(DEEMED TO BE UNIVERSITY)

MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS

APPLICABLE FOR B.TECH. STUDENTS
ADMITTED IN A.Y. 2018-19

B.Tech Y18 Batch Course Structure								
Humanities & Social Sciences								
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**Pre-Req**
1	18UC1101	Basic English	0	0	4	0	2	Nil
2	18UC1202	English Proficiency	0	0	4	0	2	Nil
3	18UC2103	Professional Communication Skills	0	0	4	0	2	Nil
4	18UC2204	Aptitude Builder -1	0	0	4	0	2	Nil
5	18UC3105	Aptitude Builder -2	0	0	4	0	2	Nil
6	18UC0007	Indian Heritage and Culture	0	0	2	0	0	Nil
7	18UC0008	Indian Constitution	0	0	2	0	1	Nil
8	18UC0009	Ecology & Environment	2	0	0	0	0	Nil
9	18UC0010	Universal Human Values & Professional Ethics	1	0	2	0	2	Nil
		Sub-Total	***3***	***0***	***26***	***0***	***13***	
Basic Sciences								
10	18SC1104	Foundations of Computational Mathematics	0	0	2	0	1	Nil
11	18PH1010	Physics Elective (Mechanics)	3	0	2	0	4	Nil
12	18SC1103	Single Variable Calculus and Matrix Algebra	3	0	0	0	3	Nil
13	18SC1105	Logic and Reasoning	0	0	2	0	1	Nil
14	18MT1201	Multivariate Calculus	3	0	2	0	4	Nil
15	18CY1002	Solid State Chemistry	3	0	2	0	4	Nil
16	18MT2102	Theory of Differential Equations in Engineering and Mechanics	2	0	2	0	3	Nil
17	18BT1001	Biology for Engineers	2	0	0	0	2	Nil
		Sub-Total	***16***	***0***	***12***	***0***	***22***	
Engineering Sciences								
18	18ME1201	Mechanics and Materials-I	3	0	2	0	4	18PH1010
19	18ME1002	Engineering Graphics for Mechanical Engineers	0	0	4	0	2	Nil
20	18ME1003	Workshop Practices for Mechanical Engineers	0	0	4	0	2	Nil

21	18SC1101	Problem Solving and Computer Programming	3	0	2	0	4	Nil
22	18ME1204	Introduction to Computational Thinking and Data Sciences	2	0	2	0	3	Nil
23	18ME2205	Numerical Computation for Mechanical Engineers	2	0	2	0	3	Nil
24	18EE2205	Circuits and Electronics	3	0	2	0	4	Nil
		Sub-Total	***13***	***0***	***18***	***0***	***22***	
Professional Core								
25	18ME2106	Measurements and Instrumentation	2	0	2	0	3	Nil
26	18ME2107	Thermal-Fluids Engineering-I	3	0	2	0	4	Nil
27	18ME2108	Mechanics and Materials-II	3	0	2	0	4	18ME1201
28	18ME2109	Kinematics and Dynamics of Machines	3	0	2	0	4	18PH1010
29	18ME2110	Machine Drawing	0	0	4	0	2	18ME1002
30	18ME2211	Design and Manufacturing-I	3	0	2	0	4	18ME1201
31	18ME2212	Thermal-Fluids Engineering-II	3	0	2	0	4	18ME2107
32	18ME2213	Vibrations and Controls	3	0	0	0	3	18ME2109
33	18ME3114	Machine Design	3	2	0	0	5	18ME2108
34	18ME3115	Design and Manufacturing-II	3	0	2	0	4	18ME2211
35	18ME3116	Robotics and Controls	3	0	0	0	3	Nil
36	18ME3117	Product Design and Development	0	0	6	0	3	Nil
37	18ME3218	Engineering Management	3	0	0	0	3	Nil
38	18ME3219	Heat Transfer	3	0	2	0	4	18ME2107
		Sub-Total	***35***	***2***	***26***	***0***	***50***	
Professional Electives								
39	PE	Professional Elective Course - 1	2	0	2	0	3	Nil
40	PE	Professional Elective Course - 2	2	0	2	0	3	Nil
41	PE	Professional Elective Course - 3	2	0	2	0	3	Nil
42	PE	Professional Elective Course - 4	2	0	2	0	3	Nil

43	PE	Professional Elective Course - 5	2	0	2	0	3	Nil
44	PE	Professional Elective Course - 6	2	0	2	0	3	Nil
		Sub-Total	***12***	***0***	***12***	***0***	***18***	
Open Electives								
45	18PH2007	Restricted Open Elective Course - 1(Materials for Mechanical Engineering Applications)	2	0	2	0	3	Nil
46	OE	Open Elective Course - 2(Management Course)	3	0	0	0	3	Nil
47	OE	Open Elective Course - 3 (Communication Skills)	0	0	4	0	2	Nil
48	OE	Open Elective Course - 4 (Foreign Language)	2	0	0	0	2	Nil
49	OE	Open Elective Course – 5	3	0	0	0	3	Nil
50	OE	Open Elective Course – 6	3	0	0	0	3	Nil
		Sub-Total	***13***	***0***	***6***	***0***	***16***	
Projects								
51	18IE2246	Industrial Training	0	0	0	0	2	Nil
52	18IE3247	Term Paper	0	0	4	0	2	Nil
53	18IE4048/ 18IE4050	Project (Part I) / Practice School	0	0	0	24	6	Nil
54	18IE4049/ 18IE4050/18IE4051	Project (Part II) / Practice School/ Internship	0	0	0	24	6	Nil
		Sub-Total	***0***	***0***	***4***	***48***	***16***	
Technical Skills								
55	18SC1106	Technical Skill - 1 (Coding)	0	0	0	6	1.5	Nil
56	18SC1207	Technical Skill - 2 (Coding)	0	0	0	6	1.5	Nil
57	18TS701	Skilling for Engineers-1 (Manufacturing Technologies)	0	0	0	6	1.5	Nil
58	18TS702	Skilling for Engineers-2 (Artificial Intelligence)	0	0	0	6	1.5	Nil
59	18TS703	Skilling for Engineers-3 (Problem Solving techniques in Thermal)	0	0	0	6	1.5	18ME2107
60	18TS704	Skilling for Engineers-4 (Problem Solving techniques in Design)	0	0	0	6	1.5	18ME1201
61	18TS705	Technical Proficiency & Training-1(Data Analytics)	0	0	0	4	1	Nil

62	18TS706	Technical Proficiency & Training - 2(Machine Learning)	0	0	0	4	1	Nil
		Sub-Total	***0***	***0***	***0***	***44***	***11***	
Counseling & Cocurricular Activities								
63	18GN1101	Counseling -1	0	0	1	0	0	Nil
64	18GN1202	Counseling -2	0	0	1	0	0	Nil
65	18GN2103	Counseling -3	0	0	1	0	0	Nil
66	18GN2204	Counseling -4	0	0	1	0	0	Nil
67	18GN3105	Counseling -5	0	0	1	0	0	Nil
68	18GN3206	Counseling -6	0	0	1	0	0	Nil
69	18GN1107	Cocurricular Activity -1	0	0	0	2	0.5	Nil
70	18GN1208	Cocurricular Activity -2	0	0	0	2	0.5	Nil
71	18GN2109	Cocurricular Activity -3	0	0	0	2	0.5	Nil
72	18GN2210	Cocurricular Activity -4	0	0	0	2	0.5	Nil
73	18GN3111	Cocurricular Activity -5	0	0	0	2	0	Nil
74	18GN3212	Cocurricular Activity -6	0	0	0	2	0	Nil
		Sub-Total	***0***	***0***	***6***	***12***	***2***	
Bridge / Refresher Courses								
75	--	Bridge/ Refresher Course in Mathematics	0	0	2	0	0	Nil
76	--	Bridge/ Refresher Course in Physics	0	0	2	0	0	Nil
77	--	Bridge/ Refresher Course in Chemistry	0	0	2	0	0	Nil
78	--	Bridge/ Refresher Course in English	0	0	2	0	0	Nil
		Sub-Total	***0***	***0***	***8***	***0***	***0***	
Induction Courses (Non Credit)								
79	18IN1001	Fundamentals of Mathematics	5	0	0	0	0	Nil
80	18IN1002	Basics of Physics	5	0	0	0	0	Nil
81	18IN1003	Introduction to Engineering	5	0	0	0	0	Nil
82	18IN1004	Human Values	5	0	0	0	0	Nil
83	18IN1005	SWEAR Analysis	5	0	0	0	0	Nil
84	18IN1006	Cocurricular Activities	5	0	0	0	0	Nil
		Sub-Total	***30***	***0***	***0***	***0***	***0***	
		Total	**122**	**2**	**118**	**104**	**170**	

List of Professional Electives							
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Cr**	**Pre-requisite**
Design Specialization							
1	18ME4051	Design of Transmission Elements	2	0	2	3	18ME2214
2	18ME4052	Theory of Elasticity and Plasticity	3	0	0	3	18ME2108
3	18ME4053	Advanced Vibrations and Noise Control	2	0	2	3	18ME2109
4	18ME4054	Computer Aided Design	2	0	2	3	Nil
5	18ME4055	Creep, Fatigue and Fracture Mechanics	3	0	0	3	18ME2108
6	18ME4056	Advanced Strength of Materials	2	0	2	3	18ME2108
7	18ME4057	Mechanics of Composite Materials	2	0	2	3	18ME2108
Strategic Manufacturing Specialization							
8	18ME4061	Modern Manufacturing Processes	2	0	2	3	18ME1003
9	18ME4062	Advanced Materials	3	0	0	3	Nil
10	18ME4063	Additive Manufacturing	2	0	2	3	Nil
11	18ME4064	Tool Engineering and Design	2	0	2	3	18ME2211
12	18ME4065	Flexible Manufacturing Systems	2	0	2	3	18ME3115
13	18ME4066	Geometric Dimensioning and Tolerancing	2	0	2	3	Nil
14	18ME4067	Reverse Engineering and Rapid Prototyping	3	0	0	3	Nil
Automobile Engineering Specialization							
15	18ME4071	Automobile Engineering	2	0	2	3	Nil
16	18ME4072	Automobile Engine Design	2	0	2	3	18ME2214
17	18ME4073	Automotive Transmission	2	0	2	3	Nil
18	18ME4074	Autotronics & Safety	2	0	2	3	Nil
19	18ME4075	Alternative Energy Sources for Automobiles	2	0	2	3	Nil
20	18ME4076	Automotive Electrical and Electronics System	2	0	2	3	Nil
21	18ME4077	Automobile Engine System and Performance	2	0	2	3	Nil
Autotronics Specialization							

22	18ME4081	Automotive Sesnsor and Applications	2	0	2	3	Nil
23	18ME4082	Autotronics	2	0	2	3	Nil
24	18ME4083	Electronic Engine Management System	2	0	2	3	Nil
25	18ME4084	Instrumentation in Automotive Industries	2	0	2	3	Nil
26	18ME4085	Autotronics and Vehicle Intelligence	2	0	2	3	Nil
27	18ME4086	Automotive Systems	2	0	2	3	Nil
28	18ME4087	Programmable Logic Controller	2	0	2	3	Nil
Robotics and Mechatronics Specialization							
29	18ME4091	Artificial Intelligence for Robotics	2	0	2	3	Nil
30	18ME4092	Automation System Design	2	0	2	3	Nil
31	18ME4093	Industrial Automation and Control	2	0	2	3	Nil
32	18ME4094	Industrial Hydraulic and Pneumatic Systems	2	0	2	3	Nil
33	18ME4095	Industrial Robotics and Material Handling Systems	2	0	2	3	Nil
34	18ME4096	Micro Controllers and PLC	2	0	2	3	Nil
35	18ME4097	Mechatronics System Design	2	0	2	3	Nil
Soft Computing and Data Analytics							
36	18ME4101	Programming Skills	2	0	2	3	Nil
38	18ME4102	Data Analytics	2	0	2	3	Nil
37	18ME4103	Python	2	0	2	3	Nil
39	18ME4104	Machine Learning	2	0	2	3	18ME4102
40	18ME4105	Artificial Intelligence	2	0	2	3	18ME4102
41	18ME4106	Fuzzy Logic and Neural Networks	2	0	2	3	Nil
42	18ME4107	Robotics	2	0	2	3	Nil

List of Open Electives								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	18BT40A1	IPR & Patent Laws	3	0	0	0	3	Nil
2	18CE40A2	Environmental Pollution Control Methods	3	0	0	0	3	Nil
3	18CE40A3	Solid and Hazardous waste management	3	0	0	0	3	Nil
4	18CE40A4	Remote Sensing & GIS	3	0	0	0	3	Nil
5	18CE40A5	Disaster Management	3	0	0	0	3	Nil
6	18CS40A6	Fundamentals of DBMS	3	0	0	0	3	Nil
7	18CS40A7	Fundamentals of Software Engineering	3	0	0	0	3	Nil
8	18CS40A8	Fundamentals of Information Technology	3	0	0	0	3	Nil
9	18EC40A9	Image Processing	3	0	0	0	3	Nil
10	18EM40B1	Linux Programming	3	0	0	0	3	Nil
11	18EM40B2	E-Commerce	3	0	0	0	3	Nil
12	18EE40B3	Renewable Energy Sources	3	0	0	0	3	Nil
13	18ME40B4	Robotics	3	0	0	0	3	Nil
14	18ME40B5	Mechatronics	3	0	0	0	3	Nil
15	18ME40B6	Operations Research	3	0	0	0	3	Nil
16	18PH40B7	Nano Materials & Technology	3	0	0	0	3	Nil
17	18PE40B8	Subsea Engineering	3	0	0	0	3	Nil
18	18PE40B9	Oil and Gas Management	3	0	0	0	3	Nil
19	18GN40C1	Self Development	3	0	0	0	3	Nil
20	18GN40C2	Indian Culture and History	3	0	0	0	3	Nil
21	18GN40C3	Emotional Intelligence	3	0	0	0	3	Nil
22	18GN40C4	Professional Ethics and Values	3	0	0	0	3	Nil
23	18GN40C5	Behavioral Sciences	3	0	0	0	3	Nil

List of Management Electives								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	18MB4051	Paradigms in Management thought	3	0	0	0	3	Nil
2	18MB4052	Indian Economy	3	0	0	0	3	Nil
3	18MB4053	Managing Personal Finances	3	0	0	0	3	Nil

4	18MB4054	Basics of Marketing for Engineers	3	0	0	0	3	Nil
5	18MB4055	Organization Management	3	0	0	0	3	Nil
6	18MB4056	Resources Safety and Quality Management	3	0	0	0	3	Nil
7	18MB4057	Economics for Engineers	3	0	0	0	3	Nil

List of Foreign Language Elective								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	18FL3051	Arabic Language	2	0	0	0	2	Nil
2	18FL3052	Bengali Language	2	0	0	0	2	Nil
3	18FL3053	Chinese Language	2	0	0	0	2	Nil
4	18FL3054	French Language	2	0	0	0	2	Nil
5	18FL3055	German Language	2	0	0	0	2	Nil
6	18FL3056	Hindi Language	2	0	0	0	2	Nil
7	18FL3057	Italian Language	2	0	0	0	2	Nil
8	18FL3058	Japanese Language	2	0	0	0	2	Nil
9	18FL3059	Kannada Language	2	0	0	0	2	Nil
10	18FL3060	Russian Language	2	0	0	0	2	Nil
11	18FL3061	Simhali Language	2	0	0	0	2	Nil
12	18FL3062	Spanish Language	2	0	0	0	2	Nil

List of Honor Degree Courses								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	18ME5001	Advanced Heat and Mass Transfer	3	0	2	0	4	18ME3119
2	18ME5002	Computational Fluid Dynamics	3	0	2	0	4	18ME2107
3	18ME5003	Incompressible and Compressible flows	3	0	2	0	4	18ME2107
4	18ME5004	Mechanisms Design and Simulation	3	0	2	0	4	Nil
5	18ME5005	Advanced Mechanics of Solids	3	0	2	0	4	18ME2108

Minor in Industrial Engineering								
List of Minor Degree Courses								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	18ME3121	Industrial Engineering Techniques	3	0	2	0	4	Nil
2	18ME3122	Operations Research	3	0	2	0	4	Nil
3	18ME3123	Engineering Management	3	0	2	0	4	Nil
4	18ME3124	Work Study and Ergonomics	3	0	2	0	4	Nil
5	18ME3125	Operations Management	3	0	2	0	4	Nil

HUMANITIES
AND
SOCIAL SCIENCES

BASIC ENGLISH

Course code : 18UC1101
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's	PO	BTL
1	Apply the practical knowledge of using action words in sentence construction.	PO10	3
2	Apply and analyse the right kind of pronunciation with regards to speech sounds and able to get different types of pronunciations.	PO10	3
3	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
4	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.
4. Language LaboratoryTeacher Manual, KLEFU

ENGLISH PROFICIENCY

Course code : 18UC1202
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's	PO	BTL
1	Apply the concepts of accurate English while writing and become equally at ease in using good vocabulary and language skills.	PO8, PO9, PO10	3
2	Understand the importance of pronunciation and apply the same day to day conversation.	PO8, PO9, PO10	3
3	Apply the concepts of Ratios, Percentages, Averages and Analysing the given information, a student is required to understand the given information and thereafter answer the given questions on the basis of comparative analysis of the data in the form of tabulation, bar graphs, pie charts, line graphs. Analyse the given data to find whether it is sufficient or not.	PO1, PO4	3
4	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 finding the solutions. Analyze the given conditions and finding out all 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. Sangeetha Sarma: *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, KLEFU

PROFESSIONAL COMMUNICATION SKILLS

Course code : 18UC2103
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's	PO No	BTL
1	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. One should be enabled to use English Language efficiently in the written medium to communicate Personal as well as Professional.	PO9, PO10	3
2	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. One is able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the Organization. As a professional, one is mature to bridge the gulf between the existing behavior/ lifestyle and the expected corporate behaviour cum lifestyle.	PO8	4
3	Apply the concepts of Time and work, the students will be able to solve the questions related to 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, problems based on trains, boats, circular tracks, races and games.	PO1	3
4	Apply Venn diagrams to the given statements to find out whether the given conclusions can be deducted from the given statements. Apply the logical implications and also the negations of various connectives to find the solutions. Analyze the given data and representing the data in the form of Venn Diagrams to find relations between any given set of elements.	PO1, PO5	3

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.
4. Asher Cashdan: Language, Reading and Learning.Oxford:Basil Blackwell.1979.

