(DEEMED TO BE UNIVERSITY)

MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS

APPLICABLE FOR B.TECH. STUDENTS
ADMITTED IN A.Y.2019-20

A. 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	19UC1101	Basic English	HSS	0	0	4	0	2	2				2					2				
2	19UC1202	English Proficiency	HSS	0	0	4	0	2	2			2	2			2	2	2				
3	19UC2103	Professional Communication Skills	HSS	0	0	4	0	2	2				2			2	2	3				
4	19UC2204	Aptitude Builder-I	HSS	0	0	4	0	2	2				2	2	2			2				
5	19UC3105	Aptitude Builder-II	HSS	0	0	4	0	2	2				2			2		3				
6	19UC3206	Campus to Corporate	HSS	0	0	4	0	2	2				2									
7	19UC0007	Indian Heritage and Culture	HSS	0	0	2	0	0	1													
8	19UC0008	Indian Constitution	HSS	0	0	2	0	1													1	
9	19UC0009	Ecology & Environment	HSS	2	0	0	0	0						3							1	
10	19UC0010	Universal Human Values & Professional Ethics	HSS	1	0	2	0	2								2						
11	19UC0011	Entrepreneurship	HSS	2	0	0	0	0												2	3	
12	19SC1104	Mathematics for Computation	BS	3	1	0	4	5	2													
13	19PH1010	Science Elective-1 (Mechanics)	BS	3	1	0	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
14	19PH2007	Science Elective-2 (Materials for Mechanical Engineering Applications)	BS	2	0	2	0	3	1			1							1			
15	19MT2102	Mathematics for Engineers	BS	2	0	2	0	3	2													
16	19BT1001	Biology for Engineers	BS	2	0	0	0	2						1	1							
17	19ME1103	Design Tools Workshop –I	ES	0	0	4	0	2			1	2	2									
18	19SC1209	Design Tools Workshop –II	ES	0	0	4	0	2			1	2	2									
19	19SC1202	Data Structures	ES	3	0	2	0	4	2		2											
20	19ME1201	Mechanics of Solids-I	ES	3	0	2	0	4		2	2										2	2
21	19ME2108	Mechanics of Solids -II	ES	3	0	2	0	4	1	2	1										2	1
22	19ME1002	Engineering Graphics for Mechanical Engineers	ES	0	0	4	0	2		1	1	1	1								1	
23	19ME1003	Workshop Practices for Mechanical Engineers	ES	1	0	4	0	3		1		2										
24	19SC1101	Problem Solving and Computer Programming	ES	3	0	2	0	4	2	2		2										
25	19ME1204	Computational Thinking and Data Sciences	ES	2	0	2	0	3	2	2												
26	19ME2205	Numerical Computation for Mechanical Engineers	ES	2	0	2	0	3	3													
27	19EE2105	Circuits and Electronics	ES	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
28	19ME2110	Machine Drawing	ES	0	0	4	0	2	1		1		1								1	1
29	19SC1106	Technical Skills-1 (Coding)	ES	0	0	0	6	1.5	3	2												
30	20UC1102	Design Thinking and Innovation – 1	ES	1	0	0	4	2	1	2	3	2	2				3		2			
31	20UC1203	Design Thinking and Innovation – 2	ES	1	0	0	4	2	1	1	3				3	3			3			
32	19ME2106	Metrology and Measurements	Prof. Core	2	0	2	0	3		2			2									
33	19ME2107	Thermal-Fluids Engineering-I	Prof. Core	3	0	2	0	4	2												1	2
34	19ME2127	Engineering in the Physical World	Prof. Core	1	0	2	4	3		2											2	
35	19ME2109	Kinematics and Dynamics of Machines	Prof. Core	3	0	2	0	4		2	2		2									
36	19ME2211	Manufacturing Techniques	Prof. Core	3	0	2	0	4	1	2	2										2	2
37	19ME2212	Thermal-Fluids Engineering-II	Prof. Core	3	0	2	0	4	2												1	2
38	19ME2213	Vibrations and Controls	Prof. Core	3	0	0	0	4	1	2											2	
39	19ME3114	Machine Design	Prof. Core	3	2	0	0	5		3	2	3	3								3	3
40	19ME3115	Design for Manufacturing	Prof. Core	3	0	2	0	4	3	1	2	1	1								1	2
41	19ME3116	Robotics and Artificial Intelligence	Prof. Core	3	0	0	0	3	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
42	19ME3218	Engineering Management	Prof. Core	3	0	0	0	3							3				1			2
43	19ME3219	Heat Transfer	Prof. Core	3	0	2	0	4	2												2	2
44	19ME3117	Product Design and Development	Flexi. Core	0	0	8	0	4	3		2											
45	19ME3220	Machine Learning	Flexi. Core	3	0	2	0	4		1	2											
46	19ME3221	Internet of Things	Flexi. Core	2	0	2	0	3	2		2											
47	19ME3222	Computer Aided Design	Flexi. Core	2	0	2	0	3	2				2									
48	19ME3223	Geometric Dimensioning and Tolerancing	Flexi. Core	2	0	2	0	3	1		1											
49	19ME3224	Automotive Transmission	Flexi. Core	2	0	2	0	3			1	1										
50	19ME3225	Autotronics	Flexi. Core	2	0	2	0	3	1	2	2	2										
51	19ME3226	Automation System Design	Flexi. Core	2	0	2	0	3	1	2		2										
52	19TS701	Skilling for Engineers-1 (Manufacturing Technologies)	Tech. Skill	0	0	0	6	1.5				2										
53	19TS702	Skilling for Engineers-2 (Control Systems for Machines)	Tech. Skill	0	0	0	6	1.5			2		2									
54	19TS703	Skilling for Engineers-3 (Problem Solving techniques in Thermal)	Tech. Skill	0	0	0	6	1.5	1	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
55	19TS704	Skilling for Engineers-4 (Problem Solving techniques in Design)	Tech. Skill	0	0	0	6	1.5			2	2	2								2	
56	19TS705	Technical Proficiency & Training-1 (Automobile Design and Building)	Tech. Skill	0	0	0	4	1	2				2									
57	19TS706	Technical Proficiency& Training -2 (Robot Design)	Tech. Skill	0	0	0	4	1	2				2									
58	19ME4051	Design of Transmission Elements	Prof. Electives (Engineering Design)	2	0	2	0	3			2		2									
59	19ME4052	Theory of Elasticity and Plasticity		3	0	0	0	3	2	2												
60	19ME4053	Advanced Vibrations and Noise Control		2	0	2	0	3	2	2												
61	19ME4054	Creep, Fatigue and Fracture Mechanics		3	0	0	0	3		2		2										
62	19ME4055	Advanced Strength of Materials		2	0	2	0	3	2	2												
63	19ME4056	Mechanics of Composite Materials		2	0	2	0	3	2													
64	19ME4061	Modern Manufacturing Processes	Prof. Electives (Strategic Manufacturing)	2	0	2	0	3		1												
65	19ME4062	Advanced Materials		3	0	0	0	3		1												
66	19ME4063	Additive Manufacturing		2	0	2	0	3		1												
67	19ME4064	Tool Engineering and Design		2	0	2	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
68	19ME4065	Flexible Manufacturing Systems		2	0	2	0	3		1												
69	19ME4066	Reverse Engineering and Rapid Prototyping		3	0	0	0	3	1		1											
70	19ME4071	Automobile Engineering	Prof. Electives (Automobile Engineering)	2	0	2	0	3	1	1												
71	19ME4072	Automobile Engine Design		2	0	2	0	3	1		2	1										
72	19ME4073	Autotronics& Safety		2	0	2	0	3			1											
73	19ME4074	Alternative Energy Sources for Automobiles		2	0	2	0	3	2		2		2									
74	19ME4075	Automotive Electrical and Electronics System		2	0	2	0	3	1	1	1											
75	19ME4076	Automobile Engine System and Performance		2	0	2	0	3	2	2		1										
76	19ME4081	Automotive Sesnsor and Applications	Prof. Electives (Autotronics)	2	0	2	0	3	1		2	2										
77	19ME4082	Electronic Engine Management System		2	0	2	0	3	1		2	2										
78	19ME4083	Instrumentation in Automotive Industries		2	0	2	0	3	1		2	2										
79	19ME4084	Autotronics and Vehicle Intelligence		2	0	2	0	3	2	2	2											
80	19ME4085	Automotive Systems		2	0	2	0	3	1		2											
81	19ME4086	Programmable Logic Controller		2	0	2	0	3	1		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
82	19ME4091	Artificial Intelligence for Robotics	Prof. Electives (Robotics and Mechatronics)	2	0	2	0	3	1		2	2										
83	19ME4092	Industrial Automation and Control		2	0	2	0	3	1		2	2										
84	19ME4093	Industrial Hydraulic and Pneumatic Systems		2	0	2	0	3	1	2	2	2										
85	19ME4094	Industrial Robotics and Material Handling Systems		2	0	2	0	3	1		2	2										
86	19ME4095	Micro Controllers and PLC		2	0	2	0	3	1		2											
87	19ME4096	Mechatronics System Design		2	0	2	0	3	1		2	2										
88	19ME4101	Programming Skills	Prof. Electives (Soft computing and Data Analytics)	2	0	2	0	3	1				2									
89	19ME4102	Data Analytics		2	0	2	0	3	1				2									
90	19ME4103	Python		2	0	2	0	3	1				2									
91	19ME4104	Machine Learning		2	0	2	0	3	1				2									
92	19ME4105	Artificial Intelligence		2	0	2	0	3	1	1	2		2									
93	19ME4106	Fuzzy Logic and Neural Networks		2	0	2	0	3	1	1			1									
94	19ME4201	Design for Quality and Reliability	Prof. Electives (Product Design)	3	0	0	0	3	1		1											
95	19ME4202	Designing Intelligence Systems		3	0	0	0	3	1		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
96	19ME4203	Sustainable Design		3	0	0	0	3	1		1											
97	19ME4204	Systems Thinking for Design		3	0	0	0	3	1		1											
98	19ME4205	Design with Advanced Engineering Materials		3	0	0	0	3	1		1											
99	19ME4206	Design for Manufacture and Assembly		3	0	0	0	3	1		1											
100	19ME40B4	Robotics	Open Electives	3	0	0	0	3			2		2									
101	19ME40B5	Mechatronics		3	0	0	0	3		2	2											
102	19ME40B6	Operations Research		3	0	0	0	3					2									
103	19IE2246	Industrial Training	Project	0	0	0	0	2		2			2				2				2	2
104	19IE3247	Term Paper	Project	0	0	4	0	2		3		3									2	2
105	19IE4048/ 19IE4050	Project (Part I) / Practice School	Project	0	0	0	24	6		3			3				3				2	2
106	19IE4049/ 19IE4050/ 19IE4051	Project (Part II) / Practice School/ Internship	Project	0	0	0	24	6		3			3				3				2	2

HUMANITIES
AND
SOCIAL SCIENCES

19UC1101 – BASIC ENGLISH

Course code : 19UC1001
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	Apply the practical knowledge of using action words in sentence construction.	PO10	3
CO2	Apply and analyze the right kind of pronunciation with regards to speech sounds and able to get different types of pronunciations.	PO10	3
CO3	Apply the concept of fundamental principle of counting to solve the problems on linear, circular permutations and also for the problems on selections. Apply the concept of probability, while doing the problems on Leap year & Non-Leap year problems, coins, dice, balls and cards.	PO1	3
CO4	Analyze the given conditions and finding out all the possible arrangements in linear & circular order. Analyze the given numbers or letters to find out the hidden analogy and apply that analogy to find solutions. Finding the odd man out by observing the principle which makes the others similar.	PO5	4

Syllabus:

Interactive Grammar: Action Words-Modifiers, Intensifiers, Connectives - 5 Passages- 5 Worksheets (Revision tests of Bridge Course topics) –Parsing.
Sentence Skills: Tense, Voice, Case, Gender, Reported Speech, Syntax, Types of Sentences, Syntactic Ordering.

Introduction to the Sounds of English: Basic English Sounds, Distinctive Sounds of English, Assimilation, Contraction, Elision, Twinning, Stress, Syllables, Word- stress, Tone and Intonation- Rising, Falling, Rise-fall and Fall-rise.

Language Laboratory Interactive: Esca talk, JAM, Ranking, Shrinking Story, Desperate Decision, Listening for Specifics, Pronunciation Practice

Quantitative Aptitude: Permutations and Combinations, Probability
Reasoning: Number and Letter Analogy, Odd Man out, Analytical Reasoning-I

Reference Books:

1. Kerry Patterson, Joseph Grenny, Ron McMillan:*Crucial Conversations: Tools for Talking When Stakes Are High.*Switzler: Paperback – Animated, September 9, 2011.
2. Douglas Stone, Bruce Patton, Sheila Heen, and Roger Fisher :*Difficult Conversations: How to Have Conversations that Matter the Most* .Paperback – November 2, 2010
3. R.K. Bansal, J.B. Harrison: *Spoken English*. Delhi: Orient Black Swan.2009.

19UC1202 - ENGLISH PROFICIENCY

Course code : 19UC1202
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	Apply the concepts of accurate English while writing and become equally at ease in using good vocabulary and language skills.	PO8, PO9, PO10	3
CO2	Understand the importance of pronunciation and apply the same day to day conversation.	PO8, PO9, PO10	3
CO3	Apply the concepts of ratios, percentages, averages and analyze the given information on the basis of comparative analysis of the data in the form of tabulation, bar graphs, pie charts, line graphs.	PO1, PO4	3
CO4	Apply the basic functionality of clocks and calendars to find the solutions for the problems. Analyze the given symbols to understand the hidden meaning of the given expression and find the solutions. Analyze the possible arrangements in linear & circular order.	PO1, PO5	4

Syllabus:

Writing Skills: How to Write a Definition, Defining Technical Terms, Product and Process Description.

Advanced Grammar Skills: Transformation of Sentences, Phrases, Clauses, Sentences Simple, Compound, Complex Sentences, Concord, Lexis 1:Synonyms, Antonyms, Analogies, Sentence Equivalence-One-Word Substitutes.

Language Laboratory Interactive: Debate, Blind-fold, Role Play, Situation Reaction Test--Build an Island nation.

Quantitative Aptitude: Data Interpretation, Data Sufficiency.

Reasoning: Symbols and Notations, Clocks and Calendars, Analytical Reasoning-II

Reference Books:

1. Dictionary of Technical Terms
2. Dr. Meenakshi Raman and Dr. SangeethaSarma: *Technical Communication*.Oxford University Press: Delhi.2016.
3. The Ultimate Verbal and Vocabulary Builder. Texas: Lighthouse Review.2000.
4. Rajeev Vasisth: *Interactive Vocabulary Drills*. New Delhi: Arihant Publications Limited. 2011.
5. Language LaboratoryTeacher Manual, KLEF

19UC2103 – PROFESSIONAL COMMUNICATION SKILLS

Course code : 19UC2103
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	Able to spot the common grammatical errors related to sentence structure, preposition, concord, relative and conditional clauses and parallel structures. The learner should be efficient to construct a context-determined text in addition to learning Technical Writing Skills.	PO9, PO10	3
CO2	Able to read, understand, and interpret a text intrinsically as well as extrinsically. The learner can browse a text quickly to come-up with a gist and personal interpretation. Able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the organization.	PO8	4
CO3	Apply the concepts of time and work; men-time-work problems based on wages, pipes and cisterns. Apply the concepts of time and distance and solve the problems related to average speed, relative speed.	PO1	3
CO4	Apply Venn diagrams to find out appropriate conclusions from the given statements. Apply the logical implications and also the negations of various connectives to find the solutions. Analyze the data and represent in the form of Venn diagrams to find relations between any given set of elements.	PO1, PO5	3

Syllabus:

Grammar and Usage: Error Analysis.
Writing Skills: Topic sentence, Linkers, Connectors and Transition, Paragraph Writing, Letter Writing
Reading Comprehension: Techniques, Skimming and Scanning, Vertical Reading, Reading Perception Tests (RPT): (Graphic) Reading Perception Tests (RPT), Semantic Interpretation of the Text, Reading Speed Enhancement.
Soft Skills: Interpersonal Skills, Adjusting Your Attitude-Arrogance has no Place in the Workplace, Cultural Sensitivity in the Workplace, Corporate Culture: Learning How to Fit In.
Quantitative Aptitude: Time and Work, Time and Distance
Reasoning: Deductions, Logical Connectives, Venn Diagrams

Reference Books:

1. Gajendra Singh Chauhan and SmitaKashiramka. *Technical Communication.* Delhi:Cengage Learning India.2018.
2. Andrea Penruddocke and Christopher A. Warnasch.English for the Real World.USA:Living Language.2004
3. GeraldJ Alfred, Charles T Brusaw and Walter E.Oliu. Hand Book of Technical Writing. USA:Betford.2000.

