrial Applications", CRC press, 2000.

20ME4063 - ADVANCED MATERIALS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Ability to identify different types of optimization problems	PO2	2
CO2	Understand basic concepts in solving nonlinear optimization problems	PO2	2
CO3	Understand optimality conditions for unconstrained and constrained optimization problems and be able to apply them in verifying the optimality of a solution	PO2	2
CO4	Understand basics of choosing and implementing optimization methods	PO2	2

Syllabus:

Introduction to composite materials: Introduction, classification: Polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber-reinforced composites and nature-made composites, and applications.

Reinforcements: Fibres-glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres. Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.

Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

Macromechanical analysis of alumina: Introduction, generalized hooke's law, reduction of hooke's law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of an orthotropic lamina, laminate-laminate code.

Functionally graded materials: Types of functionally graded materials-classification-different systems-preparation-properties and applications of functionally graded materials.

Shape memory alloys: Introduction-shape memory effect- classification of shape memory alloys-composition-properties and applications of shape memory alloys.

Nano Materials: Introduction-properties at Nano scales-advantages & disadvantages-applications in comparison with bulk materials (Nano-structure, wires, tubes, composites).

Text Book:

1. Nano material by A.K. Bandyopadyay, New age Publishers.
2. Material science and Technology- Cahan.

3. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press.

Reference Books:

1. R. M. Jones, Mechanics of Composite Materials, McGraw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van-NostrandRainfold.
3. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
4. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), AutarK.Kaw, Publisher: CRC.

20ME4064 - FLEXIBLE MANUFACTURING SYSTEMS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Analyze various production schedules and plant layouts.	PO2	2
CO2	Apply the concept of group technology to the development of FMS.	PO2	2
CO3	Identify hardware and software components of FMS.	PO2	2
CO4	Analyze materials handling and storage system in FMS.	PO2	2
CO5	Conduct experiments & hands on experience related to NC part programming	PO4	3

Syllabus:

Production systems: Types of production-Job Shop, Batch and Mass production-Functions in manufacturing - Organization and information processing in manufacturing - Plant layout - Work in progress inventory - Scheduling, problems.

Group technology: Formation of part families - Part classification - Coding system - Opitz, Multi Class, Production flow analysis - Machine cell design - Clustering methods - Modern algorithms - Benefits - System planning - Objective, guide line, system definition and sizing - Human resources - Objective, staffing, supervisor role.

Flexible manufacturing systems: FMS - Introduction - Evolution - Definition - Need - Economic Justification, Application - Machine tool Selection and Layout - Computer control system - Data files - Reports - Planning the FMS - Analysis Methods for FMS - Benefits and limitations.

Flexible manufacturing cells: Introduction - Cell description and classifications - Unattended machining - Component handling and storage system - Cellular versus FMS - System - Simulation, Hardware configuration - Controllers - Communication networks - Lean production and agile manufacturing.

Text Books:

1. William W. Luggen, “Flexible Manufacturing Cells and Systems”, Prentice Hall, New Jersey, 1991.
2. Mikell P. Groover, “Automation Production Systems & Computer Integrated manufacturing”, Prentice Hall of India, New Delhi, 2007.
3. Jha.N.K, "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.

Reference Books:

1. David J. Parrish, “Flexible Manufacturing”, Butterworth-Heinemann, Newton, MA, USA, 1990.
2. Radhakrishnan.P and Subramanyan.S, “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 1994.
3. Raouf.A and Ben-Daya.M, Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.

20ME4065 - ROBOTICS & INDUSTRIAL AUTOMATION

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Explain the General function of Industrial Automation	PO3	2
CO2	Identify Safety in Industrial Automation,	PO3	2
CO3	Identify and understand the types of Industrial Sensors	PO3	2
CO4	Identify Practical Programmable Logic Controller Applications	PO3	2

Syllabus:

Evolution of Robotics and Automation: Robotics in science fiction, industrial revolution, history and need of robotics, definition of a robot, robot terminology, types and applications of robot, overview of present status and future trends, robotics market and future prospects.

Industrial Automation: Reasons for automation, arguments for and against automation, type of Industries and components of automation.

Types of Industrial Sensors: Optical, Inductive, Capacitive, Encoders, Ultrasonic, Thermocouples, Demonstrate Proper Wiring Techniques and Practical Applications.

Programmable Logic Controller: Introduction to PLC, Need of PLC in Designing, Architecture of PLC, Application and Advantage of PLC, Automation Concept And Basic Design, PLC Programming.

Text Books:

1. Terry Bartlet, “Industrial Control Electronics Devices, Systems, & Applications”, 3rd Edition, Delmar Publisher.

20ME4066 - REVERSE ENGINEERING AND RAPID PROTOTYPING

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the need of reverse engineering	PO1	2
CO2	Understand working principles of RP techniques	PO3	2
CO3	Understand Rapid tooling and RP case studies	PO3	2
CO4	Understand applications of RP techniques	PO3	2

Syllabus:

Reverse Engineering: Introduction, Need, RE taxonomy, RE types, RE Contact techniques, CMM, RE noncontact techniques, RE Applications. Definition of prototype, Types of Prototype, History (RP) systems, Classification of RP Systems.

Data processing for rapid prototyping, Liquid based techniques: Principle of operation, Machine details, Material, Process details of SLA, SGC, SCS, SOUP, two layer beams and applications.

Solid based techniques: Principle of operation, Machine details, Material, Process details LOM, FDM, PLT, MJM, MEM and applications.

Powder based techniques: Principle of operation, Machine details, Material, Process details of SLS, 3DP, LENS, DSPC, MJS, EBM and applications.

Rapid tooling and RP case studies: Introduction, Classification of RT routes- RP of Patterns, Soft tooling, production and bridge tooling, Aerospace Industries, Automotive Industries and Bio Medical application

Case Studies: Wind Tunnel Testing with Rapid Prototyped Models, RP applied to investment casting. integration of reverse engineering and rapid prototyping.

Text Books:

1. Karunakaran K.P,Vijay P Bapat, Ravi B “Rapid Prototyping And Tooling”, Rapid Prototyping Cell, IIT-Mumbai.
2. Pham D T and Dimov S S, “Rapid Manufacturing”, Verlag, (2001).
3. Paul F Jacobs, “Stereo lithography and other RP&M Technologies”, SME, (1996).
4. ElancheZhianC,Sunder Selwyn T,ShanmugaSundar G “Computer Aided Manufacturing”, Laxmi Publications
5. Ali K Kamrani “Rapid Prototyping: Theory and Practice” Publisher: Springer.

20ME4067 – SUSTAINABLE DESIGN & SOCIAL INNOVATION IN SMART MANUFACTURING

L-T-P-S : 1-0-4-0
Credits : 3
Contact Hours : 5
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Able to know all fundamental concepts related to the courses in Smart Manufacturing Specialization	PO1	3
CO2	Able to gain hands-on experience on all relevant software tools	PO5	3
CO3	Able to identify the real-world problem and inculcate problem solving and critical thinking skills	PO7	3
CO4	Design and execute a fully functional prototype	PO4, PSO1, PSO2	5

Course Objective:

- The objective of this course is to design a capstone project by providing understanding of all necessary fundamental concepts learned through the core and elective courses and able to identify the real-world problem and provide the solution.

Syllabus:

Fundamental concepts in Smart Manufacturing Specialization

Hands-on experience on all relevant software tools

Capstone Project:

Step-1: Define the problem and identify the objectives

Step-2: Research must be focused and incorporate new ideas and a thorough exploration of old similar ideas.

Step-3: The build process must take into consideration materials, processes, construction limitations, and cost**.**

Step-4: The entire project must be tested to see if it does the job for which it was designed.

References:

1. Text books
2. E-resources
3. Journals
4. Web resources

20ME4071- AUTOMOBILE ENGINEERING

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand various principles, components, classification of vehicles in an automobiles.	PO3	2
CO2	Understand working of Engine cooling system, coolant properties and combustion chambers.	PO3	2
CO3	Understand various lubricating systems, its properties and Transmission systems of an Automobile.	PO3	2
CO4	Understand the concepts of Suspension system and Vehicle control in an Automobile.	PO3	2
CO5	Able to apply the various concepts of Automobile engineering using simulation and analysis through suitable soft wares.	PO3	3

Syllabus:

Introduction: Classification of Vehicles – applications, Components of an automobile.
Engine and cooling system: Engine Classification, types of combustion chambers and components of engine.Coolants and its properties, Air and water cooling systems.
Lubrication and transmission Systems: Lubricants, Properties, Splash, semi-pressure and full pressure Lubricating systems. Clutches, Gear Box, Automatic transmission, propeller shaft, differential.
Suspensionsystems and vehicle control: springs, shock absorbers, wheel alignment, steering mechanisms, power steering, Brakes, Emission from automobiles.