APTITUDE BUILDER –I

Course code : 18UC2204
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's	PO	BTL
1	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
2	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
3	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
4	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

APTITUDE BUILDER-2

Course code : 18UC3105
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	BTL
1	Apply the strategies and techniques learnt in carrying out conversations in different contexts. Analyse the different parameters and formats of written technical communication and apply in everyday work and life.	PO8, PO10	3
2	Analyse the concepts of critical and analytical reading skills. Apply the strategies and techniques learnt in handling interviews in different contexts.	PO8, PO10	3
3	Apply the concepts of Ratio & Proportion, Percentages, Profit &Loss, Simple & Compound Interest, students will be able to solve the problems based on Ratios, problems involving Percentages, problems related to cost price, selling price, profit, loss, marked price and discounts, problems involving interest.	PO1, PO5	3
4	Analyze the given series of numbers to predict the next number in the series. Analyze the given set of numbers or letters to find the analogy. Analyze the given data to find the code which is used to encode a given word and use the same code in the process of 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. Sangeetha Sarma: *Technical Communication*.Oxford University Press: Delhi.2016.
2. M. Ashraf Rizvi: *Effective Technical Communication.* New Delhi:McGraw Hill Education(India) Private Limited
3. Tom Rath: Strengths Finder2.0. New York:Gallup Press.2007.
4. C. Weaver. *Reading Process and Practice*. Portsmouth US: Heinemann Educational Bokks.1988.

INDIAN HERITAGE & CULTURE

Course code : 18UC0007
L-T-P-S : 0-0-2-0
Credits : Nil
Contact Hours : 2
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No:	Course Outcome	PO	BTL
1	To familiarize with various aspects of the culture and heritage of India through ages.	PO6	1
2	To acquaint with the contributions of Indians in the areas of languages and literature, religion and philosophy	PO6	1
3	To understand the Social structure and the spread of Indian culture abroad	PO6	1
4	To know the development of Science and Technology in India through ages and to appreciate the contributions of some of the great Indian scientists	PO6	1

Syllabus:

Culture: Concept of Culture, Culture and civilization, Culture and Heritage, General Characteristic of culture and Importance of culture in human life. Indian Culture: Characteristics of Indian culture.

History and Culture through the Ages: Ancient India: Harappan Civilization, Vedic Culture: Society and Religion; Ashoka the Great. Gupta period: Architecture and Painting; Nalanda's Emergence as a great centre of learning; Christianity in India.

Medieval India: Arrival of the Muslims. Cultural Development in India. Influence on Religion and Society. Development of Folk Arts, Music, Painting.

Modern India: Impact of western Renaissance and Reformation Movements on India. India by the end of the Eighteenth Century: Social and Religious conditions. Social and Religious Reformers: Ram Mohan Roy, Swami Dayanand Saraswati, Jyotiba Phule, Narayana Guru and Pandita Ramabai. India since Independence: Social and Political Developments.

Indian Languages and Literature: Indian Languages: The role of Sanskrit. The Vedas: Rig Veda, Yajur Veda, Sama Veda, Atharva Veda. The Upanishads. Epics: Ramayana and Mahabharata. Bhagavad Gita.

Religion and Philosophy in Ancient India: Pre-Vedic and Vedic Religion. Unorthodox Religious movements - Buddhism and Jainism.Theistic Religions - Vaishnavism, Shaivism and Shaktism.Jain Philosophy.Buddhist Philosophy.

Religion and Philosophy in Medieval India: The Sufi movement, The Bhakti movement, Philosophy in medieval India - Vishistadvaita, Sivadvaita, Dvaita, Dvaitadvaita and Suddhadvaita.

Religious Reform Movements in Modern India: Brahmo Samaj and Raja Rammohan Roy. Prarthana Samaj and Ranade.Arya Samaj and Dayanand Saraswati.Ramakrishna Mission and Swami Vivekananda.Theosophical Society and Annie Besant.

Social Structure: Indian Social Structure: Tribes, Varna and Jati, Untouchability, Slavery. Family and Marriage in India, Position of women, Tribal communities of India.

Socio-Cultural Issues in Contemporary India: Caste System, Issues Related to women, Dowry system. The problems of girl child and women. Communalism, Issues related to the Elderly, Issues of poverty and unemployment, Beggary, Problem of Children.

Spread of Indian Culture Abroad: Spread of Indian Culture Abroad: Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies. Indian Culture in Central and East Asia.Indian culture in Sri Lanka and South East Asia.India's Cultural contact with the Arab civilization.India's contact with Rome.The Role of Ships and Foreign Trade in the cultural exchange between India and the world.

Science and Technology in India: Development in different branches of Science in Ancient India: Contributions of Aryabhatta and Varahamihira in the fields of Astronomy and Mathematics; Contribution of Charaka and Sushruta; Developments in metallurgy; Development of Geography.

Scientific and Technological Developments in Medieval India: Influence of the Islamic world and Europe; Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine; Innovations in the field of agriculture - new crops introduced, new techniques of irrigation etc.

Science and Technology in Modern India: Development of research organizations like CSIR and DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites, other advances made in Science and Technology.

Scientists of Ancient India: Mathematics and Astronomy: Aryabhata, Brahmgupta, Bhaskaracharya, Mahaviracharya, Varahamihira and Nagarjuna. Medical Science of Ancient India (Ayurveda & Yoga): Susruta, Charak, Yoga and Patanjali.

Science and Scientists of Medieval India: Sciences in Medieval Period. Mathematics, Biology, Chemistry, Astronomy, Medicine and Agriculture.

Scientists of Modern India: (i) Srinivas Ramanujan. (ii) Sir C. V. Raman (iii) Jagdish Chandra Bose (iv) Homi Jehangir Bhabha (v) Vikram Sarabhai (vi) A. P. J. Abdul Kalam

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 & Kalikinkar Datt: Macmillan India Ltd.
6. The Wonder that was India : A.L.Bhasham

INDIAN CONSTITUTION

Course code : 18UC0008
L-T-P-S : 0-0-2-0
Credits : 1
Contact Hours : 2
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No	Course outcome's	PO	BTL
1	To understand Constitutional development after Independence	PO12	2
2	To learn the fundamental features of the Indian Constitution	PO12	2
3	To get a brief idea of the powers and functions of Union and State Governments	PO12	2
4	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 Lok Sabha and the Rajya Sabha, 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 Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti
5. 'Constitutional Law of India' by Seervai H.M.
6. 'Constitution Of India' by Shukla V.N.
7. 'The Indian Constitution: Cornerstone of a Nation' by Granville Austiin
8. 'Indian Constitutional Law' by M.P. Jain

ECOLOGY AND ENVIRONMENT

Course code : 18UC0009
L-T-P-S : 2-0-0-0
Credits : Nil
Contact Hours : 2
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Understand the importance of Environmental education and conservation of natural resources.	PO6	1
2	Understand the importance of ecosystems and biodiversity.	PO12	1
3	Apply the environmental science knowledge on solid waste management, disaster management and EIA process.	PO6	3

Syllabus:

The Multidisciplinary nature of Environmental Studies - Natural Resources- Forest resources - Mining 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. Anubha Kaushik, C.P.Kaushik, “Environmental Studies”, New Age International, (2007).
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill companies, New Delhi, (2009).

UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS

Course code : 18UC0010
L-T-P-S : 1-0-2-0
Credits : 2
Contact Hours : 3
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Understand and identify the basic aspiration of human beings	PO8	2
2	Envisage the roadmap to fulfill the basic aspiration of human beings.	PO8	4
3	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 Book:

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

BASIC SCIENCES

SINGLE VARIABLE CALCULUS AND MATRIX ALGEBRA

Course code : 18SC1103
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No:	COURSE OUTCOME	PO	BTL
1	Model the physical laws and relations mathematically as a first order differential equations, solve by analytical and numerical methods also interpret the solution.	PO1	3
2	Model physical laws and relations mathematically as a second/higher order differential equations, solve by analytical method and interpret the solution.	PO1	3
3	Obtain the Fourier series expansions of periodic functions and use the series to solve ordinary differential equations.	PO1	3
4	Model physical problems mathematically as a system of linear equations and solve them by analytical and numerical methods. Also, determine the nature of Quadratic form using Eigen values.	PO1	3

SYLLABUS:

Differential Equations: Definitions and terminology and mathematical models used in differential equations. First-order and higher-order differential equations, along with the methods of solutions and their applications. Modeling with first and higher-order also systems of linear first-order differential equations. Solutions of first order ordinary differential equations by Numerical methods.

Fourier series: Definitions and Fourier series for a periodic signal. Fourier series for simple functions. Fourier series of the summation of sinusoids directly from the definition by using Euler's formula. Solving particular solution to differential equation by Fourier series.

Matrix algebra: Solving linear System of equations by Gauss-elimination, L U decomposition and Jacobi, Gauss Seidal iteration methods, orthogonal, symmetric, skew-symmetric, Hermitian, Skew-Hermitian and unitary matrices, Eigen values, Eigen vectors and their properties, Cayley -Hamilton theorem (without proof) and its applications, and quadratic forms.

Text books:

1. Advanced Engineering Mathematics, Erwin Kreyszig. John Wiley & Sons, Inc. 10 th Edition.
2. Advanced Engineering Mathematics, Greenberg, PHI Publishers, 2nd Edition.

Reference Books:

1. Differential Equations for Engineers, Wei-Chau Xie, Cambridge University Press, New York. R1
2. Higher Engineering Mathematics, BS Grewal. Publisher: Khanna, New Delhi. R2
3. Advanced Numerical Methods with MATLAB, SC Chapra, Tata McGraw-Hill. R3

FOUNDATIONS OF COMPUTATIONAL MATHEMATICS

Course code : 18SC1104
L-T-P-S : 0-0-2-0
Credits : 1
Contact Hours : 2
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome	PO	BTL
1	Identify the quantities of Real world problems by using the concepts of arithmetic.	PO1	2
2	Computing the areas of regular and irregular solids of real world problems.	PO1	2
3	Identifying the numbers by successive division also finding the solution of equations.	PO1	2
4	Estimating the roots of an equations and find the unknown values from the data by numerical methods	PO1	2

SYLLABUS:

Foundations in Arithmetic:

Real world applications in the concepts of Ratio, Proportion, variation, percentages, profit & loss, time & distance, time & work

Practical applications of common solids, irregular solids:

Computation of areas, volumes and other characteristics of both regular and irregular solids including Triangles, quadrilaterals, polygons, cylinders, cones etc., and their application in various engineering problems.

Fundamentals of Mathematics:

Simple Equations, Quadratic Equations, Fractions & Decimals, Classification of numbers, Divisibility rules, factorization, Division & Successive division, finding unit digits,Remainders in divisions involving higher powers.

Numerical Methods:

Solution of equations by Iteration: Bisection method and Newton-Raphson method, Lagrange's interpolation method, Numerical integration and differentiation.

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, Erwin Kreyzig ISBN: 978-81-265-5423-2

Reference Books:

1. Quantitative Aptitude, R. S. Aggarwal, Schand Publications.
2. Quantitative Aptitude - G. L. Barrons. ISBN: 13:978-1438009049
3. Quantitative Aptitude - Abhijit Guha, Mc Graw Hills. ISBN: 978-93-5260-437-1

LOGIC AND REASONING

Course code : 18SC1105
L-T-P-S : 0-0-2-0
Credits : 1
Contact Hours : 2
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome	PO	BTL
1	Understand how to use Venn diagrams to find the conclusion of statements, solve puzzles using binary logic.	PO1	2
2	Understand to solve problems on clocks, calendars and problems on non-verbal reasoning.	PO1	2
3	Understand the available models for Venn diagrams with given data, solve problems relating to cubes and number and letter	PO1	2
4	Understand the techniques used to solve problems puzzles using analytical reasoning on coding and decoding and blood relations	PO1	2

SYLLABUS:

Deductions: Introduction, expressing different types of statements using venn diagram, Definition of complimentary pairs, finding the conclusions using venn diagrams for two and more statements.

Logical Connectives: definition of simple statements, Definition of compound statement, finding the implications for compound statements.

Binary Logic: Definition of truth teller, Definition of liar, definition of an alternator, solving problems using method of assumptions, solving analytical puzzles using binary logic.

Clocks: Finding the angle when the time is given, finding the time when the angle is known, relation between Angle, Minute an hour's exceptional cases in clocks.

Calendar: Definition of a leap year, finding the number of odd days, Framing the year code for centuries, finding the date of any random calendar date.

Non-verbal reasoning: Identification of hidden rule set in the given set of pictures and using that rule set to predict the next course of action, series and completion of incomplete patterns.

Venn Diagrams: Representing the given data in the form of a venn diagram, problems on venn diagrams with two sets, problems on venn diagrams with three sets, problems on venn diagrams with four sets.**Cubes:** Basics of a cube, Finding the minimum number of cuts when the number of identical pieces are given, Finding the maximum number of pieces when cuts are given , problems on painted cubes of same and different colors**Number and letter series:** coding using the same set of letters, coding using the different set of letters, coding into a number of comparison and elimination

Analytical reasoning puzzles: problems on Linear arrangements, problems on circular arrangements.

Coding and decoding: coding using same set of letters, coding using different set of letters, coding into a number comparison and elimination.

Blood relations: Defining the various relations among the members of the family, solving Blood relation puzzles, solving the problems on blood relation using symbols and notations.

Text books:

1. A modern approach to logical reasoning **,** R. S. Aggarwal, Schand Publications.

Reference Books:

2. Logical Reasoning, Arun Sharma,McGraw Hill.
3. Analytical &Logical Reasoning, Peeyush Bhardwaj,Arihant Publications

MULTIVARIATE CALCULUS

Course code : 18MT1201
L-T-P-S : 3-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No:	Course Outcome	PO	BTL
1	Determine extreme values for functions of several variables	PO1	3
2	Determine area, volume moment of inertia through multiple integrals in Cartesian or polar coordinates.	PO1	3
3	Apply the concepts of vector calculus to calculate the gradient, directional derivative, arc length, areas of surfaces and volume of solids in practical problems	PO1	3
4	Obtain analytical and numerical solutions of Heat and wave equations	PO1	3

SYLLABUS:

Differential Calculus: Partial derivatives, Jacobian, total differentiation and their applications, chain rule, Taylor's series for function of two variables, maxima and minima of functions of two variables, Lagrange's multipliers method.