19UC2204 – APTITUDE BUILDER –I

Course code : 19UC2204
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	Apply the concept of Critical Reading and Analytical Reading and comprehend the key ideas and gist of a passage. Understand the importance of the presentation skills, analyze the given topic, apply various strategies and the principles of grammar in written expression.	PO5, PO6	3
CO2	Apply the concepts of grammar, various strategies and the usage of formal language in written expression. By using synonyms rewrite the same text in the same format and meaning. Write the gist of the given text.	PO7, PO10	3
CO3	Apply the concepts of Numbers to solve the problems related to divisibility rules, problems based on Unit's digit, Remainders, Successive Division, Prime Factorization, LCM & HCF problems. Apply the concepts of Averages &Alligations, students will be able to solve the problems related to Averages as well as problems based on Mixtures.	PO1, PO5	3
CO4	Apply the various concepts of cubes to find out how to cut a cube to get the maximum number of smaller identical pieces, how to minimize the number of cuts required to cut a cube into the given number of smaller identical pieces, how to count the number of smaller cubes which satisfy the given painting scheme. Apply the principles of binary logic to solve problems involving truth-tellers, liars and alternators. Analyze the given data to form an ordered arrangement from an unorganized raw data.	PO1, PO5	4

Syllabus:

Directed Listening and Thinking Activity (DLTA) Skills: Reading, Listening, Thinking, Writing, Presentation - Method: Flipped Classroom.

Writing Skills**:** Paraphrasing, Summarizing, Notice, Circular, Agenda, Minutes, Memo

Body Language (Kinesics) :Postures, gestures, eye contact
Self-confidence: Self-esteem

Soft Skills: The Art of Compromise, Learn to Say: "I Don't Know", Being organized, Showing Self-awareness,

An eye on success, being self-motivated, Showing self-awareness, Find Direction from Someone Who Is Lost: "The Drifter"

Self-Assessment for Attainable Career Objectives--Defining a Career Objective

Quantitative Aptitude: Numbers, Averages and Alligations, Mensuration

Reasoning: Cubes, Binary Logic, Ordering and Sequencing

Reference Books:

1. Daniel G.Riordan and Steven E. Pauley: *Technical Report Writing Today.* New Delhi*:* Biztantra.2004.
2. Ken Taylor.Telephoning and Teleconferencing Skills. Hyderabad:Orient Black Swan.2008.
3. E. Suresh Kumar, B. Sandhya.Communication for Professional Success. Delhi: Orient Black Swan.2013
4. Reasoning Trainer Plus.:Hyderabad:Brain Mapping Academy.2012

19UC3105 – APTITUDE BUILDER-II

Course code : 19UC3105
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	Apply the strategies and techniques for conversations in different contexts. Analyze the different parameters and formats of written technical communication and apply in everyday work and life.	PO8, PO10	3
CO2	Analyze the concepts of critical and analytical reading skills. Apply the strategies and techniques learnt in handling interviews in different contexts.	PO8, PO10	3
CO3	Apply the concepts of Ratio & Proportion, Percentages, Profit &Loss, Simple & Compound Interest	PO1, PO5	3
CO4	Analyze the series of numbers or letters to predict the next number in the series or to find the analogy. Analyze the data to find the codes in the process of encoding and decoding. Apply the given set of conditions to select a team from a group of members.	PO1	4

Syllabus:

Critical Reading: Reading to Identify the Theme**,** Reading to Identify the Central Idea**;** Reading to Identify the Tone, Reading to Identify Writer's Attitude, Reading to Identify Parallel Ideas, Reading to Identify Logical Conclusions.

Writing Skills: Note- making and Note- taking, Report Writing.

Presentation Skills- Preparing for the Presentation, Audience Analysis, Processing Information, Ice-breakers, Quotations, Presentation Structure**,** Say what you want to say- Say it, Say what you have said to say**,** Preparing for Question Hour, Funnel Effect and How to Overcome it.

Trinity Guild Hall - Communication Skills - Graded Evaluation and Testing-1-8 grades

Quantitative Aptitude: Ratio and Proportion, Percentages, Profit and Loss, Simple Interest and Compound Interest

Reasoning: Number and Letter Series, Number and Letter Analogy, Coding and decoding, Odd man out. Selections

Reference Books:

1. Dr. Meenakshi Raman and Dr. SangeethaSarma: *Technical Communication*.Oxford University Press: Delhi.2016.
2. M. Ashraf Rizvi: *Effective Technical Communication.* New Delhi: McGraw Hill Education(India) Private Limited

20UC3206 – CAMPUS TO CORPORATE

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

Syllabus:

Verbal Ability

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

Soft Skills: Goal Setting, Team Building, Leadership, Time Management, Managing Stress

Quantitative Aptitude:

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

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.

19UC0007 – INDIAN HERITAGE AND CULTURE

Course code : 19UC0007
L-T-P-S : 0-0-2-0
Credits : 1
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

19UC0008 – INDIAN CONSTITUTION

Course code : 19UC0008
L-T-P-S : 0-0-2-0
Credits : 1
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.

19UC0009 – ECOLOGY AND ENVIRONMENT

Course code : 19UC0009
L-T-P-S : 2-0-0-0
Credits : 0
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).

19UC0010 – UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS

Course code : 19UC0010
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	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.

19UC0011 – 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

19SC1104 –MATHEMATICS FOR COMPUTING

Course code : 19SC1104
L-T-P-S : 3-1-0-4
Credits : 5
Contact Hours : 8
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Explain the basic structures, relations, permutations, combinations, probability.	PO1	2
CO2	Demonstrate the system of equations and game theory through matrix algebra.	PO1	2
CO3	Demonstrate the rules of propositional logic to establish validity of argument, induction, recurrence relations and lattices.	PO1	2
CO4	Interpret the problems associated with graphs, trees, correlation and regression.	PO1	2
CO5	Demonstrate the Aptitude & Reasoning skills (Tests in skilling hours)	PO1	2

Syllabus:

Foundations of Computational Mathematics-I

Basic Structures: Sets, Functions, Sequences and Summations, Cardinality of Sets, Relations and their Properties, Equivalence Relations. P**ermutations and combinations probability**: Linear Permutation, Circular Permutation and combinations, addition theorem, conditional probability, multiplication theorem.

Foundations of Computational Mathematics-II

Matrix Algebra: Introduction, Types of Matrices, Rank of matrix, Solutions of linear Equations - Gauss elimination, Jacobi and Gauss Seidal, Eigen values, Eigen vectors. **Game Theory:** Pay off Matrix, Mini-Max criteria, objective function, Saddle points, Optimal Strategy, Mixed Strategy, Value of a game and Decision under uncertainty.

Discrete Mathematics-I

Logic and Proofs: Propositional Logic, Applications of Propositional, Propositional Equivalences, Predicates and Quantifiers, Rules of Inference Predicate logic, Consequences, Introduction to proofs, Proof methods and strategy. **Applications of Number theory**: Fermat's theorem, Euclidean Algorithm,

Counting Techniques: Recursive definitions, Solving Linear Recurrence Relations, Fibonacci series, Divide-and-Conquer Algorithms, Generating Functions, Inclusion–Exclusion, **Lattices:** Introduction, Properties of Lattices, Sub lattices, Partial order relation, Homomorphism and Isomorphism, Hasse diagrams.

Discrete Mathematics-II& Statistics:

Graphs & Trees: Terminology, Types of Graphs, Bipartite graphs, Graph Isomorphism,Connectivity, Euler and Hamilton Paths, Shortest-Path, Planar Graphs , Trees,Tree traversal and application of trees, spanning trees and Minimal spanning trees. **Statistics**: Curve fitting, Correlation, Linear Regression

Skilling: {Tests in skilling hours} 4 hours per week [60 hours]

LOGIC AND REASONING: Deductions, Logical Connectives, Linear and circular arrangements, Ordering and sequencing, Clocks, Calendars, Blood Relations, Cubes, Direction sense, Number and letter series, Number and letter Analogy, Odd man out, Coding and Decoding, Symbolic representations of given data, Binary Logic, Non Verbal reasoning.

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

Geometry: Lines, Triangles, Quadrilaterals, Polygons, Practical applications of common solids, irregular solids and their application in various engineering problems.

Text Books:

1. Basic Engineering Mathematics**,** John Bird, sixth Edition, Elsevier, ISBN:978-1-1380 5382-3
2. Advanced Engineering Mathematics, ISV Tenth Edition, John Wiley &sons,ErwinKreyzigISBN: 978-81-265-5423-2

Reference Books:

1. Quantitative Aptitude, R. S. Aggarwal, Schand Publications. ISBN: 978-81-219-2498-6
2. Quantitative Aptitude - G. L. Barrons. ISBN: 13:978-1438009049
3. Quantitative Aptitude - AbhijitGuha, McGraw Hills. ISBN: 978-93-5260-437-1

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.

19PH1010 – MECHANICS

Course code : 19PH1010
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	Develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics	PO1, PO2	3
CO2	Analyze planar and spatial systems and analyze the forces in the members of trusses, frames.	PO1, PO2	4
CO3	Determine first moment and second moment for a given cross sections and problems related to friction	PO1, PO2	3
CO4	Analyze the motion characteristics of a body subjected to a given force system.	PO2	4

Course Objective:

This course aims at enabling the students of engineering to analyze various systems of forcesand thereby be able to determine the forces in various systems in statics & dynamics.

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.

19PH2007 – MATERIALS FOR MECHANICAL ENGINEERING APPLICATIONS

Course Code : 19PH2007
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 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 Introduction,.6th edition, 2007, Wiley India Pvt. Ltd, ISBN-13: 978-0470556733.
4. Kodgire. V. D., Material Science and Metallurgy, ISBN-10: 8186314008.

List of Experiments:

1. Lattice constant by X-Ray Diffraction method.
2. Identification of crystal planes by XRD spectra.
3. Particle size of amorphous material by LASER diffraction.
4. Dielectric properties of material.
5. Thermal conductivity of ceramic material by Lee's method.
6. V-I Characteristics of PN junction diode.
7. Hall coefficient of Semi conducting material.
8. Energy band gap of a Semi conducting material.
9. Annealing Process.
10. Hardening Process.
11. Microstructure study of Ferrous.
12. Microstructure study of Non- Ferrous.

19BT1001 – BIOLOGY FOR ENGINEERS

Course code : 19BT1001
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

19SC1108 - DESIGN TOOLS WORKSHOP -I

Course code : 19SC1108
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	PO-3	2
CO2	Visualize and practice innovative design by final drafting using photogrammetric and model the design using prototyping technique	PO-4	3
CO3	Apply the concept of AI & Data analytics & finalize the requirements to design his idea	PO-5	3
CO4	Draft a report of his project from the initial stage & make a report which include scope, time and cost management of his project	PO-4	3

Syllabus:

Introduction to Design thinking: Design thinking, usage of visualization tool, Physics and preparation for Innovation, Idea generation and mind mapping, Strategic opportunities, Storytelling tool. **Photogrammetry:** Basic concepts of photogrammetry, types of photogrammetric techniques and measurements. **Prototyping:** Prototyping, including paper and tool-based prototyping, design principles and patterns, 3D Modeling, 360 Prototyping, 3DPrinting.**Engineering Project Management:** Scope, Time and Cost Management. **Data Analytics:** Introduction, Basics of Statistical Analysis System (SAS)**,** Logistic regression using SAS. **Artificial Intelligence:** Introduction, Turing Test, Breadth first Search techniques, Depth first Search techniques using python. **Machine Learning:** Linear regression, Naive Bayes, gradient descent algorithms using python.

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.ClaudiaTom Dieck, 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/introduction-virtual-reality?specialization=virtual-reality
3. https://www.coursera.org/learn/scope-time-management-cost

19SC1209 - DESIGN TOOLS WORKSHOP -II

Course code : 19SC1209
L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO/PSO	BTL
CO1	Practice the design ideology by artistic skill	PO-3	2
CO2	Visualize the design ideology by using VR technology	PO-4	3
CO3	Visualize the design ideology by incorporating VR technique	PO-5	3
CO4	Visualize and present his design idea by applying AR technique	PO-4	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.ClaudiaTom Dieck, 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?

19SC1202 - DATA STRUCTURES

Course code : 19SC1202
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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.

Horowitz, Sahni, Anderson Freed, “Fundamentals of datastructures in C” , Second Edition-2007.

19ME1201 – MECHANICS OF SOLIDS -I

Course code : 19ME1201
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19PH1010

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.

19ME2108 – MECHANICS OF SOLIDS -II

Course code : 19ME2108
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19ME1201

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	Analyze various machine components using different materials	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, ReliabilityDesign 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

Text Books:

1. Gere &Goodno "Mechanics of Materials" Cenage Learning India Pvt Ltd

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. Pytel A H and Singer F L, Harper Collins "Strength of Materials", New Delhi.

19ME1002 – ENGINEERING GRAPHICS FOR MECHANICAL ENGINEERS

Course code : 19ME1002
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	Construct and Interpret drawing scale to visualize the geometries of Engineering objects using points, lines both manually and by AutoCAD	PO2	2
CO2	Draw projection of planes, solids and Generate the sectional views of solids both manually and by AutoCAD	PO3, PO4	2
CO3	Draw Engineering curves and develop the lateral surface of solids both manually and by AutoCAD	PO3, PO5	2
CO4	Build orthographic projections, create isometric sketches and identify standard features both manually and by AutoCAD	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

19ME1003 – WORKSHOP PRACTICES FOR MECHANICAL ENGINEERS

Course code : 19ME1003
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	Understanding different manufacturing techniques and their relative advantages/ disadvantages with respect to different applications.	PO2	2
CO2	Fabricate components with their own hands.	PO4	4
CO3	Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.	PO4	4
CO4	Assemble different components and produce small devices of their interest	PO4	4

Course Objective:

To familiarize with the procedures of basic manufacturing processes through hands on practice on the use of various hand tools and equipment in the carpentry, fitting, welding, tin smithy, electrical house wiring, casting, machine tools, IC engine, surface grinding and driling,refrigeration trades. 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:

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.