Text books:

1. Automotive Mechanics – Crouse / Anglin, TMH
2. Automotive Mechanics, Principles & Practices – Joseph Heitner, EWP

Reference Books:

1. Joseph Heitner, “Automotive Mechanics”, Oscar Publications.
2. G.B.S. NARANG, “Automobile Engineering”, Khanna Publications.

List of Experiments:

1. Simulation and analysis of automobile Engine using Lotus Engine simulation software (LSA).

2. Simulation and analysis of automobile suspension system using Lotus Simulation Analysis software.
3. Modeling and thermal analysis of automobile engine piston using Ansys software tool.
4. Structural Analysis of Propeller shaft using Ansys software.
5. Simulation and analysis of friction clutch using ADAMS software.
6. Modeling and structural analysis of front axle using Ansys software.
7. Simulation and analysis of car suspension system using ADAMS software.
8. Structural analysis of knuckle joint using Ansys.
9. Structural analysis of Automobile frame using Ansys.
10. Simulation and analysis of spur gear using ADAMS.
11. Structural analysis of rear axles using Ansys software
12. Structural analysis of leaf spring of a bus using Ansys.

20ME4072 - HYBRID & ELECTRIC VEHICLE DESIGN

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the functioning of electric vehicle components and comparison with Internal combustion	PO1	2
CO2	Determine the Motor Torque Calculations for Electric Vehicle	PO4	3
CO3	Understand the classification of Electric vehicles and working of various fuel cells	PO1	2
CO4	Understand the importance and working of motors in Electric drive.	PO4	2

Syllabus:

Introduction: Electric Vehicle History, Components of Electric Vehicle, Comparison with Internal combustion, Engine: Technology, Comparison with Internal combustion Engine: Benefits and Challenges, EV classification and their electrification levels, EV Terminology

Motor Torque Calculations for Electric Vehicle: Calculating the Rolling Resistance, calculating the grade resistance, Calculating the Acceleration Force, Finding The Total Tractive Effort, Torque Required On The Drive Wheel.

Electric Vehicle Architecture Design: Types of Electric Vehicle and components, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV, Comparison of fuel vs Electric and solar power, Solar Power operated Electric vehicles.

Electric Drive and controller: Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers, Component sizing, Physical locations, Mechanical connection of motor, Electrical connection of motor.

Text Books:

1. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Husain, CRC Press
2. “Modern Electric Hybrid Electric and Fuel Vehicles” by Mehrdad Ehsani, Yimin Gao, Stefane Longo, Kambiz Ebrahimi., CRC Press, 3rd Edition.

20ME4073 - AUTOTRONICS & SAFETY

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand various principles, characteristics, testing, maintenance, and servicing of batteries.	PO1, PO2	2
CO2	Understand working of ignition system of an S I engine, its maintenance and service.	PO1, PO2	2
CO3	Understand wiring for Auto electrical systems for I C Engines	PO1, PO2	2
CO4	Understand the concepts of safety for various domains in automobiles.	PO1, PO2	2
CO5	Apply the various concepts of Automobile engineering using electronics through suitable soft wares.	PO4	2

Syllabus:

INTRODUCTION TO BATTERY AND ITS PRINCIPLES: Lead acid battery, principles and characteristics, Types, testing, Effect of temperature and battery on capacity and voltage, charging of batteries, sulphation and desulphation, fault diagnosis, maintenance and servicing, new developments in electrical storage.

IGNITION SYSTEM: Conventional Ignition, Crumble zone, safety sandwich construction, Types, Spark advance and retarding mechanism, Types of spark plugs, ignition timing, maintenance, servicing and fault diagnosis, Electronic Ignition systems

WIRING FOR AUTO ELECTRICAL SYSTEMS: Earth return and insulated return systems, six volt and twelve volt systems, fusing of circuits, low and high voltage cables, maintenance and servicing.

SAFETY CONCEPT: Active safety, conditional safety, perceptibility safety, operating safety – crash safety passive safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

Text Books:

1. P. L. Kohli “Automotive Electrical Equipment”
2. William H. Crouse “Automotive Electrical Equipment”
3. Bosch Automotive Handbook, 5th edition SAE publication
4. Jnusz Pawlowski, “Vehicle Body Engineering”, Business Books Limited (1989).

Reference Books:

1. Kirpal Singh, “Automobile Engineering”.
2. R. B. Gupta, “Automobile Engineering”.

List of Experiments:

1. Analysis of engine spark plug firing order using Ni lab View software.
2. Analysis of Automobile automatic lighting circuit using Ni lab view.
3. Analysis automobile Engine control system using Ni Lab View software.
4. Analysis of automobile safety alert Circuit system using Ni Lab view software.
5. Analysis of automatic parking sensor circuit system using Ni lab view.
6. Analysis of automatic safety alert system circuit using Ni lab View.
7. Analysis of driverless vehicle technology using Ni lab view.
8. Automobile vehicle (Car) side crash test using L S Dyna Software tool.
9. Automobile vehicle (Car) front crash test using L S Dyna Software tool.
10. Automobile Vehicle back crash test using L S Dyna Software tool.
11. Analysis of automatic speed control circuit using Ni Lab View.
12. Analysis of safety air bags operating circuit using Ni lab View.

20ME4074 - ROBOTICS & INDUSTRIAL AUTOMATION

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Explain the General function of Industrial Automation	PO3	2
CO2	Identify Safety in Industrial Automation,	PO3	2
CO3	Identify and understand the types of Industrial Sensors	PO3	2
CO4	Identify Practical Programmable Logic Controller Applications	PO3	2

Syllabus:

Evolution of Robotics and Automation: Robotics in science fiction, industrial revolution, history and need of robotics, definition of a robot, robot terminology, types and applications of robot, overview of present status and future trends, robotics market and future prospects.

Industrial Automation: Reasons for automation, arguments for and against automation, type of Industries and components of automation.

Types of Industrial Sensors: Optical, Inductive, Capacitive, Encoders, Ultrasonic, Thermocouples, Demonstrate Proper Wiring Techniques and Practical Applications.

Programmable Logic Controller: Introduction to PLC, Need of PLC in Designing, Architecture of PLC, Application and Advantage of PLC, Automation Concept And Basic Design, PLC Programming.

Text Books:

1. Terry Bartlet, “Industrial Control Electronics Devices, Systems, & Applications”, 3rd Edition, Delmar Publisher.

20ME4075 - AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understanding battery, Cranking motor construction and testing methods.	PO1	2
CO2	Understand the principle of alternator and to test the alternator.	PO3	2
CO3	Understand the Electronic Controls in Gasoline Engine.	PO2	2
CO4	Understand the basics of Vehicle Motion Control and telematics system	PO2	2
CO5	Perform OBD II test on vehicle and Program MYRIO hardware using Lab view.	PO1	2

Syllabus:

Batteries and Starting Systems: Vehicle Batteries – Lead acid battery Construction, Working Principle, Battery Rating, Lead Acid battery Charging methods . Requirement of a starting System, Starter motor Construction and Working. Starter Drive Mechanism – Bendix drive and Folo-thru drive, Starter Drive Mechanism – Over Running Clutch and Solenoid Mechanism.

Charging System and Lighting Auxiliaries: Alternator Principle, Construction, Working and its merits over D.C Generator, Alternator Charging Circuits, Alternator Testing Methods, Mechanical and Electronic Voltage regulator –Principle and Working, Lighting Fundamentals and Lighting Circuit, Conventional Headlamps and LED Lighting System, Wiper system and Signalling and Warning system

Electronic Engine Management System: Electronics and feedback in injection system, Conventional ignition vs electronic ignition methods and knock control system, Digital Engine Control Modes, EGR Control and variable valve timing.

Fundamentals of Vehicle Motion Control: Cruise Control System working – Throttle Actuator Stepper Motor Based Control, Antilock Braking Mechanism Electronic Suspension System – Variable Damping, Variable Spring rate, Electric Power Assisted Steering Mechanism, Four Wheel Steering.