Integral Calculus: Line integrals- double and triple integrals and applications to area, volume, mass & moment of inertia. Change of order of integration, change of variables in polar, cylindrical and spherical polar coordinates.

Vector Calculus: Scalar and vector point functions, gradient and directional derivative of a scalar point function, divergence and curl of a vector point function. Line, surface and volume integrals, Green's, Gauss divergence and Stoke's theorems and their applications

Partial differential equations: Formation of partial differential equations, solutions of first order linear and nonlinear PDEs by Lagrange method, solution of second order PDEs by method of separation of variables i.e., one dimensional wave and heat equations, Laplace equation in two dimensions. Solving Laplace equation by Finite difference method.

Text books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, John Wiley &Sons, Inc, Newyork . (2015)
2. Nakhle H Asmar, Partial differential equations with Fourier series and boundary value problems, Second edition Pearson Pub.

Reference Books:

1. Michael Greenberg, Advanced Engineering Mathematics. Second edition, Prentice Hall, USA.
2. Zafar Ahsan, Differential equations and their applications, second edition, PHI
3. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, India.

PHYSICS ELECTIVE (MECHANICS)

Course code : 18PH1010
L-T-P-S : 3-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics	PO1, PO2	2
2	Analyze planar and spatial systems and to analyze the forcesin the members of trusses, frames.	PO1, PO2	4
3	Determine first moment and second moment for a given cross sections and problems related to friction	PO1, PO2	3
4	Analyze the motion characteristics of a body subjected to agiven force system.	PO2	4
5	Understand and analyze the engineering systems with the help of mechanics concept to solve the engineering problems.	PO4	4

Syllabus:

Introduces classical mechanics. Space and time: straight-line kinematics; motion in a plane; forces and static equilibrium; particle dynamics, with force and conservation of momentum; relative inertial frames and non-inertial force; work, potential energy and conservation of energy; kinetic theory and the ideal gas; rigid bodies and rotational dynamics; vibration motion; conservation of angular momentum; central force motions; basic principles and fundamentals of fluid mechanics.

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.
4. Engineering Mechanics staticsand Dynamics /MeriamandKraige

Reference books:

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

SOLID STATE CHEMISTRY

Course code : 18CY1002
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	BTL
1	Ability to understand the electronic structure, chemical bonding, and atomic order and arrangements.	PO1, PO3, PO7	2
2	Ablity to develop "chemical intuition" and quantitative understanding of chemical principles	PO1, PO3	2
3	Ability to Understand the crystal structure and its relationship to properties	PO1, PO7	2
4	Ability to understand the Materials properties such as conductivity, optical transmission, stiffness, thermal expansion, and strength	PO1, PO7	2
5	An ability to analyze and generate experimental skills	PO1, PO4	3

Syllabus:

Structure of the Atom: The periodic table, elements and compounds, chemical formulas. **Evolution of atomic theory:** Thomson & Rutherford, Bohr model of hydrogen, Bohr-Somerfield model and multi-electron atoms, atomic spectra, Schrödinger equation. Electron orbitals: Aufbau principle, Pauli Exclusion Principle, and Hund's rules.

Bonding and Molecules : Primary bonding: ionic, covalent, metallic. Secondary bonding: dipole-dipole, induced dipole-induced dipole, London dispersion/van der Waals, hydrogen. **Shapes of molecules:** hybridization, LCAO-MO, VSEPR theory.

Reactions and Kinetics: Reaction kinetics: rate laws, thermal activation, and the Arrhenius equation. Diffusion: Fick's first and second laws.

Applications:

Electronic Materials: Band theory: metals, insulators, and semiconductors. Band gaps, doping, and devices.

Crystalline Materials: Crystal structure: 7 crystal systems, 14 Bravais lattices, Miller indices. Properties of cubic crystals. X-ray diffraction. Defects: point, line, surface, bulk.

Amorphous Materials: Inorganic glasses: silicates, other oxides, metallics.

Aqueous Solutions: Liquids and solutions: solubility rules, acids, bases, pH.

Organic Materials: Organic compounds: nomenclature, alkanes, alkenes, alkynes, aromatics, functional groups. Polymers: structure, composition, synthesis and applications. Biochemistry: amino acids, peptides and proteins, lipids, nucleic acids, protein biosynthesis.

Solid Solutions: Phase stability: unary and binary phase diagrams.

Text Books:

1. EngineeringChemistry,Jain&Jain,DhanpatRaiPublishingCompany.NewDelhi.
2. Engineering Chemistry, O G Palanna, The Tata McGraw Hill, NewDelhi.

Reference Books:

1. Chemistry in Engineering and Technology, Volume 2, J C Kuriacose & J Rajaram, Tata McGraw Hill, New Delhi.
2. Chemistry for Engineers Rajesh Agnihotri, Wiley, New Delhi.
3. Engineering Chemistry, B. Sivasankar, The Tata McGraw Hill, New Delhi.
4. A text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co. New Delhi.
5. Engineering Chemistry, C Parameswara Murthy, C V Agarwal and Andra Naidu, B S Publications, Hyderabad.
6. Engineering Chemistry, Shikha Agarwal, Cambridge University Press.

THEORY OF DIFFERENTIAL EQUATIONS IN ENGINEERING AND MECHANICS

Course code : 18MT2102
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome (CO)	PO	BTL
1	Obtain the response of a mechanical system having single degree-of-freedom for free and forced vibrations through linear differential equations.	PO1	3
2	Model and solve free and forced vibrations of a two- degree-of-freedom system through system of linear differential equations.	PO1	3
3	Obtain canonical forms of linear second order PDEs and Demonstrate the nature of the incompressible fluid flow using Euler and Bernoulli equations.	PO1	3
4	Identify the heat and wave equations in different forms, obtain their responses and develop empirical relations.	PO1	3
5	Determine the response of mechanical vibrating systems and heat equations which are modelled by ordinary or partial differential equations using MATLAB.	PO11	3

Syllabus:

Linear differential equations: Equation of motion, Response of a system having single degree-of-freedom, free and forced vibrations, vibrations of a vehicle passing a speed bump, Duffing equation, beams-columns, various application problems related to jet engine vibrations, piston vibrations and fly wheel vibrations.

System of linear differential equations: Mathematical modelling of mechanical vibrations, vibration absorbers (tuned mass dampers), free and forced vibrations of a two-storey shear building.

Partial differential equations: Euler and Bernoulli equations for incompressible flows, Canonical forms of the second-order PDEs (Elliptic, Hyperbolic and Parabolic type), Heat Equation, Two-dimensional steady state heat conduction equation, Fourier law of heat conduction equation, one-dimensional transient heat conduction equation, three-dimensional steady state heat conduction equation, Wave equation, Helmholtz equation, Multi-Harmonic, Bi-harmonic Equation and Flexural motion of beams.

Methods for Developing Empirical Relations of output responses in terms of input variables and error estimates.

Text Books

1. Wei-Chau Xie, “Differential Equations for Engineers”, Cambridge University Press, New York, 2010, USA.
2. K.T. Chau, “Theory of Differential Equations in Engineering and Mechanics”, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2017, USA.

Reference Books

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10^{th} Edition, John Wiley &Sons, Inc, New York (2015)
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Pub, New Delhi (2017)
3. S. C. Chapra, “Advanced Numerical Methods with MATLAB”, Tata Mc Graw Hill publishers (2015)

BIOLOGY FOR ENGINEERS

Course code : 18BT1001
L-T-P-S : 2-0-0-0
Credits : 2
Contact Hours : 2
Pre-requisite : 18PH1010

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Acquire the Knowledge of basic biology	PO6, PO7	2
2	Acquire the Knowledge of Human Biological Systems	PO6, PO7	2
3	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

MECHANICS AND MATERIALS-I

Course code : 18ME1201
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18PH1010

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome	PO/PSO	BTL
1	Analyze stresses in members with 1D axial loading or torsion	PO2, PSO1	4
2	Analyze shear force and bending moment diagrams	PO2, PSO1	4
3	Analyze deflections and stresses in beams	PO2, PSO1	4
4	Design Columns and pressure vessels	PO3, PSO1	4
5	Apply the theoretical concepts to conduct various experiments of strength of materials practically and analyze the data	PO3, PSO2	4

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.
3. E.P.Papov “Mechanics of Materials” Prentice Hall Publications
4. L S. Srinath “Strength of Materials”. Tata McGraw Hill
5. S.S.Rattan “Strength of Materials” Tata McGraw Hill

ENGINEERING GRAPHICS FOR MECHANICAL ENGINEERS

Course code : 18ME1002
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	BTL
1	Learn and practice the different views of representation of engineering drawings.	PO1, PO12	2
2	Learn and practice dimensioning and section of engineering drawings.	PO1, PO12	2
3	Learn and practice the assembly drawings.	PO1, PO12	2
4	Make basic engineering drawings using both geometric instruments as well as graphics software with equal ease.	PO1, PO12	2

Syllabus:

Isometric Drawing, Orthographic or Multiview Drawings, DimensioningSectioning, Drawing Tools, Assembly Drawings, Cross-Sectional ViewsHalf-Sections, Sections of Objects with Holes, Ribs, etc.,

Text Books:

1. N.D. Bhatt “Engineering Drawing “ Charotar publishing House
2. Saeed Moaveni “Engineering Fundamentals- An Introduction to Engineering” Cengage Learning

Reference books:

1. Engineering Drawing and Graphics, Venugopal / New age
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
3. Engineering Drawing, K L Narayana and Kannaiah / Scitech publishers

WORKSHOP PRACTICE FOR MECHANICAL ENGINEERS

Course code : 18ME1003
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	BTL
1	Understanding different manufacturing techniques and their relative advantages/ disadvantages with respect to different applications.	2	2
2	Fabricate components with their own hands.	4	4
3	Get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.	4	4
4	Assemble different components and produce small devices of their interest	4	4

Syllabus:

Manufacturing Methods: casting, forming, machining, joining, advanced manufacturing Methods.

CNC machining, Additive manufacturing.

Fitting operations & power tools.

Electrical &Electronics.

Carpentry.

Plastic moulding, glass cutting.

Metal casting

Welding (arc welding & gas welding), brazing.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury 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.

Reference Books:

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.

PROBLEM SOLVING & COMPUTER PROGRAMMING

Course code : 18SC1101
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	BTL
1	Illustrate how problems are solved using computers and programming	PO1, PO2	3
2	Illustrate and use Control Flow Statements in C.	PO1, PO2	3
3	Interpret & Illustrate user defined C functions and different operations on list of data.	PO1, PO2	3
4	Implement Linear Data Structures and compare them	PO4	3
5	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, Shashi Mogalla, "Data structures and Program Design in C", 4th Edition-2007.

4. C for Engineers and Scientists – An Interpretive Approach by Harry H. Cheng, Mc Graw Hill International Edition-2010.
5. Jeri R. Hanly, Elliot B. Koffman, “Problem Solving and Program Design in C”, 7/e, Pearson Education-2004.
6. Jean Paul Trembly Paul G.Sorenson, “An Introduction To Data Structures with applications”, 2nd Edition.

INTRODUCTION TO COMPUTATIONAL THINKING AND DATA SCIENCES

Course code : 18ME1204
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Perform basic computations in Python, including working with tabular data.	PO1	2
2	Understand basic probabilistic simulations, statistical thinking and Stochastic Programs.	PO1	2
3	Use good practices in Python programming using Computational Simulations.	PO1	3
4	Implement Computational data modeling and clustering using Python programming.	PO1, PO2	3
5	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:

Optimization Problems: Introduction, analytical method, graphical method and numerical method.
Plotting: Introduction to Plots, Implementing and using Plots, Plot optimization problems.
Stochastic Programs: Stochastic Processes, implementing a Random Process, Independence, A Simulation of Stochastic Program, Output of Simulation, Morals, Approximating Using a Simulation, Simulation Models.
Probability and Statistics: Sampling error and Standard error, Probability sampling, Means and Standard Deviations, Standard error of the Mean, Assessing the Standard error of the Mean.
Random Walks: Introduction, Structure of Simulation, simulating a single walk, Simulating multiple walks.
Monte Carlo Simulations: Introduction to Monte Carlo method, Applications of Monte Carlo method in Engineering.
Modeling Data: Data Study, Curve fitting to the Data.
Clustering: Introduction, Hierarchical clustering, K-means clustering.

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 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.
2. Singiresu S. Rao. Engineering Optimization Theory and Practice. 2009. John Wiley & Sons, Inc.

NUMERICAL COMPUTATION FOR MECHANICAL ENGINEERS

Course code : 18ME2205
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Understand elementary programming concepts, and the basics in MATLAB	PO1	3
2	Understand linear algebra, probability and statistics for solving engineering problems	PO1	2
3	Solve a system through linear and nonlinear equations, and ordinary differential equations in Mechanical Engineering	PO1	3
4	Select an appropriate numerical approach for solving engineering problems	PO1	3
5	Ability to select bench marks to confirm the computational approach	PO1	3

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.
2. Singiresu S. Rao. Engineering Optimization Theory and Practice. 2009. John Wiley & Sons, Inc.

RESTRICTED OPEN ELECTIVE-1
(MATERIALS FOR MECHANICAL ENGINEERING APPLICATIONS)

Course code : 18PH2007
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome (CO)	PO	BTL
CO1	Understand crystal structures and also to find lattice parameters using different XRD techniques	PO1, PO4, PO11	2
CO2	Understand different heat treatment processes and also understand the properties of smart materials	PO1, PO4, PO11	2
CO3	Understand different types of semiconducting materials and ceramic materials	PO1, PO4, PO11	2
CO4	Understand different types of composite materials and nano materials and its applications	PO1, PO4, PO11	2

SYLLABUS:

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

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

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

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

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

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

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

Text books:

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

CIRCUITS AND ELECTRONICS

Course code : 18EE2205
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	BTL
1	Understand the Basic of Electrical network elements	PO1, PO5	2
2	Understand the behavior of semiconductor switches and its applications	PO1, PO5	2
3	Apply Time & frequency domain analysis of first & second order networks	PO1, PO5	3
4	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.

TECHNICAL SKILLS – 1 (CODING)

Course Code : 18SC1106
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 No.	Course Outcomes (CO)	PO	BTL
1	Apply the concepts of basic programming to solve the basic problems, pattern based problems	PO1, PO2	3
2	Build solutions for problems on Numbers and array based problems , functions, recursion	PO1, PO2	3
3	Solve problems solutions for character/string based problems and pointers	PO1, PO2	3
4	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

TECHNICAL SKILLS – 2 (CODING)

Course Code : 18SC1207
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 No:	Course Outcome (CO)	PO	BTL
1	Apply the concepts of basic programming to solve the basic problems, pattern based problems	PO1, PO2	3
2	Build solutions for problems on Numbers and array based problems, functions, recursion	PO1, PO2	3
3	Solve problems solutions for character/string based problems and pointers	PO1, PO2	3
4	Build solutions to programs on Data structures concepts.	PO1, PO2	3

SYLLABUS:

Problem solving on Arrays, Array of Structures, Nested Structures, Queues: DE Queue, Circular Queue and Priority Queues, Lists: Operations on Single Linked List, Double Linked List - Operations on DLL, Circular Linked List, Problem Solving on Strings, Applications of Stacks and Queues, Implementation of Stacks and Queues using Linked List, Constructing Recursion, Heaps, Sorting: Merge Sort, Quick Sort, Heap Sort, Insertion Sort and Shell Sort, Trees: Binary Tree, Expression Tree, Binary Search Tree: Implementation- Insertion, Deletion, Tree Traversals, AVL Tree and Splay Tree , Hashing: Hash Function, Separate Chaining, Open Addressing, Re-Hashing and Extendible Hashing.