Lab Experiments:

1. Plane turning on CNC Lathe
2. Step Turning on CNC Lathe
3. Face and plane turning operation
4. Drilling operation
5. Tapping operation
6. Preparation of Lap Joint in Arc Welding
7. Preparation of Butt joint in Gas Welding
8. Manufacturing of Dumb bell in die casting
9. Manufacturing of Pipe flange in die casting
10. Manufacturing of Round rod in die casting
11. Manufacturing of stepped pulley in sand casting
12. Assembling of petrol engine
13. Disassembling of petrol engine
14. Overhauling of IC Engine
15. Vapor-compression refrigeration
16. Staircase Connection
17. Godown Connection
18. Series Connection
19. Parallel Connection
20. Square fit
21. L fit
22. V-fitting
23. Half-round
24. Plus joint
25. Lap T Joint
26. Mortise joint
27. Rectangular tray
28. Plain pipe
29. Pipe T Joint
30. Study of working on Recirculation AC Test Rig

19SC1101 – PROBLEM SOLVING AND COMPUTER PROGRAMMING

Course code : 19SC1101
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	Illustrate how problems are solved using computers and programming	PO1,PO2	3
CO2	Illustrate and use Control Flow Statements in C.	PO1, PO2	3
CO3	Interpret & Illustrate user defined C functions and different operations on list of data.	PO1, PO2	3
CO4	Implement Linear Data Structures and compare them	PO4	3
CO5	Apply the knowledge obtained by the course to solve real world problems	PO1, PO2	3

Syllabus:

Problem Solving Approach, Algorithms and Algorithm Analysis, Program Development Steps, Structure of C Program, Pre-Processor Directives, Formatted I/O,C Tokens, Data Types:

Primitive, Extended and Derived Including Pointers, Operators, Precedence, Associativity, Redirecting I/O :Files and File Operations, Control Flow Statements, Functions, Recursion, Scope of Variables and Storage classes, Arrays, 2-DimensionalArrays,Dynamic Memory Allocation, Searching:

Linear Search and Binary Search, Sorting: Bubble Sort, Strings, Structures and Unions, Introduction to Stacks-Implementation using array, Introduction to Queues – Linear Queue-Implementation using array,Introduction to Lists: Single Linked List- Insertion, Deletion, Display.

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, ShashiMogalla, "Data structures andProgram Design in C", 4th Edition-2007.

19ME1204 – COMPUTATIONAL THINKING AND DATA SCIENCES

Course code : 19ME1204
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	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.

19ME2205 – NUMERICAL COMPUTATION FOR MECHANICAL ENGINEERS

Course code : 19ME2205
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.

19ME2110 – MACHINE DRAWING

Course code : 19ME2110
L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : 19ME1002

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.	PO1, PSO1	2
CO2	Draw different line types and various dimensioning, conventional representation of materials and machine components, sectioning, limits, fits and tolerances.	PO1, PO3, PO5. PSO2	2
CO3	Develop and interpret production drawing for various machine elements	PO1, PO3, PO5, PSO2	2
CO4	Implement Computer Aided Drafting for various machine components using software.	PO1, PO3, PO5, PSO1	2

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.

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 aluminum 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.

References:

1. Narayana “Machine drawing”, New Age International
2. K.L.Narayana and P.Kannaiah “Production drawing”, New Age International
3. Bhatt N.D “Machine drawing”, Charotar

19EE2205 – CIRCUITS AND ELECTRONICS

Course code : 19EE2205
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.

19SC1106 – TECHNICAL SKILLS – 1 (CODING)

Course Code : 19SC1106
L-T-P-S : 0-0-0-6
Credits : 1.5
Contact Hours : 6
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the concepts of basic programming to solve the basic problems, pattern based problems	PO1, PO2	3
CO2	Build solutions for problems on Numbers and array based problems, functions, recursion	PO1, PO2	3
CO3	Solve problems solutions for character/string based problems and pointers	PO1, PO2	3
CO4	Build solutions to programs on Data structures concepts.	PO1, PO2	3

Syllabus:

Basic problems, Pattern based problems, Number based problems.

Array based problems (one dimensional and two dimensional), character and string based problems.

Functions and recursion (class and objects for java), pointer based problems,

Function pointers and array pointers (For C Users), linked lists, queues, stack problems.

Tools for References:

1. http://hackerrank.com

20UC1102 - DESIGN THINKING AND INNOVATION – 1

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 (CO)	PO/PSO	BTL
CO1	Understand the basics of design thinking and its implications in product or service development	PO1	2
CO2	Understand and Analyse 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.

Reference books:

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

20UC1203 - DESIGN THINKING AND INNOVATION – 2

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 (CO)	PO/PSO	BTL
CO1	Understand the problem statement, requirements and formulating approaches to solve real world problems.	PO1, PO2	2
CO2	Designing the solution by taking the user interactions & ease of use into consideration	PO3	5
CO3	Applying the design principles in building sustainable and environment friendly solutions.	PO7	3
CO4	Manage the Innovation effectively interms of resources, finances, copyright, IPR, Trademark, Patent and license agreement policies for protecting own R&D innovations and enhancing brand image.	PO8, PO11	2

Syllabus:

Problem Solving Mindset: Understanding Problem Statements, Recapping Design Principles, Design Thinking Toolsets, Formulating approaches to Solutions, Applications of Design Thinking: Case Study.

Human Centered Design : Services Development process and lifecycle, Product Vs Services, Innovation in Services, Service Experience Lifecycle, Human Computer Interaction, Usability Engineering - Heuristic Evaluation.

Design for the Environment : Design Considerations, Environmental Issues, Sustainable Development, Green Design – Design for Process, Design for Product, Qualitative and Quantitative Methods for DFE, Design for Disassembly, Design for Recyclability, Design for Energy Efficiency. The relevance of 4Rs - reduction, reuse, recycling and recovery in Environmental friendly design. Sustainable Development.

Design Thinking and Innovation Management Culture: Project Management - Project Planning, Business Plan, Planning the resources, Effective Communication, Team Management, Benchmarking the Development, Cost Estimation, Interpreting the Feedback and Troubleshooting, Pitching the idea, Revenue Model.

Intellectual property and protection of ideas: Concepts of copyright, Intellectual Property, Trademark, Service mark Patent and typical business benefits, Applying for patent, Product license agreement, Open-source license, need for protecting own R&D innovations, Enhancing brand image with IP.

Reference books:

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

PROFESSIONAL CORE

19ME2106 – METROLOGY AND MEASUREMENTS

Course code : 19ME2106
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 the basics of standards of measurement, limits, fits & tolerances industrial applications.	PO1	2
CO2	Identify the uses of gauges and comparators	PO1	2
CO3	Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices	PO1	3
CO4	Interpret measurement of field variables like force, torque and pressure	PO1	3
CO5	Comprehend the fundamentals of thermocouple and strain measurement.	PO1	3

Course Objective:

The objectives of this course are

- To achieve familiarity with and experience in the use of commonly available measuring devices and instruments in a variety of applications
- To develop an awareness and understanding of more extensive and elaborate measuring systems
- To acquire a reasonable level of competence in the design, construction, and execution of a mechanical measurements project.

Syllabus:

Linear and angular measurement: Definition of metrology, Linear measuring instruments: Vernier, Micrometer, internal measurement, Slip gauges and classification, Interferometer, optical flats.

Limits and Fits: Tolerances, and Limit gauges. Gauge Calibration: Gauge repeatability and gauge reproducibility studies.

Comparators: Mechanical, pneumatic and electrical comparators, applications.

Angular measurements: Sine bar, optical bevel protractor, angle Decker - Taper measurements. Form measurement: Measurement of screw threads, thread gauges, floating carriage micrometer. Surface finish, straightness, flatness and roundness measurement

Introduction to measurements, Precision and accuracy, generalized configuration and functional descriptions of measuring instruments – examples. Errors in measurements – sources of error, classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement– Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Measurement of Level: Direct method – Indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubler level indicators.

Measurement of Temperature: Classification – Ranges – Various Principles of measurement– Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers–Temperature Indicator

Measurement of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer(LDA).

Measurement of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Non-contact type of tachometer

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle

Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.

Measurement of Force, Torque And Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

Text Books:

1. Gupta S.C, Engineering Metrology, Dhanpatrai Publications, 1994
2. Mahajan,"Engineering Metrology ",DanpathRai Publications.
3. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh/ TMH.
4. D.S.Kumar, "Measurement Systems: Applications & design",Anuradha Agencies.
5. BeckWith, Marangoni,Linehard, " Mechanical Measurements", 6th edition, PHI/PE

Reference Books:

6. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.

List of Experiments:

1. Calibration of outside micrometer
2. Calibration of vernier height gauge
3. Calibration of verniercaliper
4. Angle of taper rod using sine bar
5. Angle of V-block optical bevel protector
6. Measurement of spur gear tooth dimensions
7. Measurement of straightness and flatness using auto collimators
8. Force measurement
9. Temperature measurement
10. Measurement of Thermal conductivity

19ME2107 – THERMAL-FLUIDS ENGINEERING-I

Course code : 19ME2107
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 fundamental principles and definitions of thermodynamics, fluid mechanics, and heat transfer.	PO1, PSO1	2
CO2	Apply the laws of thermodynamics for thermal systems associated with heat transfer and work transfer, entropy generation and its influence on engineering systems.	PO1, PSO2	3
CO3	Elucidate the basic properties, principles and applications of fluids, fluid components, fluid statics and different types of fluid flows.	PO1, PSO1	2
CO4	Describe fluid boundary layers, turbulence and their implementation in flow of fluid in engineering systems.	PO1, PSO1	2
CO5	Apply the theoretical concepts to conduct various experiments of thermodynamics, fluid mechanics practically.	PO1, PSO2	3

Course Objective:

The objectives of this course are to introduce the laws of thermodynamics and their applications and to introduce fluid mechanics and its applications.

Syllabus:

Fundamental principles of thermodynamics and fluid mechanics, Flow and Non-flow process, Law of conservation of energy and momentum with applications.
Work study during various Non-flow processes, Steady flow energy equation and its applications, first and second law of thermodynamics with special emphasis on Entropy generation.
Study of properties of fluids, hydrostatics, fluid kinematics and applications of Bernoulli equation.
Internal and external laminar and turbulent viscous flow analysis and Boundary layer theory.

Text Books:

1. Fundamentals of Thermodynamics, Borgnakke, Claus; Sonntag, Richard E., 7th edition, Wiley publishers.
2. Fluid Mechanics, Frank M. White, 8th edition, McGraw Hill Publications.

Reference Books:

1. Engineering Thermodynamics, Nag, P.K., TMH Publications.
2. Fundamentals of Engineering Thermodynamics, Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisie D, Bailey, Margaret B., 7th edition, Wiley publishers.
3. Fundamentals of Thermodynamics, G.J. Van Wylen., Sonntag (6E), Wiley India publications.

19ME2127 - ENGINEERING IN THE PHYSICAL WORLD

L-T-P-S : 1-0-2-4
Credits : 3
Contact Hours : 7
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Recalling and understanding the fundamental laws and concepts related to basic fluid and thermal systems.	PO2, PSO1	2
CO2	Applying the fundamental laws and concepts on basic fluid and thermal systems.	PO2, PSO1	3
CO3	Examining simple fluid and thermal systems based on existing design.	PO2, PSO1	3
CO4	Analyzing real time energy systems (flow and heat) by developing an innovative and novel design.	PO2, PSO1	4
CO5	Modeling and analysis of energy systems (flow and heat transfer systems)	PO2, PSO1	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, 8th edition, McGraw Hill Publications.

19ME2109 – KINEMATICS AND DYNAMICS OF MACHINES

L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19PH1010

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's criterion.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. Interferenceand 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.

19ME2211 – MANUFACTURING TECHNIQUES

Course code : 19ME2211
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19ME1201

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. SeropeKalpakjian, 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, McGrawhill
5. AmitabhaGhosh and Asok Kumar Mallik " Manufacturing science TMH publisher

19ME2212 – THERMAL-FLUIDS ENGINEERING-II

Course code : 19ME2212
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19ME2107

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the principles of thermodynamics, heat transfer, and fluid mechanics to the design and analysis of engineering systems.	PO1, PSO1	3
CO2	Elucidate the thermodynamics and fluid mechanics steady flow components of thermodynamic plant as well Laminar and turbulent flow of fluids in channels and over surfaces.	PO1, PSO1	2
CO3	Identify thermodynamic state of a pure substance and determine the thermodynamic properties and explain the design approach to thermodynamic plants.	PO1, PSO1	2
CO4	Analyze Rankine, power cyles and explain refrigeration and air conditioning systems.	PO1, PSO1	2
CO5	Apply analytical cognitive skills of the theoretical concepts to conduct various experiments of thermodynamics and fluid mechanics practically.	PO1, PSO2	3

Course Objective:

The objectives of this course are to enable the learner to study and analyze parameters related to various components of Steam Power plant, that are useful to work in industries related to power sector. The study of performance of refrigeration systems and principles of Psychrometry will be helpful to work in industries related to refrigeration and Air-conditioning.

Syllabus:

Focus on the application of the principles of thermodynamics, heat transfer, and fluid mechanics to the design and analysis of engineering systems. Thermodynamics and fluid mechanics of steady flow components of thermodynamic plant.Pure substance model.Power cycles. Design approach of thermodynamic plants – Rankine cycle.Fundamentals of refrigeration and air-conditioning.Laminar and turbulent flow of fluids in channels and over surfaces

Text Books:

1. Fundamentals of Thermodynamics, Borgnakke, Claus; Sonntag, Richard E., 7th edition, Wiley publishers.
2. Fluid Mechanics, Frank M. White, 8th edition, McGraw Hill Publications.

Reference Books:

1. Engineering Thermodynamics, Nag, P.K., TMH Publications.
2. Fundamentals of Engineering Thermodynamics, Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisie D.; Bailey, Margaret B., 7th edition, Wiley publishers.
3. Fundamentals of Thermodynamics, G.J. Van Wylen., Sonntag (6E), Wiley India publications.

19ME2213 – VIBRATIONS AND CONTROL

Course Code : 19ME2213
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisite : 19ME2109

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

Course Objective:

To understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions, be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi-degree of freedom linear systems.

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, Torsionaland 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'sOut line Series, Mc-Graw Hill Inc, 1998.

19ME3114 – MACHINE DESIGN

Course Code : 19ME3114
L-T-P-S : 3-2-0-0
Credits : 5
Contact Hours : 5
Pre-requisite : 19ME2108

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	2
CO2	Analyze the machine elements to design a new component	PO4, PSO1	3
CO3	Characterize the mechanical system to a real world application	PO2, PSO1	3
CO4	Synthesize the modal to design a mechanical system	PO2, PSO1	3
CO5	Fabricate the design subject to engineering Constraints	PO5, PSO2	3

Course Objective:

The objectives of this course is to enable the learner 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

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

Text Books:

1. V.Bhandari “Design of machine elements”, Tata McGraw Hill book Co
2. M.F.Spotts Design of Machine Elements “ Pearson Education

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

19ME3115 – DESIGN FOR MANUFACTURING

Course Code : 19ME3115
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19ME2211

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand and analyze the working of various machining processes.	PO2, PSO1	3
CO2	Implement NC and CNC programing for machining simple components	PO1, PSO2	3
CO3	Apply the automation of production lines.	PO4, PSO1	3
CO4	Design of various manufacturing processes.	PO3, PSO2	3
CO5	Implement modern manufacturing techniques	PO5, PSO2	3

Syllabus:

Lathe, milling and drilling machine, boring, shaper, slotter, planer, broaching,

Forces, power consumption in machinery, MECHANICS OF METAL CUTTING: Orthogonal Vs oblique cutting- merchant's force circle diagram. Force and velocity relationship

Historical development and future trends of NC Machines. CNC Machine outline, Selection of parts for NC machining. Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity, Tooling for NC. NC Part Programming: Manual (word address format) programming. Examples Drilling and Milling. (b) APT programming. Geometry, Motion and Additional statements, Macro statement
Control of NC Systems: Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control.