Telematics and Vehicle Diagnostics: GPS Navigation, GPS Structure and Dead Reckoning using Inertial Navigation System, In vehicle infotainment systems, Electronic Control System Diagnostics, codes.

Text Books:

1. Tom Denton, “Automobile Electrical and Electronic Systems”, 3rd edition, Elsevier Butterworth-Heinemann 2004.

2. William B. Ribbens, "Understanding Automotive Electronics" 7th edition Butterworth-Heinemann publications, 2012.
3. Ed Doering "NI MYRIO Project Essential Guide" 2013, National Technology and Science Press
4. Allan. W. M. Bonnick, "Automotive Computer Controlled System 2001, Butterworth-Heinemann
5. Robert Bosch Gmbh, "Bosch Automotive Electric and Electronics", 5th edition, Springer-Verlag.

List of Experiments:

1. Testing of batteries & battery maintenance – Using CAEBAT S/w
2. Diagnosis of ignition system faults – Using SCADA S/w
3. Testing of starter motor and alternator – Using LAB VIEW S/w
4. Testing of regulators – Using LAB VIEW S/w
5. Wiring of head light, trafficators, and brake light – Using LAB VIEW S/w
6. Current –voltage characteristics of electrical components – Using LAB VIEW S/w
7. Measuring the temperature of resistors – Using Tech-Ed S/w
8. Determining internal resistance of a battery – Using Tech-Ed S/w
9. Testing of ignition timing using stroboscope – Using SCADA S/w
10. Testing of stabilizers, relays – Using LAB VIEW S/w
11. Calibration of indicators – Using BENZ S/w
12. Testing of wiring diagram of horn – Using ELGI S/w.

20ME4076 - AUTOMOBILE ENGINE SYSTEM AND PERFORMANCE

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Apply the knowledge of basic engine technology along with principle. Summaries of Engine Cycles.	PO1, PO2	3
2	Apply the concept performance aspect of mixture preparation and ignition system for SI and CI Engines and Combustion in	PO1, PO2	3
3	Pollutant Formation, Emission control methods and Emission norms	PO1	3
4	Engine Testing, Performance analysis and Emerging Engine Technologies	PO1, PO2	4
5	Experiments on I C Engines for performance calculation	PO4	2

Syllabus:

Automobile Engine Basic Theory: Working principles of IC Engines, Design of Engine Components, Analysis of Engine Cycles, Classification of I.C Engines , Wankel and other rotary engines. Mixture preparation systems for SI and CI Engines: Carburetion and Fuel Injection, ignition system. Combustion in SI and CI Engines: Knocking Phenomena, ignition delay period, Combustion Chambers. Pollutant formation, Emission control methods and Emission norms. Engine testing, operating characteristics and performance analysis. Emerging engine technologies.

Text Books:

1. Heinz Heisler “Advanced Engine Technology,” SAE International Publications USA, 1998.
2. John B Heywood “Internal combustion Engine Fundamentals”. Tata McGraw -Hill, 1988

Reference Books:

1. Ganesan V - Internal Combustion Engines, Third Ed. Tata McGraw Hill, 2007.
2. I. C. Engines – M.L Mathur and Sharma DhanpatRai& Sons.
3. Patterson D. J. and Henein N. A., “Emissions from Combustion engines and their control’, Ann Arbor Science Publication Inc., USA, 1978.
4. Gupta H. N., “Fundamentals of Internal combustion Engines”, Prentice Hall of India 2006.
5. Ultrich Adler “Automotive Electric /Electronic systems, Published by Robert Bosh GMBH, 1995.

List of Experiments:

1. Study and Demonstration of 4 stroke Diesel Engine with water cooled and Mechanical Loading
2. Study and Demonstration of 4 stroke Petrol Engine with water cooled and Electrical Loading
3. Determination of Brake thermal, Mechanical and Indicated efficiency of Diesel Engine using EES software
4. Draw Heat balance chart for 4 stroke Diesel Engine using EES software
5. Determination of Brake thermal, Mechanical and Indicated efficiency of Petrol Engine using EES software
6. Draw Heat balance chart for 4 stroke Petrol Engine using EES software
7. Drawing of Valve Timing diagram for 4 stroke I C Engine using EES software
8. Drawing of Port Timing diagram for 2 stroke I C Engine using EES software
9. Study of Emission analysis and Emission norms
10. Determination of exhaust analysis of an I C engine using EES software
11. Design of Engine cylinder dimensions using EES software
12. Study of New Engine Technologies

20ME4077 – SUSTAINABLE DESIGN & SOCIAL INNOVATION IN AUTOMOBILE ENGINEERING

L-T-P-S : 1-0-4-0
Credits : 3
Contact Hours : 5
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Able to know all fundamental concepts related to the courses in Automobile Engineering Specialization	PO1	3
CO2	Able to gain hands-on experience on all relevant software tools	PO5	3
CO3	Able to identify the real-world problem and inculcate problem solving and critical thinking skills	PO7	3
CO4	Design and execute a fully functional prototype	PO4, PSO1, PSO2	5

Course Objective:

- The objective of this course is to design a capstone project by providing understanding of all necessary fundamental concepts learned through the core and elective courses and able to identify the real-world problem and provide the solution.

Syllabus:

Fundamental concepts in Automobile Engineering Specialization

Hands-on experience on all relevant software tools

Capstone Project:

Step-1: Define the problem and identify the objectives

Step-2: Research must be focused and incorporate new ideas and a thorough exploration of old similar ideas.

Step-3: The build process must take into consideration materials, processes, construction limitations, and cost**.**

Step-4: The entire project must be tested to see if it does the job for which it was designed.

References:

5. Text books
6. E-resources
7. Journals
8. Web resources

20ME4081 - AUTOTRONICS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the automotive electronics for engine management system	PO1	1
CO2	Analyze required sensors and actuators for an automotive application	PO4	3
CO3	Apply the suitability of a control system for automotive application	PO3	3
CO4	Ability to analyze of electronic system for automotive applications	PO2	3

Syllabus:

Fundamentals Of Automotive Electronics: Electronic Engine Management System – Components – Open and Closed Loop Control Strategies – PID Control – Look Up Tables – Introduction – Modern Control Strategies Like Fuzzy Logic and Adaptive Control – Controlled Parameters – SI and CI Engines.

Sensors And Actuators: Introduction – Basic Sensor Arrangement – Types Of Sensors – Hall Effect Sensor – Hot Wire Anemometer – Thermistor – Piezo-Electric Sensor – Piezo-Resistive Sensors – Oxygen Concentration Sensor – Lambda Sensor – Crankshaft Angular Position Sensor – Cam Position Sensor – Mass Air Flow (MAF) Rate – Manifold Absolute Pressure (MAP) – Throttle Plate Angular Position – Engine Oil Pressure Sensor – Vehicle Speed Sensor – Stepper Motors – Relays – Detonation Sensor – Emission Sensors.

Spark Ignition Engine Management: Feedback Carburetor System – Throttle Body Injection – Multi Point Fuel Injection System – Injection System Controls –Advantage of Electronic Ignition Systems – Three Way Catalytic Converter – Conversion Efficiency Versus Lambda – Group and Sequential Injection Techniques – Fuel System Components – Advantages of Electronic Ignition Systems –Solid State Ignition Systems – Principle Of Operation – Types – Contact Less Electronic Ignition System – Electronic Spark Timing Control.

Compression Ignition Engine Management: Fuel Injection System – Parameters Affecting Combustion – Noise and Emissions in CI Engines – Pilot, Main, Advanced – Post Injection and Retarded Post Injection – Electronically Controlled Unit Injection System – Layout of the Common Rail Fuel Injection System – Fuel Injector – Fuel Pump – Rail Pressure Limiter – Flow Limiter – Working Principle – EGR Valve Control in Electronically Controlled Systems.

Digital Engine Control System: Open Loop and Closed Loop Control System – Engine Cooling and Warm Up Control – Idle Speed Control – Acceleration and Full Load Enrichment – Deceleration Fuel Cut-off – Fuel Control Maps – Open Loop Control of Fuel Injection – Closed Loop Lambda Control – Exhaust Emission Control – On Board Diagnostics: Diagnostics – Future Automotive Electronic Systems – Electronic Dash Board Instruments – Onboard Diagnosis System.