Tools & References:

1. http://hackerrank.com
2. http://codechef.com
3. http://hackerearth.com

PROFESSIONAL CORE COURSES

MEASUREMENTS AND INSTRUMENTATION

Course code : 18ME2106
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO/PSO	BTL
1	Understand the basics of standards of measurement, limits, fits & tolerances industrial applications and identify the uses of gauges and comparators.	PO1	2
2	Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.	PO1	2
3	Interpret measurement of field variables like force, torque and pressure.	PO1	3
4	Comprehend the fundamentals of thermocouple and strain measurement.	PO1	3
5	Apply the theoretical concepts to conduct various experiments of Measurements practically.	PO1	3

Syllabus:

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

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.

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

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. Computer assisted data acquisition, data manipulation, data presentation.

Text Books:

1. Kumar D.S., "Mechanical Measurements and Control", Metropolitan Book co. Private Ltd., N. Delhi.

Reference Books:

1. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh
2. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies.
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation & mech. Measurements by A.K. Tayal ,Galgotia Publications
5. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH
6. Mechanical Measurements / BeckWith, Marangoni,Linehard, PHI / PE
7. Experimental methods for engineers,7th Edition/J.P.Holman/Tata Mc Graw hill

THERMAL-FLUIDS ENGINEERING-I

Course code : 18ME2107
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
1	Understand and apply the fundamental principles and definitions of thermodynamics, fluid mechanics, and heat transfer.	PO1, PSO1	2
2	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
3	Elucidate the basic properties, principles and applications of fluids, fluid components, fluid statics and different types of fluid flows.	PO1, PSO1	2
4	Describe fluid boundary layers, turbulence and their implementation in flow of fluid in engineering systems.	PO1, PSO1	2
5	Apply the theoretical concepts to conduct various experiments of thermodynamics, fluid mechanics practically.	PO1, PSO2	3

Syllabus:

Fundamental principles of thermodynamics and fluid mechanics, Law of conservation of energy and momentum with applications. Focus on the applications of the first and second laws of thermodynamics with special emphasis on Entropy generation. Study of Properties of fluids, Hydrostatics, Fluid kinematics and application 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., 7^{th} edition, Wiley publishers.
2. Fluid Mechanics, Frank M. White, 8^{th} 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., 7^{th} edition, Wiley publishers.
3. Fundamentals of Thermodynamics, G.J. Van Wylen., Sonntag (6E), Wiley India publications.
4. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Mc Graw Hill.

5. Fox and McDonald's Introduction to Fluid Mechanics, Pritchard, Philip J.; Leylegian, John C.; Bhaskaran, Rajesh; Mitchell, John W., SI Version, Wiley publishers.
6. Fluid Mechanics, Frank Kreith, CRC press

MECHANICS AND MATERIALS - II

Course code : 18ME2108
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18ME1201

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Emphasize the fundamentals of mechanical behavior of materials	PO2, PSO1	2
2	Examine Fatigue failure of materials	PO2, PSO1	2
3	Interpret Fracture and Creep behavior of materials	PO3, PSO1	3
4	Select the suitable material for mechanical applications	PO2, PSO1	3
5	Determine the properties of materials or analyze through ANSYS/MSC NASTRAN software.	PO2, PSO1	3

Syllabus:

Introduces mechanical behavior of engineering materials, and the use of materials in mechanical design. Emphasizes the fundamentals of mechanical behavior of materials, as well as design with materials. Major topics: elasticity, plasticity, limit analysis, fatigue, fracture, and creep. Materials selection.

Text Books:

1. Norman E.Dowling-Mechanical Behavior of Materials, Pearson
2. Dieter- Mechanical Metallurgy Tata McGraw Hill publications

Reference Books:

1. Thomas H Courtney – Mechanical Behavior of Materials
2. Marc Meyers and Krishan Kumar Chawla-Mechanical Behavior of Materials.
3. Michael F ASHBY- Materials selection in Mechanical Design.

KINEMATICS AND DYNAMICS OF MACHINES

Course code : 18ME2109
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18PH1010

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome	PO/PSO	BTL
1	Identify, select and analyze kinematically suitable mechanisms for required motion of machinery	PO4	2
2	Develop velocity and acceleration diagrams and analyze the data	PO2	4
3	Develop cam profiles and Analyze gears and gear trains kinematically	PO4	4
4	Analyze mechanisms dynamically	PO3	4
5	Apply the theoretical concepts to design mechanisms by using the simulation software and analyzing the data	PO2	4

Mechanisms and Machines, Cams, Gears and Gear trains, Balancing, Dynamic force analysis, Gyroscopes

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.

MACHINE DRAWING

Course code : 18ME2110
L-T-P-S : 0-0-4-0
Credits : 2
Contact Hours : 4
Pre-requisite : 18ME1002

Mapping of Course Outcomes with PO/PSO:

CO No	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

Review, Part and assembly drawing, Symbols of Machine, elements and welded joints. Specification of materials, Surface roughness, Production drawing, Computer aided drawing

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

DESIGN AND MANUFACTURING-I

Course code : 18ME2211
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18ME1201

Mapping of Course Outcomes with PO/PSO:

CO No	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

Primary Manufacturing Processes, Basic Joining Processes, Metal Forming, Extrusion and Drawing Processes, Sheet metal forming processes

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

AmitabhaGhosh and Asok Kumar Mallik " Manufacturing science TMH publisher

THERMAL-FLUIDS ENGINEERING-II

Course code : 18ME2212
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18ME2107

Mapping of Course Outcomes with PO/PSO:

CO No	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

Focus on the application of the principles of thermodynamics, Thermodynamics and fluid mechanics of steady flow, Design approach of thermodynamic plants

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., 7^{th} edition, Wiley publishers.
2. Fluid Mechanics, Frank M. White, 8^{th} 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.

VIBRATIONS AND CONTROL

Course Code : 18ME2213
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisite : 18ME2109

Mapping of Course Outcomes with PO/PSO:

CO No	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

Fundamentals of Vibration, Single Degree Freedom Systems, Forced Vibration of Damped With Harmonic Excitation System, Two Degree Freedom System, Multi-Degree Freedom System And Continuous System, Eigen Values & Eigen Vectors For Large System of Equations Using Sub Space, Vibration Measurement

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 multidegree 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.

MACHINE DESIGN

Course Code : 18ME3114
L-T-P-S : 3-2-0-0
Credits : 5
Contact Hours : 5
Pre-requisite : 18ME2108

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome	PO/PSO	BTL
CO1	Design of shafts and couplings	PO3, PSO1	3
CO2	Design of fasteners and power screws	PO4, PSO1	3
CO3	Design of belt drives and chain drives, brakes and lubrication system	PO2, PSO1	3
CO4	Design of gears for the given application	PO2, PSO1	3

Shafts, Couplings, DESIGN OF FASTENERS, **Power Screws, Belt Drives, Chain Drives, Bearings, Brakes, Spur Gears, Helical Gears, Bevel Gears, Worm Gears.**

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

DESIGN AND MANUFACTURING-II

Course Code : 18ME3115
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18ME2211

Mapping of Course Outcomes with PO/PSO:

CO No	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.	PO3, PSO1	3
CO4	Design of various manufacturing processes.	PO3, PSO2	3
CO5	Implement modern manufacturing techniques	PO5, PSO2	3

Lathe, Milling and Drilling Machine, Boring, Shaper, Slotter, Planer, Broaching, Forces, Power Consumption in Machinery, Mechanics of Metal Cutting, Historical Development and Future Trends of NC Machines, Control of NC Systems, Automation, Design For Manufacturing

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

ROBOTICS AND CONTROLS

Course Code : 18ME3116
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO No	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

Intelligent Robotics, Direct Kinematics, Inverse Kinematics, Workspace Analysis and Trajectory Planning, Basic Concepts of Artificial Intelligence, Task Planning.

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, StraightLine 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.

PRODUCT DESIGN AND DEVELOPMENT

Course Code : 18ME3117
L-T-P-S : 0-0-6-0
Credits : 3
Contact Hours : 6
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO No	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	To develop a Prototype	PO1, PO3	4

Need for Integrated Product and Process Development, Concept Generation and Selection, Product Architecture, Industrial Design, Design for Manufacturing and Product Development.

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

ENGINEERING MANAGEMENT

Course Code : 18ME3218
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisite : NIL

Mapping of Course Outcomes with PO/PSO:

CO No	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

Introduction and overview of engineering management, principles and functions of engineering management, types of business organizations, Types of production systems, Financial principles, Concepts of Total Quality Management, Inventory Management, Project Management, PERT and CPM, Best management practices.

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

HEAT TRANSFER

Course Code : 18ME3219
L-T-P-S : 3-0-2-0
Credits : 4
Contact Hours : 5
Pre-requisite : 18ME2107

Mapping of Course Outcomes with PO/PSO:

CO No	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

Fundamental processes of heat transfer, Fourier's law, Heat conduction processes including thermal resistance, Elementary 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.

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.

TECHNICAL SKILL COURSES

SKILLING FOR ENGINEERS-1

(MANUFACTURING TECHNOLOGIES)

Course Code : 18TS701
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 No	Course outcome	PO	BTL
1	Preparation of sand moulds with proper gating and riser system	4	3
2	Machining using machine tools and preparation of CNC part program.	4	3
3	Preparation of work piece for various welding operations and performing welding using different welding equipment	4	3
4	Production of parts using rapid prototyping	4	3
5	Hands on experience for performing experiments in Casting, Machining, Welding and Rapid prototyping	4	3

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.

SKILLING FOR ENGINEERS-2

(ARTIFICIAL INTELLIGENCE)

Course Code : 18TS702
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. No	Course Outcome	PO	BTL
1	Problem solving by Search, Heuristic Search, Randomized search techniques and Finding Optimal paths	PO2, PO5	3
2	Analyze the appropriate methodologies for problem decompositions, planning and constraint data constraint satisfactions.	PO1, PO5	3
3	Understand Knowledge Representation using Predicate Logic, Representing Knowledge using Rules, Semantic Nets, Frames and Conceptual dependencies.	PO1, PO2	2
4	Apply the theoretical concepts to conduct various experiments on Search Techniques and Language Representation using AI	PO1	3

Syllabus:

Introduction: Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents. **State Space Search:** Depth First Search, Breadth First Search, DFID. **Heuristic Search:** Best First Search, Hill Climbing, Beam Search, Tabu Search. **Randomized Search:** Simulated Annealing, Genetic Algorithms, Ant Colony optimization. **Finding Optimal Paths:** Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search. **Problem Decomposition:** Goal Trees, AO*, Rule Based Systems, Rete Net. Game Playing: **Planning and Constraint Satisfaction:** Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graph plan, Constraint Propagation. **Logic and Inferences:** Propositional Logic, First Order Logic, Soundness and Completeness, Forward and backward chaining.

Text books:

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

Reference books:

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

SKILLING FOR ENGINEERS-3
(PROBLEM SOLVING TECHNIQUES IN THERMAL)

Course Code : 18TS703
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. No	Course Outcome	PO	BTL
1	Analyze fluid flow through pipes or channels (internal flow)	PO2	4
2	Analyze fluid flow over different geometrical objects (external flow)	PO2	4
3	Analyze steady and transient heat transfer through various systems	PO2	4
4	Analyze fluid flow and heat transfer from various systems	PO2	4

Syllabus:
Introduction to CFD (Computational Fluid Dynamics) – Ansys FLUENT
Internal fluid flows
External fluid flows
Steady and transient heat transfer
Combined study on fluid flow and heat transfer

Software Tool:
ANSYS Fluent software is required to perform Fluid flow simulation.

Text Books:

1. ANSYS Fluent Tutorial Guide by ANSYS, Inc. Release 17.0 Southpoi.
2. “Computational fluid dynamics, the basics with applications” by john D Anderson.
3. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
4. Mechanical Measurements by Thomas G. Beckwith, Addison-Wesley Publications.

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

Course Code : 18TS704
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 No.	Course Outcome	PO	BTL
1	To Perform static and dynamic analysis of 1-D structures	PO3	4
2	To Perform static and dynamic analysis of 2-D structures	PO3, PO5	4
3	To Perform static and dynamic analysis of 3-D structures	PO3, PO5	4
4	Identifying and solving the real complex engineering problems	PO4, PSO1	4

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,
- 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/Hyperworks/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. Finite Element method by R.Chandrapatla.

TECHNICAL PROFICIENCY & TRAINING-1

(DATA ANALYTICS)

Course Code : 18TS705
L-T-P-S : 0-0-0-4
Credits : 1
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Gather enough relevant data, conduct data analytics using scientific methods, and make appropriate and powerful connections between quantitative analysis and real-world problems.	PO3	3
2	Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using data analytics skills to provide constructive guidance in decision making.	PO3	3
3	Use advanced techniques to conduct thorough and insightful analysis and interpret the results correctly with detailed and useful information.	PO3	3
4	Show substantial understanding of the real problems; conduct deep data analytics using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration. Make better decisions by using advanced techniques in data analytics	PO3	3

Syllabus:

Descriptive Statistics: Introduction to the course for Data Analytics, Descriptive Statistics, Probability Distributions.

Inferential Statistics: Inferential Statistics through hypothesis testsPermutation & Randomization Test.

Regression & ANOVA: Regression**,** ANOVA (Analysis of Variance).

Machine Learning: Introduction and Concepts, differentiating algorithmic and model based

Frameworks Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbors 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:Deep learning.

Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative Rule Mining, Challenges for big data analytics.

Prescriptive analytics: Creating data for analytics through designed experiments, creating data for analytics through Active learning, Creating data for analytics through ReinforcementLearning.

Text books:

1. Data Analytics Made Accessible by Anil K. Maheshwari, 2015
2. Too Big to Ignore: The Business Case for Big Data by Phil Simon, 2013 by John Wiley & Sons, Inc.
3. Data Mining and Business Analytics with R, by Johannes Ledolter, Publisher: Wiley (2013).
4. An Introduction to Statistical Learning with Application in R, by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer (2013).

Reference 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

TECHNICAL PROFICIENCY & TRAINING-2

(MACHINE LEARNING)

Course Code : 18TS706
L-T-P-S : 0-0-0-4
Credits : 1
Contact Hours : 4
Pre-requisite : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO	BTL
1	Understand the basic Python Programming and basic computations using Python	PO2	2
2	Understand and apply the basic Machine Learning and Pre-processing techniques in Machine Learning	PO3	3
3	Understand and apply Supervised Machine Learning techniques- Regression Techniques	PO3	3
4	Understand and apply Supervised Machine Learning techniques – Classification Techniques	PO3	3

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
Multi variate 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. Tom M. Mitchell, Machine Learning, the McGraw-Hill Companies, Inc. International Edition 1997.
2. Christopher M. Bhisop, Pattern Recognition & Machine Learning, Springer, 2006.
3. Machine Learning by Orielly Publications, 2010

Reference Books:

1. Mastering Machine Learning Algorithms: Expert techniques to implement popular machine learning algorithms and fine-tune your models Author Giuseppe Bonaccorso by packt publishing limited
2. Machine Learning for Beginners: A Plain English Introduction to Artificial Intelligence and Machine Learning by John Slavio (Kumar Publisher)

PROFESSIONAL ELECTIVES

DESIGN OF TRANSMISSION ELEMENTS

Course code : 18ME4051
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2214

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Belt Drives, Chain Drives, Bearings, Brakes and Clutches, Spur Gears, Helical Gears, Bevel Gears, Worm Gears

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".

THEORY OF ELASTICITY AND PLASTICITY

Course code : 18ME4052
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : 18ME2108

Mapping of Course Outcomes with PO/PSO:

CO. No.	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

Introduction, Elasticity, 2-D Problems in rectangular co-ordinates, Stress and strain analysis in 3-D problems, Plastic analysis of beams and frames.

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

ADVANCED VIBRATIONS AND NOISE CONTROL

Course code : 18ME4053
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2109

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction to NHV, Fundamentals of noise and vibrations, types of vibrations, characteristics & sources of vibrations, power train, suspension, vibrations measurement technics and control, sources of noise, noise measurement technics and control, noise measuring instruments, noise control, safety.

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

COMPUTER AIDED DESIGN

Course code : 18ME4054
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

Introduction, Display Devices, Geometric Modelling, Surface Modelling, Solid Modelling, Windows and Clipping, Geometric Transformations, Case Study.