AUTOMATION: Reasons for Automation: Strategies of Automation, Detroit type of Automation, Flow lines, Transform Mechanisms, work part transfer, Different Methods, Problems. Automation for machining operations design & Fabrication consideration, machining center.

Design for Manufacturing: Selection of Manufacturing Processes, Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Assembly, Design for Welding, Design for Heat Treatment, Design for Reliability and Quality Failure Mode and Effect Analysis, Design for Quality, Design for Reliability, Approach to Robust Design Design for Optimization

Text Books:

1. Lindberg,"Processes and Materials of Manufacture", Prentice hall India (p) Ltd.
2. SeropeKalpakjian, Steven R. Schmid "Manufacturing Engineering and Technology" (4th Edition) Prentice Hall 2000-06-15 ISBN: 0201361310

Reference Books:

1. P.N.Rao "Manufacturing Technology", TMH Ltd 1998(Revised edition)
2. Dieter "Mechanical Metallurgy", Revised edition 1992, Mcgraw
3. CAD/CAM by Gimmers and Groovers

19ME3116 – ROBOTICS AND ARTIFICIAL INTELLIGENCE

Course Code : 19ME3116
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	Implement direct kinematics for robot design	PO1	3
CO2	Implement Inverse kinematics and Workspace analysis based robot design	PO3	3
CO3	Implement Artificial Intelligence in Robotic Applications	PO3	3
CO4	Implement the task programming for robots	PO3	3

Course Objective:

The objective of this course is to enable the learner to select and use the various hardware components required for a robotic application. The learners will be able to select appropriate control strategy corresponding to a given robotic application.

Syllabus:

Intelligent Robotics: Automation and Robots, Robot Classification, Robot Specifications, Sensory perception, Robot control and Intelligence.
Direct Kinematics: Coordinate Frames, Rotations, Homogeneous Coordinates, The arm Equation, (DK analysis of - 2 Axis and 3 Axis Planar robot, Four axis SCARA Robot, Five axis Articulated robot).
Inverse Kinematics: General Properties of Solutions, Tool Configuration, (IK analysis of - 2 Axis and 3 Axis Planar robot, Four axis SCARA Robot, Five axis Articulated robot).
Workspace Analysis and Trajectory Planning: Workspace analysis, Work envelope of 4-axis SCARA Robot, Work envelope of 5-axis articulated Robot, Workspace Fixtures, The pick-and-place operation, Continuous-Path Motion, Interpolated Motion, Straight Line Motion
Basic Concepts of Artificial Intelligence: Intelligence, Problem representation in Artificial Intelligence, Problem-solution Techniques used in Artificial Intelligence.
Elements of Knowledge Representation: Logic, Production Systems, Semantic Networks, Expert Systems.
Task Planning: Task-Level Programming, Uncertainty, Configuration Space, Gross-Motion Planning, Grasp Planning, Fine Motion Planning, Task Planning Problem.

Text Books:

1. "Robotics and AI", Andrew Staugaard, PHI
2. "Fundamentals of Robotics- Analysis and Control", Robert Schilling, Pearson Education

Reference Books:

1. "Introduction to Robotics", J. J. Craig, Pearson Education.
2. "Robotics", Fu, Gonzales and Lee, McGraw Hill.
3. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", George F. Luger, Pearson Education.

19ME3218 – ENGINEERING MANAGEMENT

Course Code : 19ME3218
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	Illustrate the primary concepts about management, its principles and functions and the types of business organizations	PO11, PSO2	2
CO2	Analyze the concepts of financial management includes present worth and future worth of invested money through cash flow diagram and differed annuities.	PO7, PSO2	4
CO3	Acquire knowledge in economic analysis and cost accountancy.	PO7, PSO2	2
CO4	Demonstrate the principles of business innovation and entrepreneurship for establishing industrial ventures	PO11, PSO2	2

Syllabus:

Introduction and overview of engineering management, principles and functions of engineering management, types of business organizations, Types of production systems

Financial principles, management of innovation, present worth and future worth of invested money through cash flow diagram and differed annuities. Definition, Scope, objectives and significance of cost accounting, its relationship with financial accounting and management accounting, Cost Objects, Cost centers and Cost Units, Elements of cost, Classification of costs.

Concepts of Total Quality Management, Inventory Management.

Project Management, PERT and CPM, Best management practices, principles of business innovation and entrepreneurship for establishing industrial ventures

Text books:

1. A.R.Aryasri, Management Science, 2nd Edition, 2005, Tata Mc-Graw Hill.
2. Panneerselvam R., Engineering Economics, PHI Learning Private Limited, Delhi, 2/e, 2013
3. Jain T.R., V. K.Ohri, O. P. Khanna, Economics for Engineers, VK Publication, 1/e, 2015
4. Drucker, P. F., Innovation and Entrepreneurship, Taylor & Francis, 2nd Edition, 2007

Reference Books:

1. I.M. Pandey, Financial Management, Vikas Publishing House Pvt. Ltd., 10th Edition, 2010, ISBN- 13 9788125937142.
2. James C Van Horne, Financial Management and Policy, Prentice-Hall of India/Pearson, 12th Edition, 2001 ISBN10: 0130326577

19ME3219 – HEAT TRANSFER

Course Code : 19ME3219
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 19ME2107

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.

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CORE

19ME3117 –PRODUCT DESIGN AND DEVELOPMENT

Course Code : 19ME3117
L-T-P-S : 0-0-8-0
Credits : 4
Contact Hours : 8
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Identify and establish product specifications.	PO1, PO3	4
CO2	Selection of concept and Product architecture.	PO1, PO3	4
CO3	Apply Industrial design techniques.	PO1, PO3	4
CO4	Prototype preparation	PO1, PO3	4

Course Objective:

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

Syllabus:

Need for Integrated Product and Process Development (IPPD) – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

CONCEPT GENERATION AND SELECTION:

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

PRODUCT ARCHITECTURE:

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

INDUSTRIAL DESIGN:

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT:

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

Text Books:

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999

Reference Books:

2. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates, 6/3,ViaOlivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
3. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992,ISBN, 1-55623-603-4
4. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing,Neyourk,NY,1991, ISBN 0-202-41639-5

19ME3220 – MACHINE LEARNING

Course Code : 19ME3220
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.

19ME3221 – INTERNET OF THINGS

Course Code : 19ME3221
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 internet of Things and its hardware and software components	PO1, PO3	2
CO2	Interface I/O devices, sensors & communication modules	PO1, PO3	3
CO3	Remotely monitor data and control devices	PO1, PO3	3
CO4	Apply Data acquisition and integration	PO1, PO3	3
CO5	Develop real life IoT based projects	PO1, PO3	4

Course Objective:

Students will be explored to the interconnection and integration of the physical world and the cyber space. They are also able to design & develop IOT Devices.

Syllabus:

Introduction to IoT: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT

Elements of IoT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces, Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP

IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

Text Books:

1. Vijay Madisetti, ArshdeepBahga, Ïnternet of Things, "A Hands on Approach", University Press.
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi

19ME3222 - COMPUTER AIDED 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
1	Understand the Fundamentals of CAD and display devices	PO1, PO5	2
2	Apply the concept of geometric modelling	PO1, PO5	3
3	Able to apply concept of Surface and solid modelling	PO1, PO5	3
4	Application of various Geometric transformations	PO1, PO5	3

Syllabus:

Introduction: Fundamentals of CAD, Design process, Applications of computer for design, Benefits of CAD, Computer peripherals for CAD work station, Graphic terminal, CAD software, CAD database and structure.

Display Devices: Video display devices–Raster scan display, CRT , DVST, Inherent memory display devices, Random Scan Display, Raster scan systems – Video controller, Random scan systems – Graphic monitors and work station, Input devices. Primitives Points and Lines, Line drawing algorithms, DDA algorithm, Bresenham's line algorithm.

Geometric Modelling: 2D wire frame modelling, 3D Wire frame modelling, Wireframe models, Entities and their definitions. Concept of Parametric and nonparametric representation of curve, Curve fitting techniques, Definitions of cubic splines.

Surface Modelling: Surface modelling and entities, Algebraic and geometric form, Parametric space of Surface, Blending functions, parameterization of surface patch, Subdividing cylindrical surface, Ruled surface, Surface of revolution, Spherical surface, Composite surface.

Solid Modelling: Solid models, Solid entities, Solid representation, sweep representation, Constructive solid geometry and Boundary representation, Solid modelling based applications.

Windows and Clipping: Introduction, The Viewing Transformation, viewing transformation implementation, Clipping operation.

Geometric Transformations: Transformation Principles, Translation, Scaling, Rotation, Matrix Representations and Homogeneous Coordinates, Composite transformations and other transformations.

Case Study: Design and optimization procedure of shafts, flywheel, gears and journal bearing using computer packages.

Text books:

1. CAD/CAM by P.N.Rao, Tata McGrawhill , Delhi
2. CAD/CAM by Ibrahim Zeid, Tata McGrawhill,Delhi
3. Computer Aided Design by C. Elanchezhian, T. Thomas Koil Raj etc.(Anuradha agencies)
4. CAD/CAM by Mikel P.Groover and Emory W.Zimmers,Prentice Hall of India , Delhi
5. CAD/CAM Concepts and applications by Chennakeava R. Alavala

Reference Books:

1. Computer Aided Design: Principles and Applications by Paul Barr (Publisher: Prentice Hall (1 June 1985))
2. Computer Aided Design by Jose L. Encarnacao (Springer-Verlag; 2 Rev Sub edition (1 September 1990))
3. Computer Aided Design and Manufacture by S.A.R Scrivenor (Publisher: Pergamon Press (1985))
4. Principles of interactive computer graphics by Newman and Sproull, McGrawhi

19ME3223 - GEOMETRIC DIMENSIONING AND TOLERANCING

L-T-P-S : 2-0-2-0
Course code : 19ME3223
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the Application of Dimensioning	PO1, PO3	2
2	Understand the application of Tolerances.	PO1, PO3	2
3	Read and interpret the industrial drawings.	PO1, PO3	2
4	Development of a Dimensional Inspection Plan	PO1, PO3	2

Syllabus:

Introduction: Applications and advantages of GD&T, fundamental drawing rules, dimensions and tolerances, limits & fits.

Maximum Material Condition (MMC), Least Material Condition (LMC) and Regardless of Feature Size: The feature control frame, general rules of GD&T. Use of MMC, LMC, RFS, Virtual condition (VC) and Resultant condition (RC), components of feature control frame Geometric characteristic symbols, External feature, Internal feature, Taylor Principle.

Datums, Form Controls, Orientation Controls, Untoleranced Dimensions, Individual or related datum, material condition, The Maximum Material Condition symbol and its Ramifications.

Location Controls, Runout Controls, Profile Controls, Dimensioning and Tolerancing Schemes: Common tolerancing methods, Design, Inspection, Production and prototype needs and capabilities regarding Dimensioning and tolerancing Methods.

Steps for the Development of a Dimensional Inspection Plan: Dimensional Inspection Plan format, Plan development, Choosing Gauge. Paper gaging, Composite Positional Controls, paper gaging with Datum Feature size, Functional Gage design, Tolerance on work, Push pin gages..

Text Books:

1. James D Meadows, “Geometric Dimensioning and Tolerancing”, Marcel Dekker.
2. James D Meadows, “Measurement of Geometric Tolerances in Manufacturing”.
3. P. S. Gill,“Textbook of Geometric Dimensioning and Tolerancing”, S. K. Kataria& Sons.
4. Gene R. Cogorno, “Geometric Dimensioning and Tolerancing for Mechanical Design”, McGraw Hill.

19ME3224 - AUTOMOTIVE TRANSMISSION

L-T-P-S : 2-0-2-0
Course code : 19ME3224
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand the importance of construction and working of a clutch in automobile industry and troubleshooting of clutch	PO5	2
CO2	Understand the importance of construction and working of gear box and total resistance to motions	PO5	2
CO3	Understand different mechanisms used while adopting a torque converter and various Automotive Transmission mechanisms	PO5	2
CO4	Understand working principle of drive line system components	PO5	2
CO5	Apply contemporary issues and their impact on provided solution in addition to that students will be able to solve open-ended problem related to design the transmission components using CAD	PO5	3

Syllabus:

CLUTCHES: Principle, Functions, Requirements, Torque capacity, lining materials,
GEAR BOX: Necessity, Types, Sliding mesh, Constant mesh, Synchromesh, Synchronizing unit, Helical gears, Gear selector mechanism, Overdrive gears, Compensation for wear, Performance characteristics.
DRIVE LINES: Effect of driving thrust and torque reaction, Propeller shaft-universal joints,
Drive line arrangements, i. e. Hotchkiss drive & torque tube drive, Rear & front wheel drive layouts.
FINAL DRIVE & REAR AXLE: Final drive & drive ratio, Types, Need of differential and differential unit, Rear axle, Axle types, Axle shafts, Final drive.
TRANSMISSION WITH FLUID FLYWHEEL & TORQUE CONVERTOR: Operating principle, Fluid flywheel, Characteristics, Advantages & limitations of fluid coupling.
CONTINUOUS VARIABLE TRANSMISSION (CVT), Applications, Advantages and disadvantages.

Text Books:

1. Newton, Steed & Garrot, “Motor Vehicles”, 13th Edition, Butterworth London.
2. A. W. Judge, “Modern Transmission”, Chapman & Hall Std., 1989.
3. Chek Chart, “Automatic Transmission”, A Harper & Raw Publications.
4. J. G. Giles, “Steering, Suspension & Tyres”, Life Book Ltd., London.

Reference Books:

1. W. Steed, “Mechanics of Road Vehicles”, Life Book Ltd.
2. N. K. Giri, “Automotive Mechanics”, Khanna Publishers, Delhi, Eighth Edition
3. Heisler, “Vehicle and Engine Technology”, Second Edition, SAE International Publication.
4. Heisler, “Advanced Vehicle Technology”, Second Edition, SAE International Publication.

5. J. Reimpell, H. Stoll and J. W. Betzler, “The Automotive Chassis”, SAE International Publication.

List of Experiments:

1. Preparing the 2D / 3D Drawings of a single plate clutch using CAD or CATIA
2. Preparing the 2D / 3D Drawings of an over running clutch
3. Preparing the 3D Drawings of sliding mesh gear arrangements using CAD or CATIA
4. Preparing the 3D Drawings of constant mesh gear arrangements using CAD or CATIA
5. Draw the equivalent synchronizing unit using Auto CAD or CATIA
6. Preparing the 2D drawings of the Epicyclic gear system using Auto CAD or CATIA
7. 2D Front and top view of front wheel transmission lay outs use Auto CAD or CATIA
8. 2D Front and top view of rear wheel transmission use Auto CAD or CATIA
9. 2D Front and top view of four wheel lay outs use Auto CAD or CATIA
10. 2D drawing of the differential arrangement - differential cashing star and planetary gears
11. Draw a 2D drawing of the three quarter floating rear axle arrangement showing the axle cashing, half shaft, bearing and the wheel positions
12. Draw a 2D drawing of the fully floating rear axle arrangement showing the axle cashing, half shaft, bearing and the wheel positions.

19ME3225 - AUTOTRONICS

L-T-P-S : 2-0-2-0
Course code : 19ME3225
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 electronics for engine management system	PO1	1
2	Analyze required sensors and actuators for an automotive application	PO4	3
3	Apply the suitability of a control system for automotive application	PO3	3
4	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

19ME3226 - AUTOMATION SYSTEM DESIGN

L-T-P-S : 2-0-2-0
Course code : 19ME3226
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the design principles of automation and its application in an automated manufacturing system	PO1	1
2	Analyze pneumatic sub-systems of an automated manufacturing system in terms of design, operation and control aspects	PO4	3
3	Analyze hydraulic sub-systems of an automated manufacturing system in terms of design, operation and control aspects	PO4	3
4	Understand programmable automation with regard to the computer integrated manufacturing system	PO2	4

Syllabus:

Fundamental Concepts of Industrial Automation: Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating, Types of production and types of automation, automation strategies, levels of automation.