Text Books:

1. Arthur Primrose Young, Leonard Griffiths, "Automobile Electrical and Electronic Equipment: Theory and Practice for Students, Designers, Automobile Electricians and Motorists", London Butter worths, Ninth Edition, 1986.
2. William Ribbens, "Understanding Automotive Electronics: An Engineering Perspective", Butterworth-Heinemann, Seventh Edition, 2013.

Reference Books:

1. Allan Bonnick, "Automotive Computer Controlled Systems" Taylor & Francis, Fifth Edition, 2001.
2. Tom Denton, "Automobile Electrical and Electronics Systems", Butterworth-Heinemann, Fourth Edition, 2004.
3. Robert Bosch GmbH, "Diesel-Engine Management", John Wiley & Sons, Fourth Edition, 2006.
4. Robert Bosch GmbH and Horst Bauer, "Gasoline-Engine Management", Bentley Publishers, Second Edition, 2006.
5. Robert. N, Brady, "Automotive Computers and Digital Instrumentation", Prentice Hall, First Edition, 1988.
6. Hillier V.A.W, "Fundamentals of Automotive Electronics", Nelson Thornes Limited, Sixth Edition, 2012.

List of Experiments:

1. Connections and of RPM Sensors
2. Connections and Measurements of Air-Flow Sensor
3. Throttle Position Sensor (TPS)
4. Coolant Temperature Sensor (CTS)
5. Oxygen Sensor
6. Vehicle Speed Sensor
7. 3rd Gear Switch of Automatic Gearbox (3GR)
8. Park/Neutral (P/N) Switch
9. Air Condition (A/C) Switch
10. Power Steering Pressure
11. Injector Circuit
12. Control Ignition System

13. Cooling Fan Relay
14. Fuel Pump Relay
15. Circuit of A/C Compressor Relay
16. Idle Air Control Valve (A/C)
17. Torque Converter Clutch (TCC)
18. Carbon Canister Purge Valve (CCPV)
19. Exhaust Gas Recirculation Valve (EGRV)
20. ECM Operators Simulator

20ME4082 - AUTOMOTIVE SENSOR AND APPLICATIONS

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Learn the sensor classification and sensor product selection guide.	PO1	2
CO2	Analyze the measurement of engine parameter using sensor.	PO4	3
CO3	Apply required sensors and actuators for automotive applications	PO3	3
CO4	Analyze the sensors for intelligent transport systems	PO3	3
CO5	Practically study the various Sensors used in automobiles	PO4	3

Syllabus:

Introduction: Introduction to automotive sensors and instrumentation, Market perspective for sensors and instrumentation techniques, Sensor electronics and techniques, Overview of sensors measurements, Sensor linearization and characterization. Sensor classification, Signals and systems, Sensor product selection guide.

Sensors for Engines: Sensors and interfacing- Pressure, position, flow, temperature, humidity, speed, acceleration, oxygen, torque, light, distance and level

Actuators: Principles of actuation and control. DC motors, stepper motors. Relays and solenoids, Hydraulic and pneumatic.

Sensor for Chassis: Sensors and interfacing techniques for Engine control, adaptive cruise control, braking control, traction control, steering and stability.

Intelligent Sensors: Sensors for intelligent transport systems. Lighting, wipers, climate control and electronic displays, Sensors for occupant safety, The digital vehicle, Intelligent vehicle systems.

Text Books:

3. E Q Doebelin, Measurement Systems, Application and Design, 4th edition, McGraw-Hill, 2002
2.William B. Ribbens, Understanding Automotive Electronics, 5th edition, Newnes, 2006
3.Ronald k. Jurgen, Automotive Electronics Handbook, 2nd edition, McGraw-Hill, 2007

List of Experiments:

1. Study and classification of automotive sensors
2. Measurement of pressure and flow sensors
3. Measurement of humidity and temperature sensors
4. Measurement of speed, acceleration and torque sensors
5. Measurement of oxygen, light and level senors
6. Study and calibration of LVDT transducer for displacement measurement.
7. Calibration of various Sensors and interfacing techniques for Engine control, adaptive cruise control
8. Brake Pedal Position Measurement (i) using Hall Effect sensor (ii) Designing of P, PI, PID controllers using performance criteria
9. Characteristics of intelligent transport systems
10. Study and calibration of Sensors for traction control, steering and stability
11. Study of The digital vehicle
12. Study of Intelligent vehicle systems
13. Programming of micro controllers and micro processors
14. Interfacing of microprocessors, microcontroller, stepper motors and servo motors

20ME4083- ELECTRONIC ENGINE MANAGEMENT SYSTEM

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the automotive instruments and automotive sensors	PO1	2
2	Learn the measurement of engine parameter by using sensor.	PO4	2
3	Acquire ability to analyze the electronic fuel injection system	PO4	3
4	Apply the principles of digital control techniques and the application of on board diagnosis	PO3	4
5	Experiments on computerized Diesel Engine and Lab view based Engine control unit	PO4	4

Syllabus:

Sensors: Types – Air flow, Pressure, Temperature, Speed Oxygen, Detonation, Position – Principle of operation, Arrangement and material.

Gasoline Injection System: Open loop and closed loop systems, Mono point, Multi point and Direct injection systems – Principles and Features, Bosch injection systems.

Diesel Injection System: Inline injection pump, Rotary pump and injector – Construction and principle of operation, Common rail and unit injector system – Construction and principle of operation.

Ignition Systems: Ignition fundamentals, Types of solid state ignition systems, High energy ignition distributors, Electronic spark timing and control.

Engine Mapping: Combined ignition and fuel management systems. Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Hybrid vehicles and fuel cells

Text Books:

1. Bosch Technical Instruction Booklets.
2. Tom Denton, Automotive Electrical and Electronic Systems, Edward Amold,1995.

List of Experiments:

1. Introduction about lab and dividing the students in to batches
2. Study of Sensors and Actuators used in vehicles

3. Experiment on computerized Diesel Engine to measure the temperature of cooling water and exhaust gas and by sensors
4. Experiment on computerized Diesel Engine to measure the pressure and ignition details
5. Experiment on computerized Diesel Engine to measure the combustion details
6. Experiment on computerized Diesel Engine to analysis the exhaust emission
7. Experiment on computerized Diesel Engine to analysis the performance
8. Experiment on computerized Diesel Engine to draw the heat balance chart
9. Study of Emission norms
10. Measure and monitor in real time emissions of O_2, NO, CO, SO_2, and CO_2 using Virtual instrument for Emissions Measurement (VIEM) software in the platform of Labview 2010
11. Study of Labview based Engine Control Unit
12. NI CompactRIOplatformandLabVIEW software used as ECU
13. 8085 Microprocessor programming / Diagnosis of ECU

20ME4084 - INSTRUMENTATION IN AUTOMOTIVE INDUSTRIES

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the knowledge of various Measuring Instruments to design a simple Instrumentation system	PO1	2
2	Analyze the various instruments and use them in various fields	PO4	3
3	Learn and apply the measuring instruments in various industries application	PO3	3
4	Analyze suitable instrument for a given application	PO3	3

Syllabus:

Measurements in LMV & HMV: Pressure, Level, Temperature, Density, Viscosity, Torque, Vibration, Luminosity.
Instrumentation application in vehicles: Analysis of Fuel and Emitted particles Co2, Nox, Hydro carbons
Embedded application in MV: Microprocessor based front panel Indicators Ignition Systems – Engine Controls – RTOS applications.
Communication protocols: Serial bus, CAN bus, GPS tracking Systems
Automation in manufacturing industry: Assembly line applications, PLC and DCS implementation – Robotic Controls.

Reference books:

1. Instrumentation Process Industries-B.G.Liptak- Chilton Book Co.2003
2. Instrumentation, Measurement and Analysis by B.C.Nakra and K.K.Chaudhary, TMH.
3. Singh S K, “Industrial Instrumentation and Control”, Tata McGraw Hill, New Delhi, 2004.
4. William C. Dunn, “Fundamentals of Industrial Instrumentation and Process Control”, McGraw Hill, New Delhi, 2005.
5. Walt Boyes, “Instrumentation Reference Book,” Butterworth Heinemann, United States, 2003.