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

CREEP FATIQUE AND FRACTURE MECHANICS

Course code : 18ME4055
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2108

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Analysis of stresses and strains in three-dimensions, Repeated Stresses and fatigue in metals, Factors influencing fatigue behaviour of metals, Fracture Mechanics, Linear Elastic Fracture Mechanics (LEFM), Elasto-plastic fracture mechanics, Creep behaviour of metals.

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)

ADVANCED STRENGTH OF MATERIALS

Course code : 18ME4056
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2108

Mapping of Course Outcomes with PO/PSO:

CO No	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

Statically Indeterminate Beams, Curved Beams, Shear Center, Energy Methods, Centrifugal Stresses, Thick Cylinders.

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

MECHANICS OF COMPOSITE MATERIALS

Course code : 18ME4057
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2108

Mapping of Course Outcomes with PO/PSO:

CO No.	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

MODREN MANUFACTURING PROCESSES

Course code : 18ME4061
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME1003

Mapping of Course Outcomes with PO/PSO:

CO No	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
5	Apply the modern manufacturing techniques	PO5	3

Modern Manufacturing Processes, Mechanical energy-based machining processes, Chemical energy-based machining processes, Thermoelectric energy-based machining processes, Non-traditional welding processes, Non-traditional Forming processes

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

ADVANCED MATERIALS

Course code : 18ME4062
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 3
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction to composite materials, Reinforcements, Manufacturing methods, Macromechanical analysis of alumina, Functionally graded materials, Shape memory alloys, Nano Materials.

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 Books:

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.
4. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), Autar K.Kaw, Publisher: CRC.

ADDITIVE MANUFACTURING

Course code : 18ME4063
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Additive Manufacturing Process, Machines for Rapid Prototyping:Overview ofPolymerization, Rapid Prototyping, Direct Rapid Tooling Processes.

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.

TOOL ENGINEERING AND DESIGN

Course code : 18ME4064
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2211

Mapping of Course Outcomes with PO/PSO:

CO No.	Course Outcome	PO/PSO	BTL
1	Develop the ability to design cutting tools for given single component.	PO1, PO6	2
2	Design and development of various die configurations.	PO1, PO7	2
3	Design and development of jigs for given component.	PO1, PO8	2
4	Design and development of fixtures for given component.	PO1, PO8	2
5	Gain practice on designing the tools and dies using a software package.	PO11	4

Cutting tool design, Press tool design, Design of jigs, Design of fixtures, Case study.

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.
5. Prakash H. Joshi, “Tooling Data”, 1st edition, Wheeler Publishing, New Delhi, 2000.

List of Experiments:

1. Design and drawing of Single point cutting according the machining reference Systemfor turning operation
2. Design and drawing of Single point cutting according the tool reference Systemfor turning operation.
3. Design and drawing of Drilling tool for industrial mass production
4. Design and drawing of Broach tool for industrial mass production
5. Design and development of progressive and compound dies for blanking and piercing operations
6. Design and development of Jigs for mass production in a product focused system.
7. Design and development of Fixture for mass production in a product focused system.
8. Design and development of punch and dies for mass production in a product focused system.
9. Design and drawing of Single point cutting in ASA System for turning operation using Solid works
10. Design and drawing of Single point cutting according the ORS System for turning operation using Solid works
11. Analysis the temperature distribution on single point tool for turning operation-using Ansys.
12. Conceptual Design of a machine tool with better ergonomics/ environment friendly/ low cost/ less maintenance/ less running cost/ high precision

FLEXIBLE MANUFACTURING SYSTEMS

Course code : 18ME4065
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME3115

Mapping of Course Outcomes with PO/PSO:

CO No.	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
5	Conduct experiments & hands on experience related to NC part programming	PO4	3

Production systems, Group technology, Flexible manufacturing systems, Flexible manufacturing cells

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.

List of Experiments:

1. Development of line layout using source, drain, line, single proc, pick and place robot using plant simulation.
2. Development of loop layout using source, drain, line, single proc, pick and place robot using plant simulation.
3. Development of robot centred layout using source, drain, line, single proc, pick and place robot using plant simulation.
4. Development of ladder layout using source, drain, line, single proc, pick and place robot using plant simulation.
5. Preparation of production plant with the help of modelling using plant simulation.
6. Demonstrating the convergence and divergence of single proc for parallel flow of parts using plant simulation.
7. To detect the bottleneck detection in manufacturing layout
8. Modelling of automotive manufacturing plant
9. CNC Programming for symmetrical profile generation using mirror technique using vertical milling machine
10. CNC Programming for rectangular and circular pocket generation using mirror technique using vertical milling machine

GEOMETRIC DIMENSIONING AND TOLERANCING

Course code : 18ME4066
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 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

Introduction, Maximum Material Condition (MMC), Least Material Condition (LMC) and Regardless of Feature Size, A Logical Approach to part Tolerancing, Dimensioning and Tolerancing Schemes, Steps for the Development of a Dimensional Inspection Plan.

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), the feature control frame, Geometric characteristic symbols, Size Control Form, External feature, Internal feature, Taylor Principle. Rules, concepts, Characteristics, and Untoleranced Dimensions, Individual or related datum, material condition, components of feature control frame. The Maximum Material Condition symbol and its Ramifications, Relationship between Individual Features.

A Logical Approach to part Tolerancing: Refining functional Geometric Control to be more cost effective, Implying manufacturing sequence on complex part configurations.

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.

REVERSE ENGINEERING AND RAPID PROTOTYPING

Course code : 18ME4067
L-T-P-S : 3-0-0-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Reverse Engineering, Data processing for rapid prototyping, Liquid based techniques, Powder based techniques, Rapid tooling and RP case studies, Case Studies.

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.

AUTOMOBILE ENGINEERING

Course code : 18ME4071
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course outcome	PO/PSO	BTL
CO1	Understand 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
CO5	Apply the various concepts of Automobile engineering using simulation and analysis through suitable soft wares.	PO3	2

Introduction, Engine and cooling system, Lubrication and transmission Systems, Suspensionsystems and vehicle control

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. Basics of programming using MATLAB
2. Modelling an Engine piston with Mat lab
3. To Create a GUI with MATLAB
4. Modelling of a vehicle power train
5. Radar System Modelling and Simulation for Automotive Advanced Driver Assistance Systems
6. Computer Vision for Automated Driving in MATLAB
7. Understanding Model Predictive Control
8. Path Planning and Navigation for Autonomous vehicles
9. Lane Keeping Assist System Simulation in MATLAB/SIMULINK
10. A study on Driving scenario designer

AUTOMOBILE ENGINE DESIGN

Course code : 18ME4072
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME2214

Mapping of Course Outcomes with PO/PSO:

CO No.	Course outcome	PO/PSO	BTL
1	Understand the basic knowledge on automobile engine nomenclatures and its performance parameters involved in developing an engine	PO1, PO2	2
2	Apply knowledge to explore different types of design models and factors involved in modeling an engine component in details with real time application.	PO1, PO2, PO3	3
3	Comprehend different functional aspects for good performance of an engine and factors causing failure of an engine	PO1, PO2	2
4	Understand different types of maintenance activities involved and study of faultfinding equipment in detail.	PO1, PO2	2
5	Modeling and analysis of engine components of an automobile using CAD software tools- Laboratory	PO1, PO4	5

Syllabus:

OVERVIEW OF ENGINE DESIGN: History of automobile engine, Classifications of engine, Types of drive in Automobile, Nomenclature of the IC engine, Stroke length and bore diameter, Power to Weight Ratio, Power vs Torque Curve, Engine Performance Parameters, Efficiency of I.C Engines, Technologies to Increase Efficeincy, Variable Compression ratio Engine.

ENGINE COMPONENTS DESIGN: Materials used for engine components, Design of- Cylinder and cylinder liners, Piston and piston materials, Piston Rings, Piston Pin, Connecting rod, Cross section of connecting rod, Crankshaft, Cylinder liner, cylinder head, Design models and considerations of Flywheel, Design consideration of Valve, Rocker arm, Push rod, Cam shaft, cam and follower, Failure analysis of critical components, Stroke & Bore.

ENGINE FUNCTIONAL DESIGN: Selection, Design considerations for combustion chamber, types of Engine balancing, Selection of firing order, Turbocharger.

DESIGN OF COOLING & LUBRICATION SYSTEM: Design considerations of Cooling and Lubrication, Factors influencing, Design models and considerations- radiator, water pump, selection of lubricating oil and pump.

OPTIMISING ENGINE TECHNOLOGY: Preventive, predictive and over all maintenance of the vehicle, Fault finding equipment, Vacuum gauge test, Mechanical fuel pump testing, Cylinder power balance, Cylinder compression test, Cylinder leakage test, Ignition timing, Exhaust gas CO and HC analyzer, Oscilloscope engine analyzers, and Distributor dwell-angle.

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. Demonstration of lab experiments and engine components
2. Modeling of Piston and its components
3. Modeling of Engine valve (Poppet valve)
4. Modeling of Petrol Engine Connecting Rod
5. Modeling of Rocker arm
6. Modeling of Fuel Injector
7. Modeling of Petrol Engine Spark Plug
8. Modeling of Radial Engine Cylinder Head
9. Modeling of Turbo Charger Impeller
10. Static Analysis of Engine Valve
11. Static Analysis of Piston Head
12. Case study: based on Engine Maintenance
13. Modeling of Engine crank shaft

AUTOMOTIVE TRANSMISSION

Course code : 18ME4073
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 importance of construction and working of a clutch in automobile industry and troubleshooting of clutch	PO5	2
2	Understand the importance of construction and working of gear box and total resistance to motions	PO5	2
3	Understand different mechanisms used while adopting a torque converter and various Automotive Transmission mechanisms	PO5	2
4	Understand working principle of drive line system components	PO5	2
5	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

Clutches, Gear Box, Final Drive & Rear Axle, Transmission with Fluid Flywheel & Torque Convertor, Continuous Variable Transmission (CVT)

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.

AUTOTRONICS & SAFETY

Course code : 18ME4074
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction to battery and its principles, Ignition system, Wiring for auto electrical systems, safety concept.

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.

ALTERNATIVE ENERGY SOURCES FOR AUTOMOBILES

Course code : 18ME4075
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Engine Technology and Emissions of Conventional fuel,Hydrogen Energy, Solar Energy, Compressed Natural Gas,

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.

AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM

Course code : 18ME4076
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Batteries and Starting Systems, Charging System and Lighting Auxiliaries, Electronic Engine Management System, Fundamentals of Vehicle Motion Control, Telematics and Vehicle Diagnostics.

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.

AUTOMOBILE ENGINE SYSTEM AND PERFORMANCE

Course code : 18ME4077
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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	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

Automobile Engine Basic Theory, preparation systems for SI and CI Engines, Combustion in SI and CI Engines.

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

AUTOMOTIVE SENSOR AND APPLICATIONS

Course code : 18ME4081
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	Course outcome	PO/PSO	BTL
1	Understand the working of various automotive sensors and actuators.	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

Introduction to automotive sensors and instrumentation, Sensors for Engines, Actuators, Sensor for Chassis, Intelligent Sensors

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

AUTOTRONICS

Course code : 18ME4082
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Fundamentals of Automotive Electronics, Sensors and Actuators, Spark Ignition Engine Management, Compression Ignition Engine Management, Digital Engine Control System.

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

ELECTRONIC ENGINE MANAGEMENT SYSTEM

Course code :18ME4083
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Sensors, Gasoline Injection System, Diesel Injection System, Ignition Systems, Engine Mapping.

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

INSTRUMENTATION IN AUTOMOTIVE INDUSTRIES

Course code : 18ME4084
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Measurements in LMV & HMV, Instrumentation application in vehicles, Embedded application in MV, Communication protocols, Automation in manufacturing industry.

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

AUTOTRONICS AND VEHICLE INTELLIGENCE

Course code : 18ME4085
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Automotive fundamentals, Automotive sensors, Fuel injection and Ignition system, Electric vehicles and hybrid vehicles, Vehicle Intelligence.

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.

AUTOMOTIVE SYSTEMS

Course code : 18ME4086
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Automobile and Chassis, Engine Basic Theory, Transmission, Driveline and Axle, Control System.

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.

PROGRAMMABLE LOGIC CONTROLLERS

Course code : 18ME4087
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction to Factory Automation, Programmable Logic Controllers, Programming of PLC, Installation, Applications of PLC.

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

ARTIFICIAL INTELLIGENCE FOR ROBOTICS

Course code : 18ME4091
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : Nil

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction, Problem Solving, Planning, Reasoning, Learning, AI in Robotics.

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.

AUTOMATION SYSTEM DESIGN

Course code : 18ME4092
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Fundamental Concepts of Industrial Automation, Transfer Lines and Automated Assembly, Pneumatic Control, Pneumatic Control System Design, Elements of Hydraulic Systems, Hydraulic System Design, Programmable Automation, Design for High Speed Automatic Assembly.

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.

INDUSTRIAL AUTOMATION AND CONTROL

Course code : 18ME4093
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction to Industrial Automation and Control, Special Control Structures, Control of Machine tools, Introduction to Actuators, Pneumatic Control Systems.

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.

INDUSTRIAL HYDRAULIC AND PNEUMATIC SYSTEMS

Course code : 18ME4094
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Elements of Hydraulic Systems, Hydraulic System Design and Industrial Applications, Elements of Pneumatic Systems, Pneumatic Systems Design and Industrial Applications, Advances in Hydraulics and Pneumatics.

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

INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS

Course code : 18ME4095
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction, End Effectors, Sensors, Material Handling, Automated Guided Vehicle System, Robots in Material Handling.

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.

MICROCONTROLLER AND PLC

Course code : 18ME4096
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

8051 Architecture, 8051 Microcontroller design, 8051 Microcontroller applications, Programmable Logic Controllers, Applications of PLC.

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

MECHATRONICS SYSTEM DESIGN

Course code : 18ME4097
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction, Modeling and simulation of physical systems, Sensors and Transducers, Actuating Devices, System Control – Logic Methods, Signal Conditioning and Real Time Interfacing.

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

PROGRAMMING SKILLS

Course code : 18ME4101
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Basic model of computation, 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

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.

DATA ANALYTICS

Course code : 18ME4102
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Descriptive Statistics, Inferential Statistics, Regression & ANOVA, Prescriptive analytics.

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

PYTHON

Course code : 18ME4103
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

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.

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)

MACHINE LEARNING

Course code : 18ME4104
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME4102

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Machine Learning: Introduction and Concepts , Supervised Learning with Regression and Classification techniques , Supervised Learning with Regression and Classification techniques -2, Unsupervised Learning and Challenges for Big Data Analytics.

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.

ARTIFICIAL INTELLIGENCE

Course code : 18ME4105
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : 18ME4102

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Introduction, State Space Search, Heuristic Search, Randomized Search, Finding Optimal Paths, Problem Decomposition, Planning and Constraint Satisfaction, Logic and Inferences.

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.

FUZZY LOGIC AND NEURAL NETWORKS

Course code : 18ME4106
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	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

Basic Concepts of Fuzzy Sets**,** Operations on Fuzzy Sets, Fuzzy Measures, Probability and Possibility Measures, Fuzzy Inference Methodologies, Fuzzy Relations, Applications of Fuzzy Sets in ManagementNeural Network,Computing with Neural Nets and Applications of Neural Network.

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.

ROBOTICS

Course code : 18ME4107
L-T-P-S : 2-0-2-0
Credits : 3
Contact Hours : 4
Pre-requisites : NIL

Mapping of Course Outcomes with PO/PSO:

CO No.	Course outcome	PO/PSO	BTL
1	Understand the concept of robotics with respect to their anatomy, Sensors and Controllers.	PO1	2
2	Understand the image processing techniques in Robot vision	PO3	2
3	Understand the working of Robots in various mechanical applications	PO3	2
4	Understand the various Robot Languages	PO3	2

Syllabus:

Introduction to Robotics: Automation, Anatomy of Robots, Industrial Manipulators & AGVs

Sensors and Controllers in robots: Sensors and controllers (sensor types), Incremental encoders and position, velocity sensors, external state sensors, Tactile and slip sensors, measurement of forces

Robot Vision: Robot vision, image processing, image acquisition camera, Camera transformation and calibrations, Image processing (spatial and frequency domain analysis), Image enhancements, histogram Equalisation & specification, discrete transformations, Image Segmentation(based on discontinuity and similarity) & region based segmentation

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
3. Robotics – K.S. Fu, Gonzalez & Lee, Mcgraw Hill Publications.
4. Robotics For Engineers by YoramKkoren, Mcgraw Hill Publications.
5. Introduction to Robot Technology, - P.Coiffet and M.Chairenze / Kogam Page Ltd. 1983 London.