Transfer Lines and Automated Assembly: General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines.AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

Pneumatic Control: Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipment.

Pneumatic Control System Design: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application

Elements of Hydraulic Systems: Pumps and motors- types, characteristics. Cylinders, types, typical construction details.Valves for control of direction, flow and pressure, types, typical construction details.

Hydraulic System Design: Power pack–elements, design. Pipes- material, pipe fittings.seals and packing. Maintenance of hydraulic systems.Selection criteria for cylinders, valves, pipes, Hydro-Mechanical servo systems. PLC-construction, types, operation, programming, Heat generation in hydraulic system

Programmable Automation: Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

Design for High Speed Automatic Assembly: Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation, Case studies-pick and place robot, CNC Machines, Conveyor systems

Text Books:

1. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi,2001.
2. Srinivasan R, "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints Private Ltd, 2005
3. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press, 2011

Reference Books:

1. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.
2. Yeaple F.D, "Hydraulic and Pneumatic Power and Control Design", McGraw-Hill, USA, 2007
3. Wemer Depper and Kurt Stoll, "Pneumatic Application", Kemprath Reihe, Vogel Buch Verlag Wurzbutg, 1987.
4. Bolton W, "Mechatronics", Pearson Education, 1999.

SKILLING COURSES

19TS701 – SKILLING FOR ENGINEERS-1 (MANUFACTURING TECHNOLOGIES)

Course Code : 19TS701
L-T-P-S : 0-0-0-6
Credits : 1.5
Contact Hours : 6
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Preparation of sand moulds with proper gating and riser system	PO4	3
CO2	Machining using machine tools and preparation of CNC part program.	PO4	3
CO3	Preparation of work piece for various welding operations and performing welding using different welding equipment	PO4	3
CO4	Production of parts using rapid prototyping	PO4	3
CO5	Hands on experience for performing experiments in Casting, Machining, Welding and Rapid prototyping	PO4	3

Course Objective:

To provide hands on experience for the preparation of sand moulds for casting with proper gating and riser system needed for casting, for attaining sound casting. To provide hands on experience of metal cutting, working of standard machine tools such as lathe, shaping, milling, drilling, grinding and CNC machine tools, preparation of CNC part program.To provide hands on experience for the preparation of workpiece to carry out various welding operations, welding using arc welding, submerged arc welding and plasma arc welding.To provide hands on experience on rapid prototyping, CAD models to rapid prototyping, production of various products using rapid prototyping.

Syllabus:

Introduction to manufacturing technologies

Casting: Preparation of sand mould using solid pattern, Preparation of sand mould using split pattern, riser, gating system, stir casting

Welding: Preparation of various joints using arc welding, submerged arc welding and plasmaarc welding.

Machining: Conventional machine tools lathe, drilling, milling and surface grinding. CNC machine tools, part programming

Rapid prototyping: Rapid prototyping operation using 3D printing technology of various components

Text Books:

1. Rao, P. N., Manufacturing Technology, McGraw Hill (2008).
2. Welding and welding technology by Richard l. Little, McGraw Hill
3. Mikell P .Groover, Emory W. Zimmers, Pearson,Publishers
4. User's guide to Rapid Prototyping by Todd Grimm; a publication from Society of Manufacturing Engineers

Reference Books:

1. Manufacturing engineering and technology, Pearson 4e , S Kalpakjian and R Schmid
2. Manufacturing Science 2e, East west, Amitabha Gosh and A K Mallik
3. Additive Manufacturing by AmitBandyopadhyay&Susmita Bose; a publication from CRC press.

19TS702 – SKILLING FOR ENGINEERS-2 (CONTROL SYSTEMS FOR MACHINES)

Course Code : 19TS702
L-T-P-S : 0-0-0-6
Credits : 1.5
Contact Hours : 6
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand and apply the control action for first order closed loop systems for various inputs.	PO3	3
CO2	Understand and apply the control action for second order closed loop systems for various inputs.	PO3	3
CO3	Apply the concepts of stability and frequency analysis for control action on first and second order systems	PO5	3
CO4	Apply the concepts of the nature of a system by means of various control actions to stabilize the system.	PO5	3

Course Objective:

The primary objective of this course is to inculcate understanding of considerations involved in the selection of appropriate control systems as well as actuation systems for various industrial and non-industrial applications. It is expected that with this knowledge, students will be able to analyze a control system required for a given application. The course also aims at helping students acquire the ability to model a system and analyze its performance/behavior.

Syllabus:

Introduction: Systems, measurement systems, control systems, microprocessor-based controllers. **Actuation systems:** Pneumatic actuation system, hydraulic actuation, electrical actuation system.**System models:** Mechanical system, electrical system, fluid system, thermal system, electromechanical systems.**System transfer functions:** First order systems, second order system, system in series, systems with feedback loops. **Frequency response:** First order systems, second order systems, Bode plots. Closed loop controllers: Continuous and discrete processes, control modes

Text Books:

1. Bolton, “Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering”, 2nd Edition, Addison Wesley Longman Ltd., (1999).
2. DevdasShetty, Richard A.Kolk, “Mechatronics System Design”, PWS Publishing Company, (1997).

Reference Books:

1. David G. Alciatore, Michael B. Histand, “Introduction to mechatronics and measurement systems”, 2nd Edition, McGraw-Hill Professional, (2002).
2. D.A Bradley, D. Dawson, N.C Burd and A. J. Loader, “Mechatronics” CRC Press, (2010).
3. K. Ogata, “Modern Control Engineering”, Prentice Hall India (2002).

19TS703 –SKILLING FOR ENGINEERS-3 (PROBLEM SOLVING TECHNIQUES IN THERMAL ENGINEERING)

Course Code : 19TS703
L-T-P-S : 0-0-6-0
Credits : 1.5
Contact Hours : 6
Pre-requisite : 19ME2107

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the fundamentals of CFD (Computational Fluid Dynamics) and basic modules in ANSYS FLUENT	PO1, PO2	2
CO2	Analyze the laminar and turbulent flow through pipe	PO1, PO2	4
CO3	Analyze the flow visualization in L-junction and T- joint	PO1, PO2	4
CO4	Analyze the flow through pipes and flow over flat plate and different sections	PO1, PO2	4

Course Objective:

The objective of this course is to impart knowledge on basic concepts of ANSYS FLUENT software and to impart knowledge on Fluid Mechanics application using ANSYS FLUENT.

Syllabus:

Introduction to CFD (Computational Fluid Dynamics).

Flow Visualization: Introduction, Classification of visualization techniques, Interferometer, Schlieren and shadow graph

Analog Methods: Introduction, Hele-shaw apparatus, Hydraulic analogy, Hydraulic jump.

Dimensional analysis: Reynolds theorem and Buckingham π theorem.

Boundary layer theory: Introduction, laminar, turbulent boundary layer, boundary layer thickness, displacement, momentum & energy thickness, growth of boundary layer over flat plate, pressure distribution in the boundary layer, separation of boundary layer.

Analysis of Compressible Flow: Mach number and its significance, isentropic flow in passage of varying cross section, normal shockwaves in supersonic flow, shock equations, change in entropy across normal shock.

Text Books:

1. Instrumentation, measurements and experiments in fluids by E.Rathakrishnan, CRC Press, Taylor and Francis group.
2. “Computational fluid dynamics, the basics with applications” by john D Anderson.
3. Experimental methods for engineers by J.P.Holman, TMH publications.
4. Engineering Fluid Mechanics by P. Balachandran, PHI Publications.

Reference Books:

1. Mechanical Measurements by Thomas G. Beckwith, Addison-Wesley Publications.

19TS704 – SKILLING FOR ENGINEERS-4 (PROBLEM SOLVING TECHNIQUES IN DESIGN)

Course Code : 19TS704
L-T-P-S : 0-0-0-6
Credits : 1.5
Contact Hours : 6
Pre-requisite : 19ME1201

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	To Perform static and dynamic analysis of 1-D structures	PO3	4
CO2	To Perform static and dynamic analysis of 2-D structures	PO3, PO5	4
CO3	To Perform static and dynamic analysis of 3-D structures	PO3, PO5	4
CO4	Identifying and solving the real complex engineering problems	PO4, PSO1	4

Course Objective:

To skill the student in identifying and applying the different concepts / methods such as analytical, numerical and computational to solve a specific design problem / issue and validate the results.

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.

Capstone Project: Design and model using Solid works or CATIA of mechanical component / system and do analysis using ANSYS/ Hyper works/NASTRAN or any analysis software. After completion of the project student must submit the report.

Text Books:

1. Engineering Design by George E.Dieter, 4th Edition, McGraw-Hill International Editions.
2. Engineering Design Process by Haik&Shahin, Cengage learning.

Reference Books:

1. Finite Element method by R.Chandrapatla.

19TS705 – TECHNICAL PROFICIENCY & TRAINING-1 (AUTOMOBILE DESIGN AND BUILDING)

Course Code : 19TS705
L-T-P-S : 0-0-0-4
Credits : 1
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the role of power systems and transmission systems in vehicle building.	PO1, PO5	2
CO2	Analyze about various control engineering concepts for modern automobiles.	PO1, PO5	4
CO3	Model Automobile components	PO1, PO5	4
CO4	Design of Automobile components	PO1, PO5	4

Course Objective: The objective of this course is to enable the student in assembling the automobile parts and build the appropriate design for automobiles.

Syllabus:

Study of systems in Vehicle. Power systems: Gasoline, Bio-diesel, Electrical, Hybrids, solar, wind, compressed air, fuel cell, hydrogen etc. Transmission system: Clutch, Gear Trains, Differentials, Suspension, Steering, Brakes etc., Control Engineering Concepts for Modern Automobiles: Clutch, Gear, Dashboard display and Automatic control.

Understanding automobiles (aesthetics (exterior/interior), human factors/ vehicle packaging, display & controls etc.) Hands on Practices on Assembly and Maintenance of Automobiles (Two Wheeler & Four Wheeler). Vehicle Structure: Chassis, mononcoque, pre-stressed, sheet metal details and tooling.
Vehicle development Process, Types of BIW, Standard procedures in BIW design, Exercises and techniques in BIW design, Clean edge modeling technique, Method for shaping the part, Creating complex and complex contoured depressions, Creating flanges, beads, darts.
Completion of a BIW component from drawing sheet. Design of Hood/Fender/Body side outer and side doors, Roof Design

Text Books:

1. S. P. Patil, “Mechanical System Design”, Jaico Publications.
2. V. L. Maleev, “I. C. Engine”, McGraw Hill Book Co. Ltd., New Delhi, Second Edition.
3. Gill P. W., Smith J. H., Zurich E. J., “Fundamentals of I. C. Engine”, Oxford & IBH Pub. Co., New Delhi.
4. J. B. Heywood, “I. C. Engine Fundamentals”, McGraw Hill Book Co., New Delhi.

Reference Books:

1. Litchy, I. C. Engine, McGraw Hill
2. George E. Dieter, “Engineering Design- A Material and Processing Approach”, Second Edition, McGraw-Hill International Edition

19TS706 –TECHNICAL PROFICIENCY & TRAINING -2 (ROBOT DESIGN)

Course Code : 19TS706
L-T-P-S : 0-0-0-4
Credits : 1
Contact Hours : 4
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the importance and working of various elements of a Robot and kinematics of serial and parallel robots	PO1, PO5	2
CO2	Analyze the direct and inverse kinematics for Robot design	PO1, PO5	4
CO3	Analyze the motion planning and control of robots	PO1, PO5	4
CO4	Analyze the components of Electrical and Electronic Interface required for Automated Machine Tools	PO1, PO5	4

Course Objective:

The students are able to design a Robot like device which will serve the purpose of doing the useful task as programmed.

Syllabus:

Elements of Robots, Joints, Links, Actuators and Sensors. Kinematics of Serial and Parallel Robots. Direct and inverse kinematic synthesis for Robot design. Modeling and control of flexible robots. Motion planning and control. Components of Electrical and Electronic Interface required for Automated Machine 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.

Text Books:

1. Ghosal, A., Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2nd reprint, 2008.
2. Fu, K., Gonzalez, R. and Lee, C. S. G., Robotics: Control, Sensing, Vision and Intelligence¸ McGraw- Hill, 1987.

PROFESSIONAL ELECTIVES

19ME4051 - DESIGN OF TRANSMISSION ELEMENTS

L-T-P-S : 2-0-2-0
Course code : 19ME4051
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME3114

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Design and selection of various belt and chain drives	PO3	6
CO2	Design and Selection of the suitable bearing for the given loading condition	PO3	6
CO3	Analyze kinematic and dynamic aspects in design of brakes, clutches	PO3	6
CO4	Design and analysis of different types of gear drives	PO3	6
CO5	Analyze machine elements using analysis software	PO5	4

Syllabus:

Belt Drives :Materials and construction of flat and V-belts, Geometric relationships for length of belt, Power rating of belts, Maximum power condition, Selection of flat and V-belts from manufacturer's catalogue, Belt tensioning methods, Relative advantages and limitations of flat and V-belts, Construction and applications of timing belts.

Chain Drives: Construction and materials of roller chain, Length of chain and number of links, Polygonal effect, Power rating of roller chains, Construction of sprocket wheels, Silent chains, Relative advantages and limitations-of chain drives.

Bearings: Classification, modes of Lubrication, Sliding contact bearing design, bearing materials, selection of lubricant.
Rolling contact bearings- types, selection of ball, roller bearings- under static load, dynamic load.

Brakes and Clutches: Introduction to Brakes, Types, Analysis and Design of Block brakes, internal shoe Brakes, End shoe Brakes, Pivoted shoe Brakes, Band Brakes, Temperature raise, Friction materials.
Introduction to Clutches, Analysis and Design of simple and multiple disc Clutches, Cone Clutches and Centrifugal Clutch, friction materials, comparison of Brakes and Clutches.

Spur Gears :Introduction, force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Estimation of module based on beam and wear strength, Methods of lubrication.

Helical Gears: Transverse and normal module, Virtual number of teeth, Force analysis, Beam and wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.

Bevel Gears: Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, 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, Selection of materials for bevel gears, comparison of spiral bevel gears and hypoid gears and straight tooth bevel gears.

Worm Gears: Design and analysis of worm gear drive

Text Books:

1. Shigley J.E, “Mechanical Engineering Design”, McGraw-Hill, 1996.
2. Norton, R. L. Machine design: an integrated approach: Prentice Hall

Reference books:

1. Budynas, R. G., &Nisbett, J. K. Shigley's mechanical engineering design: McGraw-Hill.
2. Spotts, M. F., Shoup, T. E., &Hornberger, L. E. Design of machine elements: Pearson /Prentice Hall
3. Black P.H. and O. Eugene Adams, “Machine Design”, McGraw Hill Book Co. Ltd.
4. Bhandari V.B., “Design of machine elements”, Tata McGraw Hill Public Co. Ltd.

Note: “Usage of: “Design Data”, P.S.G. College of Technology, Coimbatore is recommended”.

19ME4052 - THEORY OF ELASTICITY AND PLASTICITY

L-T-P-S : 3-0-0-0
Course code : 19ME4052
Credits : 3
Contact Hours : 3
Pre-requisites : 19ME2108

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

19ME4053 - ADVANCED VIBRATIONS AND NOISE CONTROL

L-T-P-S : 2-0-2-0
Course code : 19ME4053
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME2213

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the concepts of acoustics and vibrations	PO1, PO2	4
2	Determine the sources of vibrations	PO1, PO2	4
3	Measure the level of vibration and control the vibrations	PO1, PO2	4
4	Measure and control the noise observed from vehicles.	PO1, PO2	4

Syllabus:

Introduction to NHV: Definition of Noise, Vibrations & Harshness in reference to Vehicular application. Study principles of Rolling, Pitch & Yaw velocity and moments.