List of Experiments:

1. Calibration of Pneumatic pressure to Current (P to I) and Current to Pneumatic Pressure (I to P) Converters (C01)
2. Measurement of RPM using opto-coupler and comparing it with stroboscope. (C01)
3. Measurement of intensity of Light. (C01)

4. Measurement of Viscosity of Edible Oil using Redwood Viscometer. (C01)
5. Measurement of Density. (C01)
6. Measurement of torque. (C01)
7. Measurement of fuel level through eddy current sensor. (C01)
8. Flue gas analyzer. (C02)
9. Carbon residue test. (C03)
10. Introduction to Lab VIEW through examples -Front Panel, Block Diagram , Creating sub- VI using Icon and Connector Pane

20ME4085 - AUTOTRONICS AND VEHICLE INTELLIGENCE

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Acquire comprehensive knowledge on Automotive Electric and Electronic Systems with diagnosis and service	PO1, PO2	2
2	Understand the technologies embedded in Automotive systems with applications	PO1, PO2	2
3	Comprehend about Vehicle Intelligence and the applications in modern vehicles	PO1, PO2	2
4	Explore and conjecture the emerging technologies in Autonomous Vehicles with future aspects	PO1, PO2	2
5	Practical Implementation of electronics embedded in automotive technology using NI LABVIEW software	PO1, PO5	3

Syllabus:

Automotive fundamentals: The engine components, Drive train, starting & charging systems operation, Ignition system, Suspension systems, brakes, ABS, Steering system.

Automotive sensors: Temperature sensor, gas sensor, knock sensor, pressure sensor, flow sensor, torque sensor, crash sensor, Speed sensor and acceleration sensor, micro sensor, smart sensor.

Fuel injection and Ignition system: Introduction, fuel system components, electronic fuel system, fuel injection, types, throttle body versus port injection, electronic control fuel injection operation, different types, fuel injectors, idle speed control, continuous injection system, high pressure diesel fuel injection, MPFI system, Electronic ignition system: operation, types, Electronic spark timing control.

Electric vehicles and hybrid vehicles: Introduction, Electric Vehicle development, system layout, basic system components, Electric battery, solar cells, rapid charging system, motor drive system, fuel cell Electric vehicle, hybrid vehicle, series Hybrid Vehicle, parallel Hybrid Vehicle, CNG Electric hybrid vehicle.

Vehicle Intelligence: Introduction, basic structure, vision based autonomous road vehicles, architecture for dynamic vision system, features, applications, A visual control system using image processing and fuzzy theory, An application of mobile robot vision to a vehicle information system. Object detection, collision warning and Avoidance system, low tire pressure warning system.

Text Books:

1. Willium B. Ribbens,Understanding Automotive Electronics -Sixth edition Elsevier Science 2003
2. Ronald K.Jurgen, Sensors and Transducers - SAE 2003
3. Jack Erjavec, Robert Scharff, Automotive Technology - Delmar publications Inc 1992
4. Ronald K.Jurgen, Electric and Hybrid-electric vehicles - SAE 2002
5. Ichiro Masaki, Vision-based Vehicle Guidance - Springer Verlag, Newyork 1992
6. Jay Webster, Class Room Manual For Automotive Service And System - Delmer Publications Inc 1995.

20ME4086 - AUTONOMOUS VEHICLE DESIGN

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the rational for and evolution of automotive electronics and understand which automotive systems have been replaced by electronic control systems	PO1, PO2	2
CO2	Understand the fundamental theory of operation of electronic control systems and basics of how automotive ECUs function in conjunction with the vehicle data bus networks and sensors	PO1, PO2	2
CO3	Become familiar with the various types of advanced driver assistance systems and Understand the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles.	PO1, PO2	2
CO4	Understand the concept of remote sensing and the types of sensor technology needed to implement remote sensing and Understand the basic concepts of wireless communications and wireless data networks.	PO1, PO2	2

Syllabus:

Introduction to Automated, Connected, and Intelligent Vehicles: Introduction to the Concept of Automotive Electronics, Automotive Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Advanced Driver Assistance Electronic Systems.

Connected and Autonomous Vehicle Technology: Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy.

Sensor Technology for Advanced Driver Assistance Systems: Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.

Overview of Wireless Technology: Wireless System Block Diagram and Overview of Components, Transmission Systems, Modulation/Encoding, Receiver System Concepts, Demodulation/Decoding, Signal Propagation Physics, Basic Transmission Line and Antenna Theory.

Text Books:

1. G. Mullett, Wireless Telecommunications Systems and Networks, Thomson – Delmar Learning.
2. G. Mullett, Basic Telecommunications: The Physical Layer, Thomson – Delmar Learning

20ME4087 – SUSTAINABLE DESIGN & SOCIAL INNOVATION IN AUTOTRONICS

L-T-P-S : 1-0-4-0
Credits : 3
Contact Hours : 5
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Able to know all fundamental concepts related to the courses in Autotronics Specialization	PO1	3
CO2	Able to gain hands-on experience on all relevant software tools	PO5	3
CO3	Able to identify the real-world problem and inculcate problem solving and critical thinking skills	PO7	3
CO4	Design and execute a fully functional prototype	PO4, PSO1, PSO2	5

Course Objective:

- The objective of this course is to design a capstone project by providing understanding of all necessary fundamental concepts learned through the core and elective courses and able to identify the real-world problem and provide the solution.

Syllabus:

Fundamental concepts in Autotronics Specialization

Hands-on experience on all relevant software tools

Capstone Project:

Step-1: Define the problem and identify the objectives

Step-2: Research must be focused and incorporate new ideas and a thorough exploration of old similar ideas.

Step-3: The build process must take into consideration materials, processes, construction limitations, and cost**.**

Step-4: The entire project must be tested to see if it does the job for which it was designed.

References:

1. Text books
2. E-resources
3. Journals
4. Web resources

20ME4091 - DESIGN FOR QUALITY AND RELIABILITY

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Model repairable and non-repairable systems and calculate failure rate, repair rate, reliability and availability	PO1	2
CO2	Use various probability density distributions significant to reliability calculations	PO3	2
CO3	Fit a given failure data set of a product into a Weibull distribution and estimate the reliability parameters.	PO3	2
CO4	Preventive maintenance failure modes and effects	PO3	2

Syllabus:

Quality Function Deployment / House of Quality
Six Sigma, Basic concepts of repairable and non-repairable systems

Reliability, Availability and Maintainability

Fitting discrete and continuous distributions to failure data sets, Weibull analysis, estimation of important reliability parameters

Markov modeling of repairable and non-repairable systems

Reliability Logic Diagrams,· Fault-tree analysis

Preventive and Predictive maintenance:Failure Modes and Effects Analysis.

Text Books:

1. Louis Cohen, Joseph P. Ficalora, *Quality Function Deployment and Six Sigma: A QFD Handbook*, Prentice Hall, Second Edition, 2009, ISBN: 9780137035441.
2. VNA Naikan, *Reliability Engineering and Life Testing*, PHI Learning, 2010, ISBN: 978-8120335936.
3. Singiresu S Rao, *Reliability Engineering*, Pearson Education, 2014, ISBN: 978-0136015727

20ME4092 - DESIGN OF AGRICULTURAL PRODUCTS & MACHINERY

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Design and selection of machinery elements required for Agricultural machinery	PO3	4
CO2	Measurement of force, stress, torque, speed, displacement and acceleration on machine elements	PO3	4
CO3	Study of Design considerations on Farm Machinery	PO3, PO7	4
CO4	Study of Design considerations on Tractors and Power tillers	PO3, PO7	4

Syllabus:

Design and selection of machinery elements: Gears, pulleys, chains and sprockets and belts; overload safety devices used in farm machinery;

Measurement of force, stress, torque, speed, displacement and acceleration on machine elements - shafts, couplings, keys, bearings and knuckle joints.

Farm Machinery: Soil tillage; forces acting on a tillage tool; hitch systems and hitching of tillage implements, functional requirements, principles of working, construction and operation of manual, animal and power operated equipment for tillage, sowing, planting, fertilizer application, inter-cultivation, spraying, mowing, chaff cutting, harvesting and threshing calculation of performance parameters - field capacity, efficiency, application rate and losses; cost analysis of implements and tractors.

Tractors and Power tillers: Type, selection, maintenance and repair of tractors and power tillers; tractor clutches and brakes; power transmission systems – gear trains, differential, final drives and power take-off; mechanics of tractor chassis; traction theory; three point hitches - free link and restrained link operations; steering and hydraulic control systems used in tractors; tractor tests and performance; human engineering and safety considerations in design of tractor and agricultural implements.