OPEN ELECTIVES

IPR & PATENT LAWS

SYLLABUS

Intellectual Property Rights Patents and intellectual property rights (IPR): Definition, History of intellectual property; Types of intellectual property rights, copy rights, trade marks, geographical indication, Industrial design rights, patents. Sources of patent information, patent application procedures. **Principles, Scope and Functions Of GATT&WTO** GATT- Historical perspective, objectives and fundamental principles, impact on developing countries. WTO-Objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India-tasks and challenges.

Regulatory Affairs Indian contest-requirements and guidelines of GMP, understanding of Drugs and cosmetic act 1940 and rules 1945 with reference schedule M,U & Y. Related quality systems-objectives and guidelines of USFDA,WHO & ICH; Introduction to ISO series.

Documentation and Protocols Documentation: Types related to pharmaceuticals industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, CTD, Dealing with post approval changes-SUPAC, handling and maintenance including electronic documentation.

Case Studies on Patents

Case Studies on - Patents (Basumati rice, turmeric, Neem, and related medicinal plants and byproducts)

Textbooks:

1. S. H. Willig, Good manufacturing practices for Pharmaceuticals, Informa Healthcare (Oct 2000).

Reference books:

1. Industrial Property Rights: Vol. III-4, Kogan Pate, Kogan Pate, Kogan Page (May 1998)**.**

ENVIRONMENTAL POLLUTION CONTROL METHODS

SYLLABUS:

Air pollution: Sources, Types, and effects and Fate of air pollutants. Meteorological factors and their impacts on pollutants dispersal. Sampling and measurement of air pollutants. Air quality standards. Air pollution control methods for particulates and gaseous pollutants. Emission Control equipment for particulate and gaseous matter. **Water pollution:** Sources, Types and Effects of Water pollutants. Measurement of pollution loads: DO, BOD, COD, TOC - Water quality and Effluent discharge standards. Role of Microorganisms in wastewater treatment. Bacterial population dynamics- growth kinetics. Pre-treatment,

primary treatment, secondary and tertiary treatment of wastewater. Low cost treatment unit processes. **Solid waste:** Sources and types of Solid wastes – Disposal methods: Land filling - Composting - Incineration – Pyrolysis. Reclamation of polluted and degraded soil by Bioremediation- Phyto-remediation. Human acoustics, Sound and its general features- Noise and its measurement - Noise pollution hazards -Control methods.

Text Books:

1. Environmental Pollution Control Engineering by C.S.Rao (2006), New Age International (P)Limited Publishers, New Delhi.
2. Environmental Engineering by Howard S. Peavy, Donald R. Rowe and George Tchobanoglous(1985), Mc Graw-Hill International Editions, NewYork.

Reference Books:

1. Sewage Disposal And Air pollution Engineering by S.K. Garg, Khanna publishers, New Delhi, 2010.
2. Waste water Engineering by M.N Rao and A.K Dutta, Oxford & IBH Publishing Co.Ltd, 2000.
3. Air Pollution by M.N Rao and H.V.N Rao, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000.
4. Environmental Engineering by Davis Cornvel, McGraw Hill Book Co., New York, 2000.
5. Waste Water Engineering by Met Calf &Eddy, McGraw Hill Book Co., New York, 2006.

SOLID AND HAZARDOUS WASTE MANAGEMENT

SYLLABUS

Solid wastes: Sources, Types, reasons for increase in generation, composition and properties of solid waste, Collection and on-site handling, Separation and processing. Solid waste disposal methods, Land filling, methods of land filling, Design of Landfills, gas production, Leachate and its control.

Conversion and recovery:Incineration, Pyrolysis, Composting methods, merits and demerits, Energy recovery, Bio methanation, use of refuse derived fuels (RDF).

Hazardous Waste, Definition, Sources, Classification, Hazardous wastes rules, and Nuclear waste, Biomedical wastes, Chemical wastes, disposal methods, Waste minimization. Treatment methods, Physico-chemical processes, Biological methods, Stabilization and Solidification, Thermal methods, Disposal methods Land disposal. Remedial technologies.

TEXT BOOKS:

1. Solid waste Engineering by P.AarneVesilind , William Worrell & Debra Reinhart, Cengage Learning India Pvt. Ltd, New Delhi
2. Environmental pollution control Engineering by C. S. Rao; New age International Publishers, New Delhi.

REFERENCE BOOKS:

1. Venkatappa Rao. G and Sasidhar. R.S.(2009), Solid waste management and Engineered Landfills, Sai Master Geoenvironmental Services Pvt.Ltd, Hyderabad
2. World Health Organization, Global Water Supply and Sanitation Assessment 2000 (Geneva2000).
3. Environment and Pollution Laws: Universal, Universal Law Publishing Co. Pvt.Ltd, Ed 2011.
4. Solid and hazardous waste management by M.N.Rao and Razia Sultana, BS Publications, Hyderabad.

REMOTE SENSING AND GIS

SYLLABUS

Remote sensing basic definition and process, Passive and active remote sensing. Electromagnetic Spectrum, Resolution, Characteristics of Various sensors and satellites, Fundamentals of Image Processing. Map as a model, Spatial elements and terminology, Map scale, Spatial referencing system, Computers in map production, General software's in map production. Types of data products; Image interpretation strategy, Levels of interpretation keys; Topography, Types of Drainage Pattern and Texture, Erosion, ; Basic elements of image interpretation. Overview on visual image interpretation equipment. -

A brief history of GIS, GIS architecture, Components of a GIS, GIS workflow, Theoretical models of GIS: Functional elements, Fundamental operations, Theoretical framework, GIS categories, Levels/scales of measurement. The data stream, Data input methods: Keyboard entry, Manual digitizing, Scanning and automatic digitizing. Stages of GIS data modeling; Raster and Vector data representation, Spatial data models; Data editing, Detecting and correcting errors, Data reduction and generalization Edge matching and Rubber sheeting, Components of data quality, Sources of error in GIS.

Land use /Land cover studies, slope mapping, preparation of structures map, Ground water prospects mapping, Watershed management and Action plan, Water quality modeling, Salt Water intrusion models, pipeline alignment studies, Solid and hazardous waste disposal site selection, Landslides mapping, Urban planning and Management, GPS applications.

Text Books:

1. Remote Sensing and Image Interpretation- 5th Edition by Lillesand, Kiefer and Chipman, Published byJohn Wiley and Sons, Inc, New York, 2007**2.**
2. Text book of Remote sensing and GIS – 3rd Edition by M. Anji Reddy, BS Publications, Hyderabad, 2010.

Reference Books:

1. Geoinformatics for Environmental management" by M. Anji Reddy, B.S Publications, Hyderabad
2. Remote Sensing and GIS- by B. Bhatia Published by Oxford University Press, 2009

DISASTER MANAGEMENT

SYLLABUS

Introduction and Concept of disasters and hazards related to Earthquakes, Tsunami, Volcanic eruption, Cyclones, Floods, Drought, Landslides, Forest fires, Avalanches and Pest infestation. Prediction and perception of hazards and adjustments to hazardous activities; Rates of natural cycles and residence time. Landslide: causes, prevention and correction. Landslide hazard mitigation. Earthquakes: intensity and magnitude of earthquakes; geographic distribution of earthquake zones; precursors to the earthquakes, seismic waves, travel-time and location of epicentre; nature of destruction; ground subsidence; protection from earthquake hazards; do's and don'ts during earthquake; Tsunamis causes and consequences. Floods: Causes, nature and frequency of flooding: nature and extent of flood hazard; urban floods, environmental effects of flooding; flood mitigation methods. Tropical cyclone- formation and consequences. Coastal erosion; sea level changes and its impact on coastal areas. Drought: Nature and effect on plant and animal systems. Study of pattern and mitigation of forest fires. Geological and environmental investigations for the construction of dams, bridges, highways and tunnels. Impact of major geotechnical projects on the environment. Disaster Management: Capability- Vulnerability- risk- preparedness and mitigation- Disaster management cycle; Disaster Risk Reduction and Resilience; Disaster Management Act and Policy. Disaster Management case studies.

Text books:

1. Environmental Hazards by Smith, K., Routledge, London,1992.
2. Geological Hazards by Bell, F.G., Routledge, London,1999.

Reference books:

1. Principles of Engineering Geology by Krynine, D.S. and Judd, W.R., CBS, New Delhi, 1998.
2. Natural Hazards by Bryant, E., Cambridge University Press. London, 1985.
3. Landslide Disaster – Assessment and Monitoring Nagarajan, R., Anmol Publications, New Delhi, 2001.
4. Environmental risks and hazards by Cutter, Susan L., Prentice Hall of India, New Delhi.1999.
5. Bill Mc Juire, Ian Mason and C. Killburn (2002) Natural hazards and Environmental change, Oxford University Press, New York.
6. Gupta, Harsh K. (2003) Disaster Management, Universities Press (India) Pvt. Ltd
7. Coppola, Damon P. (2006) Introduction to International Disaster Management, Butterworth -Heinemann
8. Jha, Madan Kumar (2010) Natural and Anthropogenic Disasters: Vulnerability, Preparedness and Mitigation, Springer.
9. Glade, Thomas, Malcolm G. Anderson, Michael J. Crozier (2005) Landslide Hazard and Risk, edited Springer

FUNDAMENTALS OF DBMS

SYLLABUS

Database Fundamentals: DBMS Characteristics & Advantages, Database Environment, Database Users, Database Architecture, Data Independence, Languages, Tools and Interface in DBMS, DBMS types, **Data Modelling:** ER Model, Notation used in ER Diagram, Constraint, Types, Relationships in ER Model and other considerations in designing ER diagram. **SQL:** Data Definition and other languages in SQL, Creating tables and Data types, Constraints, DML statements, Functions and writing SQL statements using nested sub queries, complex queries, joining relations, Embedded SQL- Writing functions and procedures with PL/SQL, Relational Model, Relational Algebra, Operators in relational algebra. **Normalization:** Guidelines for good database design, Normalization- Normal Forms, First, Second, Third Normal Forms, BCNF, Multi value and join dependencies, 4^{th} and 5^{th} normal forms. File storage, Index structures, Indexing and hashing (Basics) Query Processing: Issues in query processing **Transaction Processing:** Transaction processing issues, Transaction states, problems during multiple transactions processing, ACID properties, system log, Concurrency control techniques: binary locks**,** exclusive locks, Lock based techniques, Timestamp based techniques,.

TEXT BOOKS:

1. Elmasri and Navathe, 'Fundamentals of Database Systems', 2008, 4^{th} edition, Pearson Education. '

REFERENCE BOOKS:

1. Silberschatz, Henry F Korth, S. Sudarshan, "Database System Concepts:, 2003, Fifth Edition, Tata MCGraw-Hill.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 2004, second Edition, Tata MCGraw Hill.

FUNDAMENTALS OF SOFTWARE ENGINEERING

SYLLABUS

Software and Software Engineering: Nature of software, software application domains, unique nature of web applications, software engineering, software process, software engineering practice, software myths. Process Models: Generic process model, prescriptive process models, specialized process models, unified process, personal and team process models, product and process. Agile development: Agility, agile process, extreme programming. Design issues: Software architecture, architectural styles, architectural design. Use cases, Classes, Relationships, common Mechanisms and their diagrams. Interfaces, Modelling techniques for Class & Object Diagrams. Behavioural Modelling: Interaction diagrams. Activity Diagrams. Software testing: A strategic approach to software testing, strategic issues, test strategies for conventional software, Black-Box and White-Box testing,

validation testing, system testing. Software Process Improvement, SPI, The SPI process, The CMMI.

Text Books:

1. Roger S.Pressman ,"Software Enginering – A Practitioner's Approach 7th Edition, Mc Graw Hill,(2010).
2. Ian Sommerville, 'Software Engineering', Sixth Edition,Pearson Education,(2001).
3. Jim Arlow, Ila Neustadt, "UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design", 2nd Edition, Pearson, (2005).

Reference Books:

1. Craig Larman, "Applying UML and Patterns: An introduction to OOAD and design and interface deployment", Pearson, (2002).
2. Alan Dix, Janet Finlay, Gregory d Abowd, Russel Bealel,"Human Computer Interaction", 3rd edition, Pearson education, (2008).
3. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited,(2007).

FUNDAMENTALS OF INFORMATION TECHNOLOGY

SYLLABUS:

Fundamentals of Computers: Introduction, Architecture, organization of a small computer, center Processing Unit, Execution cycle, Instruction categories, measures of CPU performance, Memory, Input/output devices, BUS-addressing modes. **System Software:** Assemblers, Loaders and linkers, compilers and interpreters. **Operating System:** introduction, memory management schemes, Process management, scheduling, threads. **Programming Fundamentals:** Problem solving with algorithms, Programming styles, coding Standards and Best practices, Introduction to C Programming, Testing and Debugging. Code reviews. **System Development Methodologies:** Software development Models. **User Interface Design:** introduction, the process, Elements of UI design & reports. **RDBMS:** Introduction, Data processing, the database technology, Data models **ER Modeling:** Concept, Notations, Extended ER features, Logical database design **Normalization:** Functional Dependency, Normal Forms. **SQL:** DDL statements, DML statements, DCL statements, writing Simple queries. **SQL tuning techniques:** Embedded SQL, OLTP. **Object oriented concepts:** Object oriented programming, relationship, Inheritance, Abstract classes, polymorphism, UML Diagrams, Object Oriented Design Methodology. **Rational Rose Tool:** Application of OOC using Rational Rose Tool.

TEXT BOOKS

1. Andrew S. Tanenbaum, Structured Computer Organization,PHI,3rd ed.,1991
2. Siberschatz and Galvin, Operating System Concepts, 4th ed., Addision-Wesley,1995
3. Dromey R.G., How to solve it by Computers PHI,1994
4. Kernighan, Ritchie, ANSI C language PHI,1992
5. Wilbert o.Galitz essential Guide to user interface design john,wiley,1997
6. Alex Berson, Client server Architecture, McGrew Hill International,1994

IMAGE PROCESSING

SYLLABUS:

INTRODUCTION: Origin of Digital Image Processing, Fields that uses Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System**.**

DIGITAL IMAGE FUNDAMENTLS: Elements of Visual perception, Image sampling and Quantization, Basic relationships between Pixels, Linear and Non-linear operations.

DIGITAL IMAGE TRANSFORMS: Image Transforms – The Discrete Fourier Transform, The FFT, Walsh, Hadamard, Discrete Cosine Transform, The Haar Transform, And the Slant Transform,

IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Some basic Grey level transformations, histogram processing, enhancement using Arithmetic/Logic operations, Smoothing Spatial Filters, Sharpening Spatial Filters.

IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Introduction to Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters.

IMAGE RESTORATION: Noise models, Restoration in the presence of Noise, only Spatial Filtering, Periodic Noise reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Inverse Filtering, Wiener Filtering, Least mean square Filtering.

IMAGE COMPRESSION: Fundamentals – Image Compression models – Error Free Compression, Lossy Compression.

IMAGE SEGMENTATION: Detection of discontinuities, Thresholding, Edge based Segmentation and Region based Segmentation.

IMAGE REPRESENTATIONS AND DESCRIPTION: Representation schemes, Boundary Descriptors, Regional Descriptors

Text books:

1. Rafael C Gonzalez, Richard E Woods," Digital Image Processing", Second Edition, Pearson Education Asia, 2002. (Chapter 1, 3, 4, 5, 6, 7, 8, 9)
2. Jorg Arndt, " DSP Algorithms for Programmers"(Chapter 3)
3. Gonzalez. R & Woods B.E.," Digital Image Processing", Addison Wesley Longman Pearson Education, 2000.