Fundamentals Of Noise And Vibrations: Basic Concepts of Vibrations: Simple Harmonic Motion, Frequency of Vibrations, Period, Natural Frequency, Resonant Frequency, Amplitude of vibrations. Un-Damped & Damped Vibrations.

Types of Vibrations: Free & Forced Vibrations induced for Single degree of freedom & Multi degrees of freedom. Basic Concepts of Noise: Fundamentals of Acoustics. General Types of sound wave propagations- wave equation, specific acoustic impedance, Plane wave & Spherical waves. Structure borne sound and air borne sound.Interior noise sources and levels of noise.Anatomy of human ear and mechanism of hearing.Sound intensity, summation of pure tones (decibel addition), subtraction & averaging.Octave and Octave bands.

CHARACTERISTICS & SOURCES OF VIBRATIONS:

Power Train: Engine, Clutch, Transmission, Propeller shaft, Differential, Drive shaft, Trans axle. Power train mounts.

Suspension: Different types of suspensions, Dampers, Rubber & Rubber embedded Metallic bushes. Passive and Active suspensions.

Road roughness & irregularities, Tyres & Wheels Low frequency vibrations: due to body structure, Seat mounting, seat materials and Steering assembly components.

VIBRATIONS MEASUREMENT TECHNICS AND CONTROL:

Vibration measuring Instruments: Vibration pick-up, Types of Transducers, Vibrometer etc. for measurement of Frequency of vibrations, Period, Amplitude, Velocity and acceleration parameters.

Methods of Control and vibrations isolation: Different Types of Dampers, Vibrations absorber / isolator (including viscous damping, sandwich construction).

SOURCES OF NOISE, NOISE MEASUREMENT TECHNICS AND CONTROL:

Noise specifications and mandatory standards regulations.Brake Squeal noise, Pass-by Noise, wind noise, squeak noise and rattle, interior noise (including noise emitted by running of accessories, indicators and all buzzers). Power train, Engine Air Intake & Exhaust noise, Engine accessories, cooling system and

vehicle body protrusion noise, under body protrusion noise. Noise due to Tyre-Road friction and slip characteristics.

Noise Measuring Instruments: Microphone, Sound intensity probes.

Noise Control: Damping treatment methods, Control through isolations and noise absorbing materials and structure. Active and semi-active control of noise.Study of anechoic chamber.**Harshness:** Definition. Its effect and acceptable degree of Harshness. Perception of Ride comfort i.e. psychological effects of Noise & Vibrations.

Study of **NVH - Legislations** applicable for vehicles in India

Safety: Passive safety Active safety. Study of Safety Regulations for vehicular application Introduction to software applications (Capabilities & Limitations of different software's) for analysis of NVH

Text Books:

1. Vehicle Noise, Vibration, and Sound Quality by Gang Sheng Chen, SAE International Publications.
2. Fundamentals of Noise and Vibration, by Norton M.P, Cambrige University Press

Reference Books:

1. Mechanical Vibrations & Noise Control, by Dr. Sadhu Singh, Khanna Publishers.
2. Mechanical Vibrations by G.K.Grover, Published by Nem Chand & Bros, Roorkee, India.
3. Mechanical Vibrations, by S.S.Rao, Pearson.
4. Theory of Vibration with Applications, by W.T.Thomson&M.D.Dahleh, Pearson Education.
5. Dynamic Vibration Absorbers, by Borris and Kornev, John Wiley Publications.
6. Noise Control of Internal Combustion Engine, by Baxa, John Wiley Publications
7. Text Book of Mechanical Vibrations, by Rao V. Dukkipati and J. Srinivas, Prentice-Hall of India Pvt. Ltd

19ME4054 - CREEP FATIQUE AND FRACTURE MECHANICS

L-T-P-S : 2-0-2-0
Course code : 19ME4054
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME2108

Mapping of Course Outcomes with PO/PSO:

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

19ME4055 - ADVANCED STRENGTH OF MATERIALS

L-T-P-S : 2-0-2-0
Course code : 19ME4055
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME2108

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Analyze statically indeterminate beams	PO1, PO2	4
2	Analyze stresses in curved beams and Examine the Shear Centre for various cross sections of beams	PO1, PO2	4
3	Apply unit load method to find deflections in beams and structures	PO1, PO2	3
4	Analyze stresses in rotating members and thick cylinders	PO1, PO2	4
5	To simulate the structural members using ANSYS and validate the results with analytical methods	PO4	4

Syllabus:

Statically Indeterminate Beams: Introduction toStatically 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

19ME4056 - MECHANICS OF COMPOSITE MATERIALS

L-T-P-S : 2-0-2-0
Course code : 19ME4056
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME2108

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Know the composite materials and manufacturing methods	PO1	2
2	Understand the behaviour of composite Lamina	PO1	2
3	Know the properties of various types composite materials	PO1	2
4	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

19ME4061 - MODREN MANUFACTURING PROCESSES

L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME1003

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	To classify and understand the need of Non-Traditional Manufacturing Processes.	PO2	2
2	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
3	To understand the working principle and the effect of various process parameters on its performance of various Non-Traditional Welding Processes.	PO2	2
4	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

19ME4062 - ADVANCED MATERIALS

L-T-P-S : 2-0-2-0
Course code : 19ME4062
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Ability to identify different types of optimization problems	PO2	2
2	Understand basic concepts in solving nonlinear optimization problems	PO2	2
3	Understand optimality conditions for unconstrained and constrained optimization problems and be able to apply them in verifying the optimality of a solution	PO2	2
4	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, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van-Nostrand Rainfold.
3. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.

19ME4063 - 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
1	To be able to properly distinguish between the hype and realities of additive manufacturing	PO2	2
2	To understand the basic AM processes, and the limitations and advantages of each.	PO2	2
3	To understand the differences between traditional processes and additive manufacturing production, including the differences in design methodology.	PO2	2
4	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:Overview ofPolymerization: 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.

19ME4064 - TOOL ENGINEERING AND DESIGN

L-T-P-S : 2-0-2-0
Course code : 19ME4064
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME3115

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Develop the ability to design cutting tools for given single component.	PO2	2
2	Design and development of various die configurations.	PO2	2
3	Design and development of jigs for given component.	PO2	2
4	Design and development of fixtures for given component.	PO2	2

Syllabus:

Cutting tool design: Different tool materials: cemented carbides, coated carbides, cermets, ceramics and polycrystalline tool materials - compositions - properties of tool materials - Selection and treatments - Plastics as tooling materials - New tooling materials Design of single point turning and threading tools - Selection of tool holders and inserts for turning - Chip breakers - Design of twist drill and reamers.

Press tool design: Press working terminology - Presses and press accessories - Computation of capacities and tonnage requirements - Strip layout - Types of dies - Design and development of various types of cutting, forming, bending and drawing dies - Progressive dies, Combination dies and compound dies - Blank development for cylindrical and non-cylindrical shells, Simple problems.

Design of jigs: Principles of jigs and fixtures - Locating elements - Drill bushes - Different types of jigs - Plate, latch, channel, post, angle plate, turn over, and pot jigs - Automatic drill
jigs, Design and development of jigs for given components.

Design of fixtures: Design principles of fixtures - Design of fixtures for milling, boring. Design of fixture for assembly, inspection and welding. Design and development of fixtures for given components.

Case study: Case study in Jigs, fixture and press tools.

Text Books:

1. Sadasivan.T.A, and Sarathy.D, "Cutting tools for Productive machining", 1st edition, Widia (India) Ltd, Bangalore, 1999.
2. Donaldson.C, Lecain.G.H and Goold.V.C, "Tool Design", Tata McGraw Hill publishing company limited, New Delhi, 2002.
3. Edward G. Hoffman, "Jigs and Fixture design", 2nd edition, Galgotia publication Pvt. Ltd., New Delhi, 1987.

Reference Books:

1. Hiram E. Grant, "Jigs and Fixtures - Non-standard clamping device", Tata McGraw Hill, New Delhi, 1971.
2. Prakash H. Joshi, "Press tool design and construction", 1st edition, Wheeler Publishing, New Delhi, 2000.
3. Kempster.M.H.A, "An Introduction to Jig and tool design", 3rd edition, ELBS, 1987.
4. Prakash H. Joshi, "Cutting tools", 1st edition, Wheeler Publishing, New Delhi, 1997.

19ME4065 - FLEXIBLE MANUFACTURING SYSTEMS

L-T-P-S : 2-0-2-0
Course code : 19ME4065
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME2211

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Analyze various production schedules and plant layouts.	PO2	2
2	Apply the concept of group technology to the development of FMS.	PO2	2
3	Identify hardware and software components of FMS.	PO2	2
4	Analyze materials handling and storage system in FMS.	PO2	2

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.

19ME4066 - REVERSE ENGINEERING AND RAPID PROTOTYPING

L-T-P-S : 2-0-2-0
Course code : 19ME4066
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the need of reverse engineering	PO1	2
2	Understand working principles of RP techniques	PO3	2
3	Understand Rapid tooling and RP case studies	PO3	2
4	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. ElancheZhian C,Sunder Selwyn T,Shanmuga Sundar G “Computer Aided Manufacturing”, Laxmi Publications
5. Ali K Kamrani “Rapid Prototyping: Theory and Practice” Publisher: Springer.

19ME4071 - AUTOMOBILE ENGINEERING

L-T-P-S : 2-0-2-0
Course code : 19ME4071
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand different types of chassis, engine components, fuel systems and its working principles	PO3	2
CO2	Understand different components of transmission system, cooling and lubrication systems	PO3	2
CO3	Understand different components of suspension, steering and braking systems	PO3	2
CO4	Understand different electric and electronic systems used in automobiles and pollution control techniques used in SI and CI engines.	PO3	2

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.

19ME4072 - AUTOMOBILE ENGINE DESIGN

L-T-P-S : 2-0-2-0
Course code : 19ME4072
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the thermodynamics first principles and design major components of an I. C. engine	PO 1	3
2	Design cooling, lubrication and engine component systems	PO 3	3
3	Simulate and Analyze the designed engine components for stresses	PO 4	4
4	Design various automobile engine components experimentally	PO 4	5

Syllabus:

THERMODYNAMIC ENGINE DESIGN: Thermal cycles, Decision on size, length of stroke, rpm of the engine, Design of engine from first principle.
ENGINE FUNCTIONAL DESIGN: Selection, Stroke & Bore, No. of cylinders, Cylinder arrangement, Design considerations for combustion chamber, Engine balancing, Selection of firing order.
DESIGN OF COOLING & LUBRICATION SYSTEM: Heat calculations and Heat balance sheet, Design of radiator, water pump, selection of lubricating oil and pump.
ENGINE COMPONENT DESIGN: Materials, Design of Piston, Piston pin, Connecting rod, Crankshaft, Cylinder liner, cylinder head, Design of Flywheel, Design of Valve, Rocker arm, Push rod, Cam shaft, cam and follower.
ANALYSIS OF THE DESIGNED ENGINE COMPONENTS
2D drawings of piston assembly, crank shaft, cam shaft, cylinder block and cylinder head, rocker and rocker arm, and valves (Using CAD/CATIA).
Failure analysis of critical components using ANSYS:
Model Simulation of piston connecting rod assembly, torque and force analysis for the designed crank shaft, stress analysis for the valve and the push rod.

Text Books:

1. S. P. Patil, “Mechanical System Design”, Jaico Publications.
2. V. L. Maleev, “I. C. Engine”, McGraw Hill Book Co. Ltd., New Delhi, Second Edition.
3. Gill P. W., Smith J. H., Zurich E. J., “Fundamentals of I. C. Engine”, Oxford & IBH Pub. Co., New Delhi.
4. J. B. Heywood, “I. C. Engine Fundamentals”, McGraw Hill Book Co., New Delhi.

Reference Books:

1. Litchy, I. C. Engine, McGraw Hill

2. George E. Dieter, “Engineering Design- A Material and Processing Approach”, Second Edition, McGraw-Hill International Edition
3. A. Kolchin and V. Demidov, “Design of Automotive Engines”, Mir Publishers, Moscow, (1984)
4. Gordon P. Blair, “Design and Simulation of Four-Stroke Engines”, Society of Automotive Engineers, Inc., USA, (1999).

List of Experiments:

1. Calculate the equivalent power from the cyclic operation, implementing the theory to solve problems for the conversation process. Calculate the number of cylinders relating to the power output.
2. Prepare 2D Drawings of the cylinder arrangements using the achieved dimensions
3. Verify different models for different firing orders.
4. Assuming permissible allowances and suitable materials for piston and connecting rod simulate the piston assembly - using ANSYS
5. Using permissible allowances and assuming suitable materials for piston and connecting rod simulate the piston assembly using ANSYS
6. Simulate the crank shaft and verify for the torque - using ANSYS
7. Simulate the crank shaft and verify for different forces - using ANSYS
8. select the suitable cooling system and prepare a 2D drawing of the arrangement using CAD or CATIA
9. Simulate for the dynamic balancing of the reciprocating parts and the crank shaft using ANSYS
10. Draw 2D detailed drawing of the designed cam shaft using AUTO CAD/CATIA
11. Show the valve positions and over-all dimensions of the cylinder head using Auto CAD or CATIA
12. Detailed drawing of the rocker, rocker arm, valves and springs using Auto CAD or CATIA.

19ME4073 - AUTOTRONICS & SAFETY

L-T-P-S : 2-0-2-0
Course code : 19ME4073
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.

19ME4074 - ALTERNATIVE ENERGY SOURCES FOR AUTOMOBILES

L-T-P-S : 2-0-2-0
Course code : 19ME4074
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Acquire comprehensive knowledge on Electric Vehicles and Hybridization of automobiles with applications.	PO1, PO2	2
CO2	Understand the technology of Hydrogen driven vehicles and fuel properties along with application in engine performance.	PO1, PO2	2
CO3	Comprehend about Solar powered automobiles and estimate the performance of engines driven by alternative liquid fuels (Biofuels) and gaseous fuels (Natural Gas and Propane vehicles).	PO1, PO2	2
CO4	Explore and conjecture the emerging technologies and future source of alternative fuels in automobiles.	PO1, PO2	2
CO5	Practically study the various technologies of alternative energy sources applied in the advanced scenario of automobile engineering.	PO1, PO5	3

Syllabus:

Engine Technology and Emissions of Conventional fuel, Alternative Energy resources and there availability, Hydrogen Energy: Properties and sources of hydrogen, Hydrogen fuel: storage and transportation methods, application to engines, Fuel Cell technology, Solar Energy: Photo-voltaic conversion, collection devices and storage, application to automobiles. Electric and Plug-in automobiles, Compressed Natural Gas: Engine principle and Performance, Propane engines. Alternative fuels conversion technology and cost analysis of fuel technology. Emerging and future fuels.

Text Books:

1. Electric and Plug-in Hybrid Vehicles (Green Energy and Technology) by Bogdan Ovidiu Varga and Florin Mariasiu, Springer, 2015.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition (Power Electronics and Applications Series) by Mehrdad Ehsani, Yimin Gao and Ali Emadi, 2009.
3. Alternative Fuels – Concepts, Technologies and Developments by S. S. Thipse, 2010.
4. Alternative Fuel Technology: Electric, Hybrid and Fuel-Cell Vehicles by Erjavec Jack, 2007.