Text Books:

1. Design of Machine Elements by Black & Adams – TMH, NewDelhi-2008- 2nd edition.
2. Design of machine elements by Bhandari, Tata McGraw Hill book Co,NewDelhi-2008
3. Engineering Principles of Agricultural Machines, 2nd Edition, Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buckmaster, American Society of Agricultural and Biological Engineers

Reference Books

1. Handbook Of Farm, Dairy And Food Machinery Engineering, Third Edition, Myer Kutz, Academic Press, Elsevier.
2. Design of Machine Elements by Shigley J E – TMH, NewDelhi-2008- 4th IRP
3. Norton, R. L. (2006) Machine Design – An Integrated Approach, Pearson-Prentice Hall, NJ.

20ME4093 - DESIGNING INTELLIGENCE SYSTEMS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Principles of complex and living systems	PO1	2
2	Concepts such as Information intensity & Knowledge	PO3	2
3	Introduction to emerging digital technologies	PO3	2
4	Apply these ideas in design	PO3	2

Syllabus:

Design Metaphors & Patterns (incl biomimetic)

Metaphors such as living systems, complex networks, viable systems

Key principles governing living / complex systems (Self-organization, self production, recursion, fractal)

Increasing information-intensity in products
• Concept of information intensity vs material/energy intensity

• Self-learning, usage patterns, early warning systems

• Using data, voice, collaborative technologies (semantic, big data, speech,Remote-help, Indic computing), Internet-of-things

• Synthesizing the above ideas for creative design.

Text Books:

1. H. G. Hey, A. M. Agogino, “Metaphors in Conceptual Design,” ASME Design Engineering Technical Conferences, Las Vegas, Nevada, in review, 2007.
2. H. Casakin, and G. Goldschmidt, “Expertise and the Use of Visual Analogy:Implications for Design Education,” Design Studies, 20(2), 153-175, 1999.
3. Kryssanov, V. V., Tamaki, H. and Kitamura, S., “Understanding Design Fundamentals: How Synthesis and Analysis Drive Creativity, Resulting inEmergence,” Artificial Intelligence in Engineering, 15, 329 – 342, 2001.

20ME4094– SUSTAINABLE DESIGN

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	To equip the design student with specific environmentally-responsive tools, principles	1	2
2	To understand the methodologies in preparation for professional application. Management	3	2
3	To use a variety of techniques to communicate effectively	3	2
4	To understand the life-cycle assessment methods	3	2

Syllabus:

Introduction, Definitions, History
• the environmental origins of sustainability

• theory of sustainability.

Environmentally-responsive design methodologies
• industrial ecology
• dematerialization
• design for reuse / modularity
• design for recycling

• Remanufacturing: issues/problems, current and future developments

Alternative resources
• alternative energy
• alternative materials

• sustainable packaging.

Life-cycle assessment methods.

Text Books:

1. Victor Papanek, *The Green Imperative*, 1995, ISBN: 978-0500278468
2. William McDonough and Michael Braungart, *Cradle to Cradle*, 2009, ISBN: 978-0099535478.
3. Stuart Walker (2006), *Sustainable by Design: Explorations in Theory and Practice*, ISBN:978-44073535
4. Charter, Tischner, *Sustainable Solutions*, Green Leaf Publishing, 2001, ISBN: 978-1874719366.

20ME4095- SYSTEMS THINKING FOR DESIGN

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	The importance of modeling systems to realize effective designs	1	2
2	Abstraction of key elements from problem situations	3	2
3	Use of specific techniques to model problems in a holistic manner	3	2
4	Use of specific techniques for self-regulating systems	3	2

Syllabus:

Real-world problems & the need for inter-disciplinary approaches
Basic concepts of systems thinking (parts, relations, patterns)

Technique #1: Rich Pictures

Technique #2: Mapping Stakeholder, Needs, Alterables, Constraints

Technique #3: Structural Modeling (Hierarchical decomposition)

Technique #4: Influence Diagrams (Self-regulating systems)

Text Books:

1. Hitchins, Derek K. (2007) Systems Engineering: A 21st Century Systems Methodology, John Wiley, ISBN: 978-0-470-05856-5.
2. Wilson, Brian (1991) Systems: Concepts, Methodologies and Applications. 2nd Edition, Wiley. ISBN: 0471927163.
3. Hutchinson, William; Systems Thinking and Associated Methodologies, Praxis Education. ISBN: 0 646 34145 6.

20ME4096 – DESIGN WITH ADVANCED ENGINEERING MATERIALS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understanding selection of materials for various engineering application	PO1, PO3	2
2	Understanding the need of high temperature materials (super-alloys)	PO1, PO3	2
3	Understanding the need of engineering plastics, elastomers	PO1, PO3	2
4	Understanding the need of ceramics, and coatings	PO1, PO3	2

Syllabus:

Engineering Design process and the role of materials; materials classification and their properties; material property charts; selection of materials based on function, objective, constraints and free variables; examples of material selection for typical applications; Computer aided materials selection. Selection of process based on material classification; pencil curve approach; material selection for multiple constraints and multiple objective cases; multiple constraints and conflicting objectives. Co-selection of material and shape; concept of macroscopic and microscopic shape factors; Four quadrant method of material selection. General Properties of plastics, polymers and elastomers; visco-elastic properties; short-term and long-term properties of plastics; mathematical modeling of plastic properties; Maxwell, Kelvin-Voigt Models; fatigue and fracture of plastics; selection of plastics based on mechanical properties, degradation due to environment, wear; Design methods for snap fits; case studies. Fundamentals of fiber reinforced plastics; Stress, strain analysis of continuous fiber composites, rule of mixtures, general deformation behavior of laminates. Introduction to high temperature materials; families of super alloys and their characteristics; creep and fatigue resistance of super alloys; role of precipitates in strengthening of super alloys; repair of super alloys after creep damage; coatings for high temperature materials. Fundamentals of ceramics, general properties, applications of ceramics for critical applications. Design considerations. Surface treatment of materials using coatings; type of coatings; PVD and CVD coatings.Basics of electro-plating and electro-less plating.

Text Books:

1. Ashby, M.F., “Materials Selection in Design”, Butterworth-Heinemann, 4/e, 2010.
2. Crawford, R. J., “Plastics Engineering”, Butterworth-Heinemann, 3/e, 2002.
3. Donachie, M. J. and Donachie, S. J., “Super alloys: A technical guide”, ASM International, 2002.

Reference Books:

1. Carter, C.B., and Grant, N. M., “Ceramic Materials: Science and Engineering”, Springer, 2007.
2. Bralla, J. C., “Design for Manufacturability Handbook”, McGraw-Hill Professional; 2/e, 1998.

20ME4097 – SUSTAINABLE DESIGN & SOCIAL INNOVATION IN PRODUCT DESIGN

L-T-P-S : 1-0-4-0
Credits : 3
Contact Hours : 5
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Able to know all fundamental concepts related to the courses in Product Design Specialization	PO1	3
CO2	Able to gain hands-on experience on all relevant software tools	PO5	3
CO3	Able to identify the real-world problem and inculcate problem solving and critical thinking skills	PO7	3
CO4	Design and execute a fully functional prototype	PO4, PSO1, PSO2	5

Course Objective:

- The objective of this course is to design a capstone project by providing understanding of all necessary fundamental concepts learned through the core and elective courses and able to identify the real-world problem and provide the solution.

Syllabus:

Fundamental concepts in Product Design Specialization

Hands-on experience on all relevant software tools

Capstone Project:

Step-1: Define the problem and identify the objectives

Step-2: Research must be focused and incorporate new ideas and a thorough exploration of old similar ideas.

Step-3: The build process must take into consideration materials, processes, construction limitations, and cost**.**

Step-4: The entire project must be tested to see if it does the job for which it was designed.

References:

1. Text books
2. E-resources
3. Journals
4. Web resources

OPEN ELECTIVES

19ME40B4 – ROBOTICS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Analyze the anatomy of existing robotic systems and their performance specifications, end effectors etc	PO3, PO5	4
CO2	Analyze a robotic system with respect to the suitable sensors, actuators for its performance.	PO3	4
CO3	Understand manipulator kinematic analysis and joint trajectory plan for a given end effector.	PO3	2
CO4	Classification of Robot Languages, Comprehensive identification of suitable Robotic system for various applications.	PO5	4

Syllabus:

Introduction to Robotics, Major components of a Robot, Robotic like devices, Classification of Robots – Classification by coordinate system and by control method, Specifications of Robots, Fixed versus flexible automation, economic analysis.