Reference books:

1. MilanSonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Thomson learning, SecondEdition, 2001.
2. William J Prati, "Digital Image Processing", John Wiley & sons
3. Tinku Acharya, Ajoy K Ray, "Image Processing Principles and Applications Principles and Applications", Wiley- Inter science.

LINUX PROGRAMMING

SYLLABUS

Linux Utilities-File handling utilities, Security by file permissions, Process utilities ,Disk utilities Text processing utilities, and Backup utilities Sed- scripts, operation, addresses, commands, applications, Awk execution, field and records , scripts, operation, patterns, actions functions using system commands in awk.
Working with Bourne again Shell (bash) responsibilities, here documents , running shell script, Shell as a programming language, shell meta characters, Control structures, arithmetic in shell, examples Interrupt processing, functions, debugging shell scripts.
Files : file Concept , File System Structure, I nodes, File Attributes, File types Library functions ,standard and formatted I/O in C, stream errors Kernel support for files ,System calls, file descriptors, low level file access File structure related system calls (FILE APIS), file and record locking File and directory management-Directory file APIS, Symbolic links and hard links
Process concept, Kernel support for process, process attributes, process creation , waiting for a process, Process termination ,Zombie process, orphan process, Process APIs Introduction to signals, signal generation and handling ,Kernel support for signals, signal function, unreliable signals , reliable signals Kill ,raise, alarm, pause, abort, sleep functions
Introduction to IPC, pipes, FIFOs- Introduction to three types of IPC-message queues, semaphores and shared memory -Kernel support for messages, Unix system V APIs for messages- Client /Server example

Text Books:

1. Unix and Shell Programming , B. A. Forouzan and R.F Gilberg, Cengage learning
2. Unix Concept and Applications, 4thedn. SumitabhadasTMH
3. Beginning Linux programming 4thedn. N. Matthew , R stones Wrox Wiley India edn.

Reference Books:

1. Linux system Programming , Robot Love, O;Reilly, SPD
2. Unix Network Programming , W.R. Stevens , PHI
3. Unix Internals , U Vahalia , Pearson Education
4. Unix and shell Programming, S.G.Kochanand P.Word3rdedn.PearsoEdn.

E-COMMERCE

SYLLABUS

Electronic Commerce: Revolution. E-Commerce Business models and concepts: The Internet and World Wide Web: E-commerce infrastructure. Building an E-commerce web site, online Security and payment systems, E-Commerce Marketing concepts, , Ethical, Social and Political issues in E-Commerce, Retailing on the Web, Online Service industries, B2B E-Commerce: Supply chain management and collaborative commerce. E-Commerce Marketing communications, Internet Resources for Commerce: Technologies for Web Servers, Internet Applications for commerce, Internet Charges, Internet Access and Architecture, Searching the Internet

Text Books:

1. Kenneth C.Laudon, Carol G.Traver , E-Commerce, (Pearson Education)

Reference Books:

1. Daniel Minoli,EmmaMinoli,'Web Commerce Technology Handbook',(TMG)
2. Elias M.Awad'Electronic Commerce'(PHI)

RENEWABLE ENERGY RESOURCES

SYLLABUS

Extra-terrestrial solar radiation, terrestrial solar radiation, solar thermal conversion, flat plate and concentrated solar thermal collectors, solar ponds, solar heating/cooling technique, solar distillation, photovoltaic energy conversion, solar cells – 4 models.

Planetary and local winds, vertical axis and horizontal axis wind mills, principles of wind power, maximum power, actual power, wind turbine operation, yaw control, pitch control and stall control mechanisms, derivation of power coefficient.

Ocean temperature differences, principles of OTEC plant operations, wave energy, devices for energy extraction, tides, simple single pool tidal system.

Origin and types, Bio fuels, classification, direct combustion for heat and electricity generator, anaerobic digestion for biogas, biogas digester, power generation.

Biomass energy conversion technologies, Biogas generation – classification of Biogas plants. Micro hydroelectric systems- different types of turbines.

Text books:

1. Godfrey Boyle "Renewable Energy", Oxford Publications, Second edition.
2. G. D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, First edition.

Reference books:

1. Roger H.Charlier, Charles W. "Ocean Energy- Tide and Tidal Power"ISBN: Library of Congress Control Number: 2008929624_c Springer-Verlag Brerlin Heidelberg 2009.
2. John Twidell& Toney Weir: E&F.N. Spon, "Renewable Energy Sources", Taylor & Francis New York, 2nd edition.
3. John F.Walker&N.Jenkins, "Wind Energy Technology", John Willey and Sons Chichester, U.K – 1997

ROBOTICS

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 centered 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 & Photodetector 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 MikellP.Groover, Mcgraw Hill Publications

REFERENCE BOOKS

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

MECHATRONICS

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.

ACTATION SYSTEMS: Pneumatic and hydraulic actuation systems, Stepper and Servo Motors

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. W.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. NitaigourPremchandMahalik, “Mechatronics”, Tata McGraw-Hill, 2003.
3. HMT Limited, “Mechatronics”, McGraw-Hill Education (India) Pvt Ltd, 2000.
4. T.G. Beckwith &N.L.Buck, “Mechanical Measurements”, 3rd Edition, Addison-Wesley Pub. Co., 1969.

OPERATIONS RESEARCH

SYLLABUS

Introduction to Operation 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 methods, 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, 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. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

NANO MATERIALS AND TECHNOLOGY

SYLLABUS

Introduction : Evolution of science and technology, Introduction to Nanotechnology, Nanotechnology-Definition, Difference between Nanoscience and Nanotechnology, Feynman predictions on Nanotechnology, Moore's law, Bottom up and top down approaches, challenges in Nanotechnology .

Nano materials : History of materials, Nanomaterials-Definition, Classification of Nanostructured materials, causes of interest in nanomaterials, some present and future

applications of nanomaterials, Bio-Medical Applications-Drugs, Drug Delivery, Photodynamic therapy, Molecular motors, Neuro-Electronic Interfaces, Protein Engineering, Nanoluminescent tags.

Synthesis and processing of nanoparticles, thin films: Nanoparticles: Processes for producing ultrafine powders-mechanical milling, wet chemical synthesis, gas condensation process, chemical vapour condensation, laser ablation.

Thin Films: Synthesis techniques- Physical Vapor Deposition: Evaporation, Molecular beam epitaxy, Sputtering. Comparison of evaporation and sputtering.

Special nanomaterials, characterization and tools: Carbon nanotubes, nano composites, carbon fullerenes-An overview over preparation, properties, applications. Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Scanning Probe Microscopy– X ray Diffraction. MEMS: – Introduction, types of MEMS: - Mechanical, Thermal, Magnetic MEMS; Fabrication of MEMS.

TEXT BOOKS

1. Nano structures & Nano materials by Guozhongcao, Imperial college press.
2. Micro manufacturing and Nano Technology by N.P.Mahalik.

REFERENCE BOOKS

1. Nano Technology by Mark Ratner &Danier Ratner, Prentice Hall
2. Nano materials by A S Edelstein& R C Cammarata, Institute of physics publishing, Bristol and Philadelphia.

SUBSEA ENGINEERING

SYLLABUS

Overview of subsea engineering, subsea field development, distribution systems, subsea surveying positioning and foundation, installation of subsea equipment, subsea control, power supply, subsea hydraulics, subsea corrosion and scale, subsea connections and jumpers, subsea well heads and X-trees, subsea drilling risers, subsea production risers, subsea pipelines, subsea risk and reliability.

REFERENCE BOOKS:

1. Yong Bai, Qiang Bai, “Subsea engineering handbook”, Gulf publishers, (2010)
2. Yong Bai, Qiang Bai, “Subsea pipeline and risers”, Gulf publishers, (2005)
3. Boyun Guo, Shanhong Song, Jacob Chacko, Ali Ghalambor, “Offshore Pipeline”, Gulf publishers, (2005)

OIL AND GAS MANAGEMENT

SYLLABUS

Global Oil and Gas: Value Chain and Geopolitics of Oil

The Upstream: Exploration, Development, and Production

The Midstream: Markets and Transportation

The Downstream: Refining and Marketing

The Future Oil and Gas Industry

REFERENCE BOOKS

1. Adedeji B. Badiru Samuel O. Osisanya, "Project Management for the Oil and Gas Industry", CRC Press, 2013.
2. Use Internet sources for present trends.

SELF DEVELOPMENT

SYLLABUS

Orientation, Discussion on Values : Understanding Values, Behavior and Attitudes, Application of Values and Universal Values, **Philosophy of Yoga :** God, Self and Ultimate goal of yoga, Brief Introduction to various types of yoga and Integration of values in Yoga, **Study of major Religions :** Identify commonality, condition of its origin or intention vs. current state, **Art of Meditation :** Observation, Introspection, Contemplation, Meditation and Concentration, Schools of Meditation, **Systematic Practice of Meditation:** Theories of life, Need for Meditation, Natural Path, Integration **Personal Responsibility:** Stress Management, Tips for Self-Management, Choices we make, Excellence.

TEXT BOOK

1. Self-development modules from Heartfulness Institute (www.heartfulness.org)

REFERENCE BOOKS

1. Complete works of Swami Vivekananda
2. Jonathan –Livingston - Seagull
3. The Monk Who Sold His Ferrari_Robin S. Sharma
4. You can win by shiv khera
5. Many lives Many Masters
6. The road less travelled – Scott Peck
7. As a man thinketh
8. Journey of the Soul
9. The Bhagavad-Gita
10. King James version of the Holy Bible
11. Holy-Quran

EMOTIONALINTELLIGENCE

SYLLABUS

Course Objective: The main objective of the course is to enable the students understand meaning and importance of emotional intelligence.

Emotional Intelligence: The Concept, dimensions of emotions; Theories of Multiple intelligences; importance of emotions; emotions and the brain; The Role of Emotions in Organizations; Self-Awareness and Self-Control; Empathy; Social Expertness; Personal Influence.

Emotional Intelligence and Personality: relationship between EQ and IQ; human mind; consequences of low and high EQ; EQ development; Emotional Skills; emotional factors: Emotional Competency, Emotional Maturity, and Emotional Sensitivity**.**

Levels of EI: Models of Emotional Intelligence; emotional intelligence competencies; emotional intelligence and leadership behaviour; emotional intelligence and stress management; art of influencing people.

The Role of Emotional Intelligence in Professional Success: Emotional Intelligence and the Complexity of Work; Emotional Intelligence and High IQ Professions; Emotional Intelligence and Leadership; manage emotional upsets; Emotional 'Winner'**.**

EQ in the Indian Perspective; EQ and Managerial Effectiveness; the soft art of being a tough leader.

Textbooks:

1.Dalip Singh - Emotional Intelligence at Work: A Professional Guide – Response Books – 2006.

Reference Books:

1. Daniel Goleman, Emotional Intelligence, Bantam Books, 2006.
2. Moshe Zeidner, Gerald Matthews, and Richard D. Roberts, What We Know About Emotional Intelligence – How It Affects Learning, Work, Relationships, and Our Mental Health, The MIT Press, 2009.
3. James Bradford Terrell and Marcia Hughes, A Coach's Guide to Emotional Intelligence: Strategies for Developing Successful Leaders, Wiley, 2008.
4. Dr. Jeanne Segal, The Language of Emotional Intelligence, McGraw-Hill, 2008.

BEHAVIORALSCIENCES

SYLLABUS

Introduction to Behavioural Science;Foundations of Individual Behavior: Personality-Personality determinants; Personality traits: The Big Five Model, Major personality attributes influencing OB; Theories of personality; Values – Types of Values.

Learning- Theories of learning; Principles of learning; Attitudes – Source of attitudes; Types of Attitudes, Attitudes and consistency – Cognitive Dissonance theory.

Perception- Perceptual process; Factors influencing **Perception;** perceptual distortion; Linkage between perception and individual decision making; Motivation – Theories of Motivation – Hierarchy Needs Theory – Two-Factor Theory – Expectancy Theory; Applications of Motivation.

Foundations of Group Behavior: Groups – Nature of groups; Types of groups; Stages of Group Development; Group Cohesiveness; Teams vs Groups
Leadership – Nature; Leadership Styles; Theories of leadership: Trait Theories, Behavioral Theories and Contingency Theories.

Text Books:

1. Aswathappa, Organizational Behaviour, Himalaya Publishing House, 2010.

Reference books:

1. Robbins, Stephen, Timothy, A &Sanghi, S. Organizational Behavior, 13thEdn, Pearson Education. 2009.
2. Fred Luthans, Organizational Behaviour, Prentice Hall, 2007
3. UdaiPareek, Organizational Behavior, Oxford Publishers, New Delhi, 2008.

PHOTOGRAPHY

SYLLABUS:

History of Photography –Cameras. Film Speed – Shutter Speed – Aperture – Figuring Focus – Depth Definitions – Camera: Types, Structure & Features. Specialized of Field – Exposure Types of Lenses – Normal lens, Wide angle, Telephoto, Fish eye & Close up lenses, Macro and Zoom Lens – Focal Length - Angle of View.

Photographic equipment and types of photography, Digital and film photography., Digital images and their characteristics, Pixels and resolutions, Digital Camera and their types, Storage and memory issues of digital images, Scanners and their applications.

Basic Lightings – Outdoor Lightings- Indoor Portrait Lighting - Flashbulbs – Electronic Flash units – Flash Techniques - B/W & Color Filters – Filter Factor Composing Effective Photographs: Picture Purpose – Centre of Interest , Rule of Third, Backgrounds, Angles – Framing – Varying Format, Focus for Effect – Good Timing – Color Consideration – Imagination. Photography under Special Conditions.

Different types of photography, Introduction to Digital Photography & Its Fundamentals. – Digital Image Sensor – Resolution - Storage Medium – File Formats – Digital Printing Technology.

Reference Books:

1. Tom Grimm, The Basic book of Photography, New York, Plume, 1979
2. George Haines, learning photography, Hamlyn Publishing Group, London 1992
3. Michael Langford , Basic photography , focus press London 1986
4. JhonHedgeco, New Book of photography , Dorling Kindersley book Lonon1994
5. Leslie D Stroebel,and Richard D Zakia, Basic photography materials and process-
6. John Hedgecoe, The Photography's Handbook,-1992
7. Chris George, Mastering Digital Flash Photography-2008.

MANAGEMENT ELECTIVES

PARADIGMS IN MANAGEMENT THOUGHT

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO. No	Course Outcome	PO	BTL
1	Understand the basic management concepts along with an insight into levels of management.	9	2
2	Understand the key contributions of classical approach to Management	12	2
3	Understand and apply Quantitative methods to improve Management performance.	9	2
4	Understand the key contributions of Behavioral and contemporary approaches to Management.	9,12	2

SYLLABUS:

Management Introduction - Early management thought - Management Concept – Nature - Management as art, science, profession - Scope and functions of Management - Levels of Management - Importance of management. **Classical Approach to Management: (a) Scientific Management-** The advent of Scientific Management – Frederick W Taylor's contributions, - Contribution by Henry L Gantt - Contribution by Frank, Lillian Gilberth. **General Administrative Approach**: Henry Fayol's contributions towards general management – Max Weber's Bureaucracy Approach. **Quantitative Approach:** Important contributions – TQM – implications in today's management – Six sigma.

Behavioral Approach: Organizational Behaviour – Contributions of Elton Mayo's – .Hawthorne studies – contributions of Mary Parker Follett – Chester Bernard.

Contemporary Approach: Systems Theory – Contingency Theory – Chao's Theory -Peter F Drucker Contributions – C K Prahlad's Contribution – Porter's theory – Worker Management – Employee Engagement – People Capability Maturity Model.