Reference books:

1. Solar Energy Fundamentals and Applications, H P Garg, Tata McGraw Hill Publishing Co.
2. Fuel Cells Principles and Applications, B. Viswanathan and Aulice Scibioh, Universities Press, Hyderabad.
3. Energy Management in Hybrid Electric Vehicles Using Co-Simulation by Christian Paar, 2011.
4. Electric and Hybrid Vehicles by Tom Denton, 2016.
5. Electric Vehicle Technology Explained, 2ed (WSE) byJames Larminie, 2015

List of Experiments:

1. Simulation and study of solar PV vehicle using PV system software.
2. Fuel property analysis of bio-fuels on laboratory scale.
3. Simulation of Hydrogen fuel systems using TRNSYS software.
4. Optimizing the performance of an IC engine with alternative source using TRNSYS software.
5. Basic experiments on Energy Balance of a Hybrid system using EES software.
6. Simulating a Hybrid energy automobile systems using TRNSYS software.
7. Engine performance analysis using Alternative fuels – ANSYS software.
8. Engine performance analysis using Electric charge – Model
9. Laboratory engine testing using different bio-oils.
10. Engine modification for bio-fuels using ANSYS software.
11. Finite Element analysis of PEM fuel cell integrated with Electric vehicle – Comsol Multi physics.
12. MATLAB program for calculation of efficiency of fuel cell integrated with Electric vehicle.

19ME4075 - AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM

L-T-P-S : 2-0-2-0
Course code : 19ME4075
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.

19ME4076 - AUTOMOBILE ENGINE SYSTEM AND PERFORMANCE

L-T-P-S : 2-0-2-0
Course code : 19ME4076
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 Engines.	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 Dhanpat Rai & 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

19ME4081 - AUTOMOTIVE SENSOR AND APPLICATIONS

L-T-P-S : 2-0-2-0
Course code : 19ME4081
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Introduction to automotive sensors and instrumentation, Sensors	PO1	2
2	Analyze the measurement of engine parameter using sensor.	PO4	3
3	Apply required sensors and actuators for automotive applications	PO3	3
4	Analyze the sensors for intelligent transport systems	PO3	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:

1. 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

19ME4082 - ELECTRONIC ENGINE MANAGEMENT SYSTEM

L-T-P-S : 2-0-2-0
Course code :19ME4082
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	1
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 CompactRIO platformand LabVIEW software used as ECU
13. 8085 Microprocessor programming / Diagnosis of ECU

19ME4083 - INSTRUMENTATION IN AUTOMOTIVE INDUSTRIES

L-T-P-S : 2-0-2-0
Course code : 19ME4083
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

19ME4084 - AUTOTRONICS AND VEHICLE INTELLIGENCE

L-T-P-S : 2-0-2-0
Course code :19ME4084
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Analyze various electronics systems like sensors	PO1, PO2	4
2	Understand Fuel injection and Ignition system	PO1, PO2	2
3	Understand Electric vehicles and hybrid vehicles	PO1, PO2	2
4	Design of intelligence vehicle systems	PO3	4

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.

19ME4085 - AUTOMOTIVE SYSTEMS

L-T-P-S : 2-0-2-0
Course code : 19ME4085
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the importance of automotive systems	PO1, PO3	2
2	Understand the Two-wheel drive, four-wheel drive vehicles	PO1, PO3	2
3	Analyze the transmission system	PO1, PO3	4
4	Analyze control system for Automotive systems	PO1, PO3	4

Syllabus:

Automobile and Chassis**:** Brief history, introduction about an automobile, layout of an automobile, automobile sub systems and their role. Classification – Passenger vehicles, goods vehicles, off highway. Two-wheel drive, four-wheel drive vehicles. Role and requirement of a chassis frame. Types of chassis – Light, medium and heavy-duty vehicle chassis, ladder chassis, integral body. Design features of a body– Types of bodies, coach built, convertibles. Body accessories, bumpers.

Engine Basic Theory: Engine types and their operation, classification, Properties of I.C. engine fuels, actual cycle, air fuel cycle, combustion charts (equilibrium), two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram.

Transmission: Flywheel, clutch, gear box types, need, general functions and design characteristics, decoupling of power, speed and torque characteristics of power transmission system. transfer case - auxiliary gearbox, gear shifting mechanisms. Automatic Transmission - Need for fluid coupling and torque converters, Borg Warner type, control mechanisms, limitations. Transmission Electronics, Automatic Manual Transmission.

Driveline and Axle: Functional and design characteristics of propeller shaft, selection criteria for material and cross section of propeller shaft, need for differential and final drive. Axle – Live and dead axles, front axle and its types, stub axle and its types, rear axle and its types, fully floating, semi- floating and three quarter floating axles, two speed axles, twin axles, swing axles. Use of different types of wheels and tyres, specification, materials.

Control System: Steering, Suspension and Brakes – Need, requirements, principle of working and types. Effort multiplication and geometry in steering, types of springs used in suspension system, need for damping. wheel locking and stopping distance, self-energizing and self-locking, Introduction to ABS.

Text Books:

1. Heinz Heister, “Vehicle and Engine Technology”, SAE Second Edition, 1999.
2. John B Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill International Editions, 1988.

Reference Books:

1. W H & Anglin D L, “Automotive Mechanics”, Tata McGraw Hill Publishing Company, 2004.
2. Robert Bosch “Automotive Hand book”, 5th Edition, 2004.
3. Kirpal Singh, “Automobile Engineering Vol 1 & 2”, Standard Publishers Distributors, 2009.
4. Ganesan V , “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 2003.
5. Ramalingham K K, “Fundamentals of Automobile Engineering”, SCITECH Publications, 2010.

19ME4086 - PROGRAMMABLE LOGIC CONTROLLERS

L-T-P-S : 2-0-2-0
Course code : 19ME4086
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the importance of Factory Automation	PO1, PO3	2
2	Understand the functions and operations of PLC	PO1, PO3	2
3	Understand the Installation and maintenance procedures for PLC	PO1, PO3	2
4	Analyze PLC for the control of industrial processes	PO1, PO3	4

Syllabus:

Introduction to Factory Automation: History and developments in industrial automation. Vertical integration of industrial automation, Control elements in industrial automation, PLC introduction

Programmable Logic Controllers: Basics of PLC, Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules, Configuring a PLC, PLC wiring.

Programming of PLC: Types of Programming - Simple process control programs using Relay Ladder Logic - PLC arithmetic functions - Timers and counters –data transfer-comparison and manipulation instructions, PID instructions, PTO / PWM generation.

INSTALLATION: Installation and maintenance procedures for PLC - Troubleshooting of PLC, PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet.

APPLICATIONS OF PLC: Case studies of Machine automation, Process automation, Selection parameters for PLC. Introduction to Programmable Automation Controller.

Text Books:

1. John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella “Programmable Logic Controllers ", McGraw Hill Inc, 2005.

Reference Books:

1. W. Bolton, “Mechatronics”, Pearson Education, 2009
2. Kelvin T Erikson, “Programmable Logic Controllers ", Dogwood Valley Press, 2005

List of Experiments:

1. Win pro ladder operations
2. Basic control circuits
3. Light control
4. Traffic light control
5. Digital clock control
6. Step motor control

7. Tank filling device control
8. Keypad control
9. DC motor control
10. Multiple PLC trainers
11. Temperature control
12. Counter application programming

19ME4091 - ARTIFICIAL INTELLIGENCE FOR ROBOTICS

L-T-P-S : 2-0-2-0
Course code : 19ME4019
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME3116

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the concepts of AI	PO1	1, 2
2	Apply basic principles of AI in solutions that require problem solving and planning.	PO4	3
3	Apply basic principles of AI in solutions that require problem solving, planning, reasoning and learning	PO4	3
4	Analyze AI in Robotics	PO3	4

Syllabus:

Introduction: History, state of the art**,** Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

Problem Solving: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

Planning: Planning with forward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world.

Reasoning: Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

Learning: Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

AI in Robotics: Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics

Text Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approach”, Pearson Education, India.
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”, Harlow: Addison-Wesley.

Reference Books:

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company.

List of Experiments:

1. Write a program in prolog to implement simple facts and Queries.
2. Write a program in prolog to implement simple arithmetic.

3. Write a program in prolog using Depth First Search.
4. Write a program in prolog using Best First Search.
5. Write a program in prolog for handling the list and its operations.
6. Write a program in prolog to solve Monkey banana problem.
7. Write a program in prolog to solve Tower of Hanoi.
8. Write a program in prolog to solve 8 Puzzle problems using Best first Search.
9. Write a program in prolog to solve 4-Queens problem.
10. Write a program in prolog to solve Travelling salesman problem.
11. Write a program for Robot (Traversal) using Mean End Analysis.
12. Write a program in prolog for Water jug problem.

19ME4092 - INDUSTRIAL AUTOMATION AND CONTROL

L-T-P-S : 2-0-2-0
Course code : 19ME4092
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the concepts industrial automation and measurement systems	PO1	2
2	Apply the controllers in automation	PO3	3
3	Analyze and select a suitable PLC system for the given application	PO4	4
4	Apply the concepts of control systems for industrial automation	PO3	4

Syllabus:

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, Measurement Systems Specifications, Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of Level, Humidity, pH, Signal Conditioning Circuits, Estimation of errors and Calibration.
Introduction to Process Control, P-I-D Control, Controller Tuning, Implementation of P-I-D Controllers, Special Control Structures: Feedforward and Ratio Control, Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Split Range Control.
Introduction to Sequence/Logic Control and Programmable Logic Controllers, Relay Ladder Logic, Scan Cycle, RLL Syntax, Structured RLL Programming, The PLC Hardware environment.
Control of Machine tools: Introduction to CNC Machines, Analysis of a control loop.
Introduction to Actuators: Hydraulic Actuator Systems: Principles, Components
Pneumatic Control Systems: Components, Pneumatic Control Systems.

Text Books:

1. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House, 2013
2. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India, 2012
3. Electric Motor Drives, Modelling, Analysis and Control, R. Krishnan, Prentice Hall India, 2002
4. Hydraulic Control Systems, Herbert E. Merritt, Wiley, 1991

List of Experiments:

1. Different applications of Push buttons.
2. Working of different types of Timers.
3. Working of different types of Counters.
4. Sequential operation of ON/OFF of a set of lights.
5. Latching and Unlatching of a Motor.
6. Automatic indication of water tank level.

7. Traffic lights indication.
8. Logic Gates
9. Latching and Unlatching
10. Interlocking
11. Sequential operation of ON/OFF of a set of lights
12. Counters
13. Forward and Reverse direction control of Motors.

19ME4093 - INDUSTRIAL HYDRAULIC AND PNEUMATIC SYSTEMS

L-T-P-S : 2-0-2-0
Course code : 19ME4093
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Learn the concepts hydraulic or pneumatic actuation system	PO1	2
2	Analyze diagnose maintenance problems of hydraulic and pneumatic system	PO4	3
3	Analyze required components to develop an automation system using pneumatics and hydraulic system	PO3	3
4	Develop circuits for controlling hydraulic and pneumatic using PLC	PO2	4

Syllabus:

Elements of Hydraulic Systems: Introduction to fluid power, Power unit and accessories, Types of power units –elements. design properties - Hydraulic fluids, Selection of hydraulic fluid, comparison of hydraulics and pneumatics. Pumps, motors and cylinders - Types, characteristics and constructional details, cylinder cushioning, Pipes- material, pipe fittings. seals and packing. Filter arrangement, maintenance of hydraulic systems. Selection criteria for cylinders, pipes, Heat generation in hydraulic system

Hydraulic System Design and Industrial Applications: Pressure, flow and direction control valves – types & constructional details, circuit symbols. Flow, Pressure and direction control circuits. Regenerative circuits, differential circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits. Design of hydraulic circuits.

Elements of Pneumatic Systems: Compressors- types, selection. Symbols of pneumatic elements. Cylinders - types, typical construction details. Valves – Types, typical construction details.

Pneumatic Systems Design and Industrial Applications: General approach, travel step diagram. Types - sequence control, cascade, step counter method. K.V.Mapping for minimization of logic equation.Metal working, handling, clamping, application with counters. Design of pneumatic circuits

Advances in Hydraulics and Pneumatics: Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application.Hydro-Mechanical servo systems. PLC-construction, types, operation, programming

Text Books:

1. Yeaple F.D, “Hydraulic and Pneumatic Power and Control: Design”, McGraw-Hill, USA, 2007
2. Srinivasan R, “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints Private Ltd, 2005

Reference Books:

1. Majumdar, S.R, “Oil Hydraulic Systems: Principles and Maintenance”, Tata McGraw- Hill, New Delhi, 2003.

2. Rohner P, “Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples”, Macmillan Press Ltd., UK, 1979.
3. Sudin Izman and Venkatesh V C, “Precision Engineering”, Tata Mcgraw-Hill Inc.New Delhi , 2007.
4. Werner Deppert and Kurt Stoll, “Pneumatic Controls : An Introduction to Principles“, Vogel-Druck Wurzburg, Germany, 1975.
5. Pippenger J.J Tyler G Hicks, “Industrial Hydraulics”, Mcgraw-Hill, USA, 2007

List of Experiments:

1. Circuit simulation for triggering of Single-Acting Air Cylinder
2. Circuit simulation for triggering Double-Acting Air Cylinder
3. Circuit simulation using OR Valve
4. Simulation of Flow Control Valve circuits
5. Simulation of Quick-Exhaust Valve circuit
6. Simulation of AND Valve circuit
7. Simulation of Directional Control Valve circuits
8. Simulation of Sequence Valve circuit.
9. Simulation of circuit using Time-Delay Valve.
10. Simulation of Two-Hand Safety Circuit
11. One-Cycle Reciprocation of Double-Acting Air Cylinder
12. Emergency Stop Circuit
13. Sequence Control of Two Air Cylinders
14. One-Cycle Cylinder Reciprocation using a Pushbutton and Single-Solenoid Valve
15. Continuous Cylinder Reciprocation using Limit Switches and Single-Solenoid Valve
16. One-Cycle Cylinder Reciprocation using Pushbuttons and Double-Solenoid Valve
17. One-Cycle Cylinder Reciprocation using Limit Switch and Double-Solenoid Valve
18. Continuous Cylinder Reciprocation using Limit Switches and Double-Solenoid Valve
19. Cylinder Advance/Reverse Control using a Pushbutton and Double-Solenoid Valve
20. Two-Cylinder Sequencing (A+B+B-A-) using Single-Solenoid Valves

19ME4094 - INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS

L-T-P-S : 2-0-2-0
Course code : 19ME4094
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/ PSO	BTL
1	Understand the concepts of robot, sensors and their applications in robots	PO1	2
2	Learn material handling equipment used both in automated and non-automated systems	PO1	2
3	Analyze and select a suitable material handling system for the given application	PO4	4
4	Apply the various applications of robots in material handling	PO3	3

Syllabus:

Introduction: Automation and robotics, robot anatomy, work volume, classification of robots: configuration, drive systems, control systems, applications.

End Effectors: Types of end effectors: grippers and tools, gripper mechanisms, considerations in gripper selection and design.

Sensors: Sensors and transducers, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics.

Material Handling: Overview of material handling equipment, consideration in material handling system design, principles of material handling. Material transport systems: Industrial trucks, monorails, conveyors, cranes and hoists.

Automated Guided Vehicle System: Types of AGV's, Vehicle Guidance technology, Vehicle management and safety. Automated storage systems: Automated storage / retrieval systems, carousel storage systems.

Robots in Material Handling: General considerations in robot material handling, material transfer applications, machine loading & unloading, characteristics of robot application.

Text Books:

1. Mikell P Groover, "Industrial Robotics- Technology, Programming and Applications", McGraw Hill.
2. Mikell P. Groover, "Automated Production system & computer integrated manufacturing", Prentice Hall of India.