ROBOT END EFFECTORS: Introduction, End effectors, interfacing, types of End effectors, grippers and tools, considerations in the selection and design of remote cantered devices.

ROBOTIC SENSORY DEVICES: Objective, Non-Optical position sensors – Potentiometers, Synchros, inductosyn, optical position sensors – opto interrupters, Optical encoders (absolute & incremental).

PROXIMITY SENSORS: Contact type, non-contact type – reflected light scanning laser sensors.

TOUCH & SLIP SENSORS: Touch sensors – proximity Rod & Photo detector sensors, Slip sensors– Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors.

TRANSFORMATIONS AND KINEMATICS: Objectives, homogeneous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure, Simple problems involving planar manipulators, inverse or backward solution – problems involved, techniques. Introduction to Trajectory Planning, the manipulator jacobian.

ROBOT APPLICATIONS: Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications.

ROBOT LANGUAGES: Introduction, AL, AML, VAL, RAIL

Text Books:

1. Robotic engineering by Richard D. Klafter, Prentice Hall India
2. Industrial robotics by Mikell P.Groover, Mcgraw Hill Publications

Reference Books:

1. Robotics – K.S. Fu, Gonzalez & Lee, Mcgraw Hill Publications
2. Robotics for Engineers by Yoram koren, Mcgraw Hill Publications
3. Introduction to Robot Technology, - P.Coiffet and M.Chairenze / Kogam Page Ltd. 1983 London.

19ME40B5 – MECHATRONICS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Identify appropriate sensor, Identify appropriate actuation system for a given application.	PO2	3
CO2	Identify appropriate microcontroller for a given application and to build a mathematical Model of system for evaluating open loop system performance and behaviour.	PO2	3
CO3	Identify an appropriate closed loop control strategy to attain the desired system behaviour.	PO2	3
CO4	Suggest a Mechatronic product design for a given application and evaluate its performance.	PO3	3

Syllabus:

INTRODUCTION TO MECHATRONICS: Introduction, Elements of Mechatronic system, Applications. SENSORS AND TRASDUCERS: Introduction, Classification of Sensors, selection of sensors. Classification of transducers - strain gauges, displacement transducers, capacitive and inductive transducers, LVDT, oscillation transducer, piezoelectric, potentiometric, velocity transducers, temperature transducers, optical transducers.

SIGNAL CONDITIONING: Introduction, data acquisition –Quantizing theory, Analog to Digital conversion, Digital to Analog conversion.

DATA PRESENTATION SYSTEMS: Data presentation elements, Data acquisition systems, systems measurement, Testing and calibration.

ACTUATION SYSTEMS: Pneumatic and hydraulic actuation systems, Stepper and Servo Motor. SYSTEM MODELS: Modelling of one and two degrees of freedom Mechanical, Electrical, fluid and thermal systems. Block diagram representations for these systems.

SYSTEM RESPONSE: Introduction, Transfer function, Time response and Frequency response analysis mechanical systems and electrical systems.

CLOSED LOOP CONTROLERS: Continuous and discrete processes, control modes, Two-step, proportional, Derivative, integral, PID controllers.

DIGITAL LOGIC: Logic gates, Boolean algebra, Karnaugh maps. PLC: Introduction, basic structure, I/P ,O/P processing, programming, ladder diagrams, Timers, Internal relays and counters ,data handling, Analogue Input and Output, selection of a PLC.

DESIGN: Mechatronics system Design, possible design solutions.

CASE STUDY: pick and place Robot, CNC Machine.

Text books:

1. Bolton, ‖Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering‖, 3rd Edition, Pearson education, 2007.
2. David G. Alciatore, Michael B. HI stand, ‖ Introduction to mechatronics and measurement systems‖, 2nd Edition, McGraw-Hill Professional, 2002.

Reference books:

1. A.K.Sawhney, "A course in Electrical and Electronic Measurement and Instrumentation"- Dhanpat Rai & Sons - 1991.
2. Nitaigour Premchand Mahalik, ―Mechatronics‖, Tata McGraw-Hill, 2003.

19ME40B6 – OPERATIONS RESEARCH

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Model and Solve for the optimum solutions using LPP	PO5	3
CO2	Model and Find the Optimized solutions for the problems in the field of Transportation and Management / Assignments.	PO5	3
CO3	Model and Optimize Game theory, Dynamic Part Programming, Queuing Theory , Inventory Control & Simulation Problems	PO5	3
CO4	Understand and solve the Concepts related to PERT/CPM	PO5	3

Syllabus:

Introduction to Operations Research: Introduction, Modeling in Operations Research, Phases of OR study, Scope and application of OR. Linear Programming and its Applications: Linear Programming Problem – Graphical solution of LP Problem. Simplex method, Big M method, two phase method, multiple solution, infeasible solution, unbounded solution, degeneracy, Dual Simplex method.

Transportation: Introduction – Methods of basic feasible solution, Optimality test, Degeneracy in transportation problem, unbalanced transportation Problem, Assignment Problems: Hungarian method for assignment problem, Traveling salesman problem.

Theory of Games: Introduction, to solve the rectangular two-person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games.

Inventory Control: Introduction – EOQ with uniform rate of demand, Economic lot size with finite rate of replenishment, Quantity discounts, Deterministic model with Shortages, ABC analysis of inventory.

Dynamic Programming: Introduction, Bellman's principle of optimality, application to shortest route problem, linear programming, tabular method.

Queuing Theory: Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population, Simulation: Introduction, Monte Carlo Simulation, And Application to Inventory Control.

Project Management by PERT/CPM: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rule, Critical path method (CPM)- floats, critical path, project duration, PERT: Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion. Crashing: Introduction, crashing of network, problem

Text books:

1. Operations Research - Hamdy Taha
2. Operations Research – Hiller & Liberman.

Reference Books:

1. Operations Research – A.M. Natarajan
2. Operations Research – S.D. Sarma

19ME40B7 – HYBRID ELECTRIC VEHICLES

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the functioning of electric vehicle components and comparison with Internal combustion	PO1	2
CO2	Determine the Motor Torque Calculations for Electric Vehicle	PO4	3
CO3	Understand the classification of Electric vehicles and working of various fuel cells	PO1	2
CO4	Understand the importance and working of motors in Electric drive.	PO4	2

Syllabus:

Introduction: Electric Vehicle History, Components of Electric Vehicle, Comparison with Internal combustion, Engine: Technology, Comparison with Internal combustion Engine: Benefits and Challenges, EV classification and their electrification levels, EV Terminology

Motor Torque Calculations for Electric Vehicle: Calculating the Rolling Resistance, calculating the grade resistance, Calculating the Acceleration Force, Finding The Total Tractive Effort, Torque Required On The Drive Wheel.

Electric Vehicle Architecture Design: Types of Electric Vehicle and components, Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV, Comparison of fuel vs Electric and solar power, Solar Power operated Electric vehicles.

Electric Drive and controller: Types of Motors, Selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers, Component sizing, Physical locations, Mechanical connection of motor, Electrical connection of motor.

Text Books:

1. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Husain, CRC Press
2. “Modern Electric Hybrid Electric and Fuel Vehicles” by Mehrdad Ehsani, Yimin Gao, Stefane Longo, Kambiz Ebrahimi., CRC Press, 3rd Edition.

19ME40B8 – INDUSTRY 4.0

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the drivers and enablers of Industry 4.0.	PO3, PO4	2
CO2	Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services	PO3, PO4	2
CO3	Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world	PO3, PO4	2
CO4	Appreciate the power of Cloud Computing in a networked economy	PO3, PO4	2

Syllabus:

Introduction to Industry 4.0:

The Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

Road to Industry 4.0:

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics.

Related Disciplines, System, Technologies for enabling Industry 4.0: Cyber physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Related Disciplines, Cyber Security.

Role of data, information, knowledge and collaboration in future organizations: Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0.

Text books:

1. Artificial Intelligence a Modern Approach by Peter Norvig, Rusell

Reference Books:

2. Internet of Things – A hands-on approach", Arshdeep Bahga and Vijay Madisetti
3. Architecting for the Cloud-AWS Best Practices

19ME40B9 – INDUSTRIAL AUTOMATION

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Explain the General function of Industrial Automation	PO3	2
CO2	Identify Safety in Industrial Automation,	PO3	2
CO3	Identify and understand the types of Industrial Sensors	PO3	2
CO4	Identify Practical Programmable Logic Controller Applications	PO3	2

Syllabus:

Evolution of Robotics and Automation: Robotics in science fiction, industrial revolution, history and need of robotics, definition of a robot, robot terminology, types and applications of robot, overview of present status and future trends, robotics market and future prospects.

Industrial Automation: Reasons for automation, arguments for and against automation, type of Industries and components of automation.

Types of Industrial Sensors: Optical, Inductive, Capacitive, Encoders, Ultrasonic, Thermocouples, Demonstrate Proper Wiring Techniques and Practical Applications.

Programmable Logic Controller: Introduction to PLC, Need of PLC in Designing, Architecture of PLC, Application and Advantage of PLC, Automation Concept And Basic Design, PLC Programming.

Text Books:

1. Terry Bartlet, “Industrial Control Electronics Devices, Systems, & Applications”, 3rd Edition, Delmar Publisher.

19ME40C1 – LOGISTICS & SUPPLY CHAIN MANAGEMENT

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the primary differences between logistics and supply chain management	PO11	2
CO2	Know the basic concepts of SCM and list out the important drivers of SC.	PO11	2
CO3	Understand the importance of SC drivers and their influence on SC performance	PO11	2
CO4	Able to apply the concepts of SCM on simple real time SC's	PO11	2

Syllabus:

Introduction to supply chain management: Supply chain basics (Definition of SC, Objectives of SC, SC stages, SC flows, SC Examples), decision phases in a supply chain (SC Strategy or Design, SC Planning and SC Operation), supply chain efficiency and responsiveness. Process view of a supply chain (Cycle view, Push/Pull View), Supply Chain Macro Processes in a firm, drivers of supply chain performance (Facilities, Inventory, Transportation, Information and Sourcing), Supply Chain performance: Competitive and supply chain strategies, achieving strategic fit.

Planning and Managing Inventories in a Supply Chain: Review of inventory concepts, Role of cycle inventory in a SC, Economies of scale to exploit fixed costs, Economics of scale to exploit quantity discounts, short-term discounting (Trade promotions). Role of safety inventory in a SC, safety inventory determination, Impact of supply uncertainty, aggregation and replenishment policies on safety inventory.

Designing distribution networks in a SC: Role of distribution in the SC, factors influencing distribution network design, Design options for distribution network, E-Business and the distribution network.

Transportation in a SC: Role of Transportation in a SC, Modes of transportation and their performance characteristics, Design options for a transportation network, tailored transportation, Trade-offs in transportation design, Risk management in transportation.

Sourcing decisions in a SC: Role of sourcing in a SC, In-house and Outsource, supplier scoring & assessment, Supplier selection – Auctions and Negotiations, Contracts, Role of IT in sourcing. **Pricing and Revenue Management in a SC:** Role of Pricing and Revenue Management in a

supply chain, Pricing and Revenue management for Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts, Role of IT in pricing and revenue management.

Information Technology in a SC: The role of IT in a Supply Chain, The Supply Chain IT framework, CRM, ISCM, SRM, Transaction Management Foundation (TMF), Future of IT in 24 SC, The role of E-business in a supply chain, E-business framework, E-business in practice, Case discussion. Co-ordination in a SC: Lack of SC Co-ordination and the Bullwhip effect, effect on performance of lack of co-ordination, Obstacles to Co-ordination in a SC.

Text Books:

1. Supply Chain Management by S. Chopra and P. Meindl, Prentice Hall, 2010 (4th Edition)
2. Supply Chain Management – Strategy, Planning & Operation. Sunil Chopra & Peter Meindl; Pearson Education Asia,

Reference Books:

1. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems - Robert B Handfield, Ernest L Nichols - Jr., 2002, Pearson Education Inc.
2. Modelling the Supply Chain -Jeremy F Shapiro, Duxbury -Thomson Learning -2002.
3. Designing & Managing the Supply Chain -David Simchi Levi, Philip Kaminsky& Edith Simchi Levi -McGraw Hill.

19ME40C2 – TOTAL QUALITY MANAGEMENT

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Learn the principles and practices of TQM.	PO11	2
CO2	Know the evolution and challenges made in industries by TQM.	PO11	2
CO3	Understand the models to solve the problems and improving the circumstances.	PO11	2
CO4	Learn the quality tools implemented in industries and its performances.	PO11	2

Syllabus:

Principles and Practice: Definition of TQM, basic approach, Obstacles to TQM, TQM Framework, benefits of TQM. **Business Evolution:** Customer Satisfaction, four fitness of Customer Satisfaction, Evolution of Customer Satisfaction Methodology, Leadership vs Empowerment, Four Practical Revolutions in Management thinking, Four Levels of Practice.

Customer Focus: Change in the Work Concept: Market-in, Philosophy-in and Philosophy-out, Evolution of Customer Focus and Its Challenges, Three Stages of Customer Focus, Customer Concerns, Integration of Concerns, Individualizing Customers.

Continuous Improvement: Management by process, WV Model of Continuous Improvement, Three types of improvements, Continuous Improvement of Processes for All Types of Work, Continuous Improvement verses breakthrough, Continuous Improvement and the Scientific Method. **Managing Existing Processes:** Process Discovery and Management: Thinking In Terms of Process, Process Discovery, steps of Process Discovery, benefits of Process Discovery. The 7 QC Tools. **Proactive Improvement:** Proactive Improvement concept, Kawakita's Five Principles, Language Data and Use of Semantics, Comparison of Affective and Report language, Five principles of Customer Visitation, The purpose of Proactive Improvement to Develop New Products. **Total Participation:** Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, three sets of skills of leader ship. QC Circles.

Text Books:

1. "Total Quality Management"- Besterfield, Pearson Education, 2011. ISBN, 817758412X, 9788177584127.

Reference Books:

1. "Management for Total Quality" -N Logothetis- Prentice Hall of India, New Delhi, 2003.

2. “Total Quality Management”-H D Ramachandra and K R Phanesh-2006 edition.

19ME40C3 – SMART MOBILITY

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Able to appreciate the advantages of ITS	PO3	2
CO2	Able to suggest the appropriate technologies for field conditions.	PO3	2
CO3	Able to suggest the appropriate system/s in various functional areas of transportation	PO3	2
CO4	Able to amalgamate the various systems, plan and implement the applications of ITS	PO3	2

Syllabus:

Introduction to Intelligent Transportation Systems (ITS) – Definition, Objectives, Historical Background, Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

Telecommunications in ITS - Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts.

ITS functional areas – Advanced Traffic Management Systems (ATMS) , Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS). ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

ITS Operations – Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning Dept. of Civil Engineering 49 M. Tech. Transportation Engg. & Management.

ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing; Transportation network operations; commercial vehicle operations; public transportation applications; Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries.

Reference Books:

1. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House.
2. Kan Paul Chen, John Miles, "Recommendations for Wor ld Road Association (PIARC)" ITS Hand Book 2000.
3. Sussman, J. M., "Perspective on ITS", Artech House Publishers, 2005.
4. Turban. E and Aronson. J. E, "Decision Support Sys tems and Intelligent Systems", Prentice Hall

19ME40C4 – MANAGERIAL ECONOMICS FOR ENGINEERS

L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio	PO11	3
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions	PO11	3
CO3	Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value	PO11	3
CO4	Apply all mathematical approach models covered in solving engineering economics problems	PO11	3

Syllabus:

Introduction to Engineering Economics: Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, Elementary economic Analysis

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

Cash Flow: Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the method

Replacement and Maintenance Analysis: Introduction-Types of maintenance –types of replacement Problem-Determination of economic life of an asset-Replacement of existing asset with a new asset. Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund

method of depreciation/ Annuity method of depreciation, service output method of depreciation- Evaluation of public alternatives- introduction.

Text Books:

1. Dr. K K Patra, Dhiraj Bhattacharjee, Engineering Economics and Costing, S. Chand & Company Ltd, New Delhi, 2013.
2. Panneer Selvam, R., ***Engineering Economics***, Prentice Hall of India Ltd, New Delhi, 2001.

Reference Books:

1. Chan S.Park, ***Contemporary Engineering Economics***, Prentice Hall of India, 2002. Donald.G. Newman, Jerome.P.Lavelle, ***Engineering Economics and analysis*** Engg. Press, Texas, 2002.
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, ***Engineering Economy***, Macmillan, New York, 1984.
3. William G. Sullivan, Elin M Wicks, and James Luxhoj, Engineering Economy, 13th edition (Prentice-Hall)