Recommended Text Book(s):

1. Management by Stephen P Robbins, Mary Coulter, Neeharika Vohra – Pearson – 10th edition

Reference Books:

1. Management by Stoner, Freeman, Gilbert – PHI – 7th edition.
2. Management A Global & Entrepreneurial Perspective – Weihrich, Cannice, Koontz – Mc Graw Hill – 13th Edition.
3. The evolution of management thought by Daniel A Wren, Arther G Bedeian : john wiley& sons

INDIAN ECONOMY

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO. No	Course Outcome	PO	BTL
1	Understand the structure of Indian Economy	7	2
2	Understand the structural problems encountered by India	7	2
3	Develop a perspective approaches to economicplanning and development in India	7	2
4	Understand the role of the Indian Economy in the global context	7,12	2

SYLLABUS:

Economy: Meaning, types, problems and functions – Features of Indian Economy: Circular flow of economic activity: two sectors, three sector and four sector models. Sectoral distribution of the economy. Nature and features of Indian Economy; Sectoral contribution of National Income-Share of Public and Private Sectors in GDP. Agricultural Sector of India: importance and general problems; Land Reforms, Agricultural marketing problems and remedies. Industrial Sector of India: Types, Importance and general problems: Small Scale Sector: Importance and general problems. Tertiary Sector in India- Importance – Infrastructure Development – Transport – Roadways, Railways – Banking and Insurance – Communication – Science and Technology – Software. Personal Income distribution and causes of inequality - Unemployment causes and remedial measures; Poverty in India-Poverty Line – anti poverty programs. Human development: concept and measurement - Human Development Index. Economic Planning in India: Role of Planning Commission - Over all Objectives and achievements of various Five Year Plans. 12th Five Year Plan; Economic Liberalisation: LPG strategy-General Agreement on Tariffs and Trade (GATT) - Objectives of GATT and Evolution of WTO – WTO and the Indian Economy, NABARD and World Bank.

Recommended Text Book(s):

1. G.Dutt and K.P.M.Sundaram: Indian Economy (2011), S.Chand&Co., New Delhi.
2. S.K.Mishra and V.K.Puri: Indian Economy, 30th ed., Himalaya Publishing House, New Delhi.
3. M.L.Jingan: Macro Economics, 6th ed., Konark Publishing House.

Reference Books:

1. P.K.Dhar, Indian Economy-Its growing dimension, Kalyani Publishers.
2. Alok Ghosh, Indian Economy, Its Nature and Problem, World Press.
3. A.N.Agarawal, Indian Economy- Problems of Development and Planning, New Age

MANAGING PERSONAL FINANCES

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO .No	Course Outcome	PO	BTL
1	Understand the need for effective financial planning	12	2
2	Analyze the basic concepts of money management, tax planning, consumer credit, housing and other consumer decisions, insurance, investments, retirement planning etc.	12	2
3	Evaluate various financial tax saving schemes to save money to get tax benefits.	12	2
4	Design savings and investment plans.	12	2

SYLLABUS

Financial planning process: Introduction-Importance of Financial Planning- Process of financial planning -The planning environment-Determinants of personal income- Financial statements and plans-Concept of Time value of money - Preparing a personal balance sheet - Preparing the income and expense statement-Using personal financial statements - Ratio Analysis. **Managing Taxes:** Introduction-Importance of tax planning-Basic concepts of income tax - Personal taxation -Income tax benefits on certain long term investments -Tax planning-Ethical consideration in tax planning. **Making decisions regarding houses and automobiles: -** Meeting housing needs-The rental option - The home buying process - Financing the housing transaction - Housing finance institutions in India - Housing schemes in India- Automobile purchase planning. **Planning for Investments: -** Types of investment vehicles-Factors considered in the choice of investments- Developing the investment strategy-Investing in Equities- Investment Process- Investing in Fixed Income Securities-Bond Market-Bond Investing Strategies-Types of Bonds-Bond Returns- Risks from Investing in Bonds. **Insurance & Mutual Funds**:-Insurance planning - Buying a life insurance - Life insurance products in India- Health Insurance-Need-Types and Sources of health care plans-Providers of Health care-Long term care insurance-Disability income insurance-Health Insurance in India; Mutual funds – Types of mutual fund products – Objectives of investing in Mutual funds.

Recommended Text Book(s):

1. Jack R Kapoor, “Personal Finance” Mc Graw Hill Publications, New Delhi, 2008.
2. KC Mishra and Steward Doss, “Basics of Personal Financial Planning” Cengage Learning, First Edition 2009.

Reference books:

1. Joehnk, Billingsley and Gitman “Planning Your Personal Finances” Cengage Learning India Private Limited, Delhi, 2012.
2. Mark Hirschey and John Nofsinger “Investments Analysis” and Behavior” Mc Graw Hill Publications, New Delhi, 2008.

BASICS OF MARKETING FOR ENGINEERS

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO. No	Course Outcome	PO	BTL
1	Understand the basic concepts of marketing management	12	2
2	Analyze the markets and consumers, the changing environmental factors with special focus on technology	12	4
3	Understand the basics of marketing mix	12	2
4	Create an appropriate strategy for the marketing of high tech products and services	12	4

SYLLABUS:

Introduction and Nature of Marketing: Evolution of Marketing Concept - Core concepts of marketing - Scope and Importance of Marketing. -Difference between Selling and Marketing - Marketing Myopia - Consumer Marketing Vs. Industrial Marketing. Understanding Consumer Behavior: nature, scope and importance of consumer behavior – Factors influencing Consumer Behavior - Buying decision making process - Market Segmentation, Targeting and Positioning (STP). Marketing mix - Product definition, levels of product, product classification, difference between goods and services, Product Life Cycle, New Product Development – Technology and Product Management - Concept of Pricing – Factors influencing the pricing policy – Pricing strategies - Pricing Considerations in High-Tech Markets. Promotion mix - Marketing Communication Tools for High-Tech Markets - Channels of distribution - Supply Chain Management in High-Tech Markets - Technology Marketing, Green Marketing, Introduction to market study.

Text Books:

1. Philip Kotler and Gary Armstrong- Principles of Marketing- 17/e, Pearson Education.
2. Jakki J Mohr, Sanjit Sengupta and Stanley Slater, Marketing of High-Technology Products and Innovations, 3/e Pearson India

Reference Books:

1. V.S. Ramaswamy and S.Namakumari – Marketing Management, 4/e, Mc Millan Publications, New Delhi.
2. RajanSaxena, Marketing Management- 3/e, TMH, New Delhi.

ORGANIZATION MANAGEMENT

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO. No	Course Outcome	PO	BTL
1	Understand the theories and approaches of organizational management	9	2
2	Understand the basics of organization structure	9	2
3	Understand the methods for motivating in competitive business environment.	9	2
4	Understand the basic modes of maintaining good industrial relations	9	2

SYLLABUS:

Development of Management thought – Introduction, Various theories; Functional approach, scientific management approach, human relations approach, latest management thoughts, organisation theory-classical organisation, neo-classical organisation theory, modern organisation theory. Organization Structure--Principles of organisation, organizational theories, departmentalism, authority, power, organizing, organizational effectiveness, structuring the organisation, organizational change, organisation charts; types of organisations—line , functional and line and staff relations, Organisational manuals. Motivation, Morale and behavioural science—Motivation: Characteristics, importance, Kinds of motivation. Thoughts of motivational philosophy: Gouglass Mc Gregore—X and Y theory; Herzberg's theory. Human needs, Incentive as motivators, Managing dissatisfaction and frustration. Morale, Absenteeism, Behavioural science, Group dynamics, Group behaviour. Leadership—Meaning, importance, styles, theories, leaders Vs managers. Management concept—Management, Administration, Organisation, Difference and Relationship between Management, Administration and Organisation, Importance of Management, Characteristics of management, Managerial Skills, Managerial Objectives, Harmonization of Objectives, Hierarchy of Objectives. Industrial Relations, Trade Union and Collective Bargaining—Industrial relations, Industrial Psychology, Industrial disputes, Conflict management, Views about conflict, Labor Policy. Workers grievances, Suggestion system. Trade Unions. Collective Bargaining, Negotiations, Industrial Safety—working conditions, Accidents, Preventive measures, Safety training.

Text books:

1. Stephen P. Robins, Organizational behavior, PHI / Pearson education, 11^{t} edition, 2008.
2. Koontz &Wehrich., Essentials of Management, 12th edition, Tata Mc Grawhill, 2007.

Reference books:

1. Banga&Sarma , Industrial Engineering Management including Productionmanagement, 11th edition, 2010.
2. O.P. Khanna, Industrial engineering management, Khanna publications, 2006.

RESOURCE, SAFETY AND QUALITY MANAGEMENT

Mapping of Course Outcomes to Program Outcomes: The students will be able to

S.No	Course Outcome	PO	BTL
1	Understand the basics systems of man power and materials management	5	2
2	Understand the basics systems of machinery management	5	2
3	Understand the basics systems of safety management	6	2
4	Understand the basics systems of quality management	5	2

SYLLABUS

Resource Management (Man Power, Materials & Machinery): Introduction; Resource smoothing; Resource Levelling, Establishing workers productivity; Objectives of material management; Functions of material management department; ABC classification of materials; Inventory of materials; Material procurement; Storage management; Classification of construction equipment; Earth moving equipment; Excavation equipment; Hauling equipment; Earth compaction equipment; Hoisting equipment; Concrete plant and equipment; Time and motion study; Selection of equipment – Task consideration, cost consideration; Factors affecting the selection; Factors affecting cost owning and operating the equipment; Equipment maintenance. **Safety and Quality Management:** Accident prevention program; Immediate attention in case of accident; Approaches to improve safety in construction; Safety benefits to employees, employees and customers; Prevention of fire in construction industries; Fault tree analysis; Safety information system; Safety budgeting;

Importance of quality; Elements of quality; Organization for quality control; Quality assurance techniques; Documentation; Quality control circles; Total quality management; ISO 9000 – 2008.

TEXT BOOKS:

1. Construction Engineering and Management by S.Seetharaman; Umesh Publications, NaiSarakl, Delhi.
2. Fundamentals of PERT/CPM and Project Management by S.K.Bhattacharjee; Khanna Publishers, NaiSarak; Delhi.

REFERENCE BOOKS:

1. Construction Management and Planning by B.Sengupta and H.Guha; Tata Mc.Graw-Hill Publishing Co. Ltd., New Delhi.
2. Construction Planning, Equipment and Methods by Peurifoy R.L; MC Graw-Hill International Book Company.

HONOR DEGREE COURSES

ADVANCED HEAT & MASS TRANSFER

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Understand 1-D steady state conduction heat transfer	1, 2	1, 2
2	Apply principles of Heat Transfer to develop Mathematical model for ducts and plates	1, 2	3, 4
3	Analyze free and forced convection problems	1, 2	3, 4
4	Apply concepts of radiation heat transfer for enclosure analysis	1, 2	1, 2

Syllabus:

Introduction - review of heat transfer Fundamentals - transient conduction and extended surface Heat Transfer, Unsteady heat conduction. Lumped capacity model, awareness of one-dimensional unsteady results (charts; Biot and Fourier numbers), Brief review of Steady Laminar and Turbulent Heat Transfer in External and Internal Flows - Heat Transfer at High Speeds - Unsteady Laminar and Turbulent Forced Convection in Ducts and on Plates - Convection with body forces, Boundary layers and internal flows. Awareness of these configurations, some knowledge of internal flow energy balances, Convection correlations. Finding heat transfer coefficients from Reynolds numbers and Rayleigh numbers, Heat Exchangers. Typical configurations and epsilon-NTU analysis, phase-change heat transfer. General awareness of processes of condensation and boiling in a pure substance, some use of correlations, Quenching of metals, Leidenfrost problem, heat transfer of sprays, jets and films, Radiation basics - Radiation in Enclosures - Gas Radiation - Diffusion and Convective Mass Transfer - Combined Heat and Mass Transfer from Plates and in Pipes.

Text Books:

1. Heat transfer, A. Bejan, John Wiley & Sons (1993)
2. Advanced Heat and Mass Transfer, A. Faghri, Y. Zhang, J. Howell, Global Digital Press (2010)

Reference Books:

1. A Heat Transfer Text Book, J. H. Lienhard iv, and J. H. Lienhard V, Phlogiston Press (2008)
2. Heat and Mass Transfer, H. D. Baehr, and K. Stephan, Springer-Verlag (1998)
3. Heat transfer, F. M. White, Addision-Wesley (1984)
4. Basic heat and mass transfer, K. C. Rolle, Prentice-Hall (2000)
5. Heat Transfer – A practical approach, Y. A. Cengel, Tata McGraw-Hill (2002)

INCOMPRESSIBLE AND COMPRESSIBLE FLOWS

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BT2L
1	Understand the fundamental concepts of continuum mechanics and shock wave theory	1	2
2	Apply techniques for analyzing inviscid incompressible flow problem	2	3
3	Apply techniques for analysis of laminar and turbulent boundary layer flows	2	3
4	Apply techniques for analysis of unsteady compressible flows.	2	3

Syllabus:

Definition and properties of Fluids, Fluid as continuum, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equation, Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows, Revisit of fluid kinematics, Stream and Velocity potential function, Circulation, Irrotational vortex, Basic plane potential flows: Uniform stream; Source and Sink; Vortex flow, Doublet, Superposition of basic plane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lift theorem; Concept of lift and drag, Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Approximate Methods, Flow separation, Entry flow into a duct, Basic concepts of thermodynamics, governing equations in various forms, concept of Mach number, one dimensional flows and normal shock wave, Rayleigh and Fanno flows, Two dimensional flows and oblique shock waves, θ-B-M relations, understanding of shock interaction and shock reflection with various graphs, Prandtl- Mayer expansion, shock-expansion theory, quasi one dimensional flows, method of characteristics and, unsteady wave motion and introduction to various experimental facilities for these speed ranges.

Text Books:

1. Boundary layer theory, H. Schlichting, and K. Gersten, Springer (2000)
2. Elements of gas Dynamics, H. W. Liepmann & A. Roshko, Dover Publications (2002)
3. Viscous fluid flow, F. M. White, Mc-Graw Hill (2005)

Reference Books:

1. Introduction to Fluid Mechanics, E. J. Shaughnessy, I. M. Katz and J. P. Schaffer, Oxford University Press (2004)
2. Compressible fluid flow, M. A. Saad, Prentice Hall (1985)

3. Incompressible flow, R. L. Panton, John Wiley & Sons (2005)
4. Advanced Fluid Mechanics, Som, and Biswas, Tata McGraw Hill (2008)
5. The dynamics and thermodynamics of compressible fluid flow, Vol. 1 & 2, A. H. Shapiro, Ronald Press (1954)

COMPUTATIONAL FLUID DYNAMICS

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Understand Fundamentals of CFD and Derive the governing equations	1, 2	3
2	Apply different CFD techniques to diffusion	1, 2	3
3	Application of time integration methods for convection diffusion	1, 2	3
4	Solving N-S equations and Modelling of turbulence	1, 2	3

Syllabus:

Introduction: Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description, Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic elliptic and hyperbolic; boundary and initial conditions; over view of numerical methods, Finite Difference Technique: Finite difference methods; different means for formulating finite difference equation; Taylor series expansion, integration over element, local function method; treatment of boundary conditions; boundary layer treatment; variable property; interface and free surface treatment; accuracy of FD method, Finite Volume Technique: Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem, Finite Element Methods: Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications, Methods of Solution: Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform, Time integration Methods: Single and multilevel methods; predictor-corrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems, Numerical Grid Generation: Numerical grid generation; basic ideas; transformation and mapping, Navier-Stokes Equations: Explicit and implicit methods; SIMPLE type methods; fractional step methods, Turbulence modeling: Reynolds averaged Navier-Stokes equations, RANS modeling, DNS and LES.

Text Books:

1. Numerical Computation of Internal and External Flows, C. Hirsch, Vols. I & II, John Wiley & Sons (2004)
2. An Introduction to Computational Fluid Dynamics, H. K. Versteeg & W. Malalasekera, Longman Scientific& Technical (1995)

Reference Books:

1. Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tannehil and R. H. Pletcher, Taylor & Francis publications, USA (1997)
2. Fundamentals of CFD, T. K. Sengupta, Universities Press (2004)
3. Computational Fluid Dynamics, T. J. Chung, Cambridge University Press (2002)
4. Computational Methods for Fluid Dynamics, J. H. Ferziger and M. Peric, Springer (1997)
5. Computational Techniques for Fluid Dynamics, C. A. J. Fletcher, Vols. I & II, Springer- Verlag (1996)

MECHANISMS DESIGN AND SIMULATION

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Understand Kinematic principles and Structures	1, 2	1, 2
2	Analyze