Reference Books:

1. Richard D Klafter , "Robotics Engineering – An Integrated Approach" , Prentice Hall of India P Ltd.
2. James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.

19ME4095 - MICROCONTROLLER AND PLC

L-T-P-S : 2-0-2-0
Course code : 19ME4095
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the concept of 8051 microcontroller	PO1	2
2	Design the 8051 microcontroller	PO1	4
3	Understand the concept of PLC	PO1	2
4	Write ladder logic in Programmable logic controllers.	PO3	4

Syllabus:

8051 ARCHITECTURE: Microcontroller Hardware – I/O Pins, Ports – External memory – Counters and Timers – Serial data I/O – Interrupts – 8051 Assembly Language Programming: Instruction set of 8051, Addressing modes, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, interrupts and returns interrupts and returns interrupt handling.

8051 MICROCONTROLLER DESIGN: 8051 Microcontroller Specification 8051 – Microcontroller System Design – Testing the Design, Timing Subroutines, Look up Tables – Serial Data Transmission.

8051 MICROCONTROLLER APPLICATIONS: Interfacing of Keyboards – Interfacing of Display Devices – Pulse measurement – Analog to Digital and Digital to Analog Converter – Interfacing Hardware Circuit – Multiple interrupts – Serial Data Communication – Network Configuration.

PROGRAMMABLE LOGIC CONTROLLERS: Introduction – Parts of PLC – Principles of operation – PLC sizes – PLC hardware components – I/O section Analog I/O Section Analog I/O modules – digital I/O modules CPU processor memory module – Programming devices – PLC programming Simple instructions – Manually operated switches – Mechanically operated and Proximity switches - Output control devices - Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram.

APPLICATIONS OF PLC: Timer Instructions On Delay, Off Delay And Retentive Timers, Up Counter, Down Counter And Up Down Counters, Control Instructions – Data Manipulating Instructions, Match Instructions: Applications of PLC – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application

Text Books:

1. Kennath J. Ayala.The 8051 Microcontroller Architecture, Programming and Applications, Penram International Publishing (India), Second Edition, Mumbai.
2. Frank D. Petruzella. Programmable Logic Controllers, McGraw–Hill Book, Company, 1989.

Reference Books:

1. B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
2. Embedded Controller Hand book, Intel Corporation, USA.
3. Microcontroller Hand Book, INTEL, 1984.

List of Experiments:

1. Introduction to TASM(turbo assembler)
2. Multi-byte addition
3. Factorial of a given 8-bit number
4. Sorting of numbers in ascending order
5. String data transfer
6. Comparison of two strings
7. Conversion of ASCII to packed BCD number
8. Conversion of packed BCD to ASCII number
9. To count positive and negative numbers in a given array
10. To count even and odd numbers in a given series
11. Count number of 0's and 1's in a multi byte number
12. Sum of n 8-bit binary numbers
13. To find the largest number in the given array

19ME4096 - MECHATRONICS SYSTEM DESIGN

L-T-P-S : 2-0-2-0
Course code : 19ME4096
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the approach used for mechatronic system design and relevant considerations	PO1	2
2	Apply suitable sensors and actuators used in a Mechatronic system	PO3	3
3	Analyze signal conditioning interface in a Mechatronic system and implementation of control systems	PO4	3
4	Modeling and Simulation for the Mechatronic System design perspective	PO3	4

Syllabus:

Introduction: Integrated Design issues in Mechatronics, Mechatronics Design process, Mechatronics Key Elements, Applications in Mechatronics.

Modeling and simulation of physical systems: Electrical systems, Mechanical systems- translational & rotational systems, fluid systems.

Sensors and Transducers: Introduction, sensor for motion and position measurement, force, torque and tactile sensors, vibration – Acceleration sensors, sensor for flow measurement, temperature sensing devices, sensor applications.

Actuating Devices: DC Motors, Stepper motors, fluid power Actuation, fluid power design elements, piezoelectric Actuators.

System Control – Logic Methods: Number Systems in Mechatronics, Binary Logic, Karnaugh Map Minimization, Programmable Logic Controllers.

Signal Conditioning and Real Time Interfacing: Elements of a Data Acquisition and Control System, Transducers and Signal Conditioning, Devices for Data Conversion, Data Conversion Process.

Text Books:

1. Devdas Shetty, Richard A. Kolk, “Mechatronics System Design”, PWS Publishing Company, 1997.
2. Bolton, “Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering”, 2nd Edition, Addison Wesley Longman Ltd., 1999

Reference Books:

1. D.A Bradley, D. Dawson, N.C Burd and A.J. Loader, “Mechatronics” CRC Press, 2010.
2. David G. Alciatore, Michael B. Histand, “Introduction to mechatronics and measurement systems”, 2nd Edition, McGraw-Hill Professional, 2002.

List of Experiments:

1. Introduction to Mat Lab
2. Introduction to Simulink.
3. To Study and simulate The Response of a Thermal System.

4. To Study and simulate The Response of an Electrical System.
5. To Study and simulate The Response of a Spring- Mass- Damper System.
6. To study and simulate The Response of a Rotary system.
7. Linear System Analysis Using MAT lab
8. To Study The System Performance of Thermal System Using PD, PI PID Controller.
9. To Study The System Performance of R –L –C circuit Using PD, PI PID Controller.
10. To Study The System Performance of spring- Mass- Damper System Using PD, PI PID Controller.
11. To Study The System Performance of Rotation Using PD, PI PID Controller.
12. Programmable Logic Controller-Study And Verification Of Truth Tables Of Logic Gates, Simple Boolean Expressions And Application Of Speed Control Of Motor

19ME4101 - PROGRAMMING SKILLS

L-T-P-S : 2-0-2-0
Course code : 19ME4101
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Able to know the Basics of Computation, Algorithms, and Functional Programming.	PO1, PO5	2
2	Able understand the Iterative style, recursive style, and efficiency issues in programming.	PO1, PO5	2
3	Able to understand the Basics of imperative style programming, Assertions, and Loop invariants.	PO1, PO5	2
4	Able to understand Top down design, Step-wise refinement, structures, encapsulation, and object-oriented programming.	PO1, PO5	2
5	Able to Apply the theoretical concepts of programming to develop and execute the programs.	PO1, PO5	3

Syllabus:

Basic model of computation, Notion of Algorithms, Principle of Mathematical Induction.
Basics of functional programming, notion of types.
Iterative versus recursive style.
Correctness and efficiency issues in programming, time and space measures.
Basics of imperative style programming.
Assertions and loop invariants.
Top down design and examples of step-wise refinement.
Programming using structures, introduction to encapsulation and object-oriented programming.

Text Books:

1. Subhashis Banerjee, S. Arun-Kumar, D. Dubhashi: Introduction to Computer Science. Manuscript.
2. Structure and Interpretation of Computer Programs by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.
3. How to solve it by Computer by R. J. Dromey, Prentice-Hall India EEE Series.

19ME4102 - DATA ANALYTICS

L-T-P-S : 2-0-2-0
Course code : 19ME4102
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Able to know the Basics of Descriptive Statistics.	PO1, PO5	2
2	Able understand the Inferential Statistics.	PO1, PO5	2
3	Able to understand the Basics of Regression & ANOVA.	PO1, PO5	2
4	Able to understand Prescriptive analytics.	PO1, PO5	2
5	Able to Apply the theoretical concepts of data analytics to solve problems.	PO1, PO5	3

Syllabus:

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. 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

19ME4103 - PYTHON

L-T-P-S : 2-0-2-0
Course code : 19ME4103
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Able to know the Basics of Programming, and Python.	PO1, PO5	2
2	Able understand Lists, Function definition, Sorting, Passing functions.	PO1, PO5	2
3	Able to understand Exception handling, Input / output, File handling, String processing, Backtracking, Scope, Data structures.	PO1, PO5	2
4	Able to understand Classes, Objects and user defines data types.	PO1, PO5	2
5	Able to Apply the theoretical concepts of python to develop and execute the programs.	PO1, PO5	3

Syllabus:

Introduction to programming

Basics of Python

Lists, Inductive function definition, Sorting

Sorting, Tuples, Dictionaries, Passing functions, List comprehension

Exception handling, Input / output, File handling, String processing

Backtracking, Scope, Data structures, Stacks, Queues and heaps

Classes, Objects and user defines data types

Text Books:

1. Dive into Python 3, Mark Pilgrim, http://www.diveintopython3.net/
2. Think Python, 2nd Edition, Allen B. Downey, http://greenteapress.com/wp/think-python-2e/
3. Algorithm Design, Jon Kleinberg and Eva Tardos, Pearson (2013)

19ME4104 - MACHINE LEARNING

L-T-P-S : 2-0-2-0
Course code : 19ME4104
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME4102

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the basics of Machine Learning.	PO1, PO5	2
2	Understand Model Validation Approaches, Discriminant Analysis.	PO1, PO5	2
3	Understand Random Forest, Neural Networks Deep learning.	PO1, PO5	2
4	Understand Clustering, Associative Rule Mining, and Challenges for big data analytics.	PO1, PO5	2
5	Apply the theoretical concepts of Machine Learning to solve problems.	PO1, PO5	3

Syllabus:

Machine Learning: Introduction and Concepts

Differentiating algorithmic and model-based frameworks Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification.

Supervised Learning with Regression and Classification techniques -1:

Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines.

Supervised Learning with Regression and Classification techniques -2:

Ensemble Methods: Random Forest, Neural Networks Deep learning.

Unsupervised Learning and Challenges for Big Data Analytics:

Clustering, Associative Rule Mining, Challenges for big data analytics.

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.

19ME4105 - ARTIFICIAL INTELLIGENCE

L-T-P-S : 2-0-2-0
Course code : 19ME4105
Credits : 3
Contact Hours : 4
Pre-requisites : 19ME4102

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Introduction to AI, Understand about intelligence, knowledge and Artificial Intelligence, techniques of AI as a State space search, Production Systems.	PO1, PO3	2
2	Problem solving by Search, Heuristic Search, Randomized search techniques and Finding Optimal paths	PO2, PO5	3
3	Analyze the appropriate methodologies for problem decompositions, planning and constraint data constraint satisfactions.	PO1, PO5	3
4	Understand Knowledge Representation using Predicate Logic, Representing Knowledge using Rules, Semantics Nets, Frames and Conceptual dependencies.	PO1, PO2	2

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: Minimax Algorithm, AlphaBeta Algorithm, SSS*.
Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning,Plan Space Planning, Graphplan, Constraint Propagation.
Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.

Text Books:

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

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.

19ME4106 - FUZZY LOGIC AND NEURAL NETWORKS

L-T-P-S : 2-0-2-0
Course code : 19ME4106
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understanding the Concepts of Fuzzy sets, Fuzzy Logic, importance of membership functions, Fuzzy Rule, and operations on fuzzy sets, Principles of Fuzzy Logic System in solving the complex engineering problems	PO1, PO2	2
2	Applications of Fuzzy sets for real time problems of various domains using Fuzzy Logic control system	PO2, PO5	2
3	Understand Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back propagation, Associative Learning,	PO1, PO2	2
4	Understanding Neuro Fuzzy Approaches, Computing with Neural Nets and Applications of Neural Network in various Domains	PO1, PO2	2

Syllabus:

Basic Concepts of Fuzzy Sets, Fuzzy Logic, Zadeh's Extension Principle, Operations on Fuzzy Sets, Fuzzy Measures, Probability and Possibility Measures, Fuzzy Inference Methodologies, Fuzzy Relations, Applications of Fuzzy Sets in Management, Decision Making, Medicine and Computer Science.
Neural Network: Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back propagation, Associative Learning, Competitive Networks, Hopfield-Network, Computing with Neural Nets and Applications of Neural Network.

Text Books:

1. Mitchell, M., 1998, an Introduction to Genetic Algorithms, Prentice-Hall.
2. Lau C., (Ed), 1992, Neural Networks, IEEE Press.

Reference Books:

1. Freeman, J. and Skapura, D., 1991 Neural Networks: Algorithms, Applications and Programming Techniques, Addison-Wesley.
2. Klir, G.J. and Folger, T.A., 1988, Fuzzy Sets, Uncertainty, and Information, PHI.

19ME4201 - DESIGN FOR QUALITY AND RELIABILITY

L-T-P-S : 3-0-0-0
Course code : 19ME4201
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Model repairable and non-repairable systems and calculate failure rate, repair rate, reliability and availability	PO1	2
2	Use various probability density distributions significant to reliability calculations	PO3	2
3	Fit a given failure data set of a product into a Weibull distribution and estimate the reliability parameters.	PO3	2
4	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 QFDHandbook*, 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

19ME4202 - DESIGNING INTELLIGENCE SYSTEMS

L-T-P-S : 3-0-0-0
Course code : 19ME4202
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.

19ME4203– SUSTAINABLE DESIGN

L-T-P-S : 3-0-0-0
Course code : 19ME4203
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	PO1, PO3	2
2	To understand the methodologies in preparation for professional application. Management	PO1, PO3	2
3	To use a variety of techniques to communicate effectively	PO1, PO3	2
4	To understand the life-cycle assessment methods	PO1, PO3	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.

19ME4204 - SYSTEMS THINKING FOR DESIGN

L-T-P-S : 3-0-0-0
Course code : 19ME4204
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	PO1, PO3	2
2	Abstraction of key elements from problem situations	PO1, PO3	2
3	Use of specific techniques to model problems in a holistic manner	PO1, PO3	2
4	Use of specific techniques for self-regulating systems	PO1, PO3	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.

19ME4205 – DESIGN WITH ADVANCED ENGINEERING MATERIALS

L-T-P-S : 3-0-0-0
Course code : 19ME4205
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.

19ME4206– DESIGN FOR MANUFACTURE AND ASSEMBLY

L-T-P-S : 3-0-0-0
Course code : 19ME4206
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
1	Understand the importance of DFMA and various manufacturing processes	PO1, PO3	2
2	Understand the various machining processes and the respective design rules	PO1, PO3	2
3	Understand the procedure and advantages of Assembling	PO1, PO3	2
4	Understand the principles in Design of Manual Assembly	PO1, PO3	2

Syllabus:

Introduction to DFMA: History of DFMA, Steps for applying DFMA during product design, Advantages of applying DFMA during product design, Reasons for not implementing DFMA, Introduction to Manufacturing Process: Classification of manufacturing process, Basic manufacturing processes, Mechanical properties of material: Tensile properties, Engineering stress-strain, True stress strain, Compression properties, Shear properties, Introduction to materials and material selection: Classification of engineering materials, Material selection for product design

Overview of various machining processes — general design rules for machining – Dimensional tolerance and surface roughness — Design for machining — Ease — Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts. Metal Casting: Appraisal of various casting processes, selection of casting process, – general design considerations for casting — casting tolerances — use of solidification simulation in casting design — product design rules for sand casting.

Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation. Automatic Assembly Transfer Systems : Continuous transfer, intermittent transfer, indexing mechanisms, and operator – paced free – transfer machine.

Design of Manual Assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening.

Text Books:

1. J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy andvSons, Inc
2. George E. Dieter and Linda C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
3. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Second Edition, CRC press, Taylor & Francis, Florida, USA

Reference Books:

1. Geoffrey Boothroyd, “Assembly Automation and Product Design”, Marcel Dekker Inc., NY, 1992.
2. Engineering Design – Material & Processing Approach – George E. Deiter, McGraw Hill Intl. 2nd Ed. 2000.
3. Geoffrey Boothroyd, “Hand Book of Product Design” Marcel and Dekken, N.Y. 1990.
4. A Delbainbre “Computer Aided Assembly London, 1992.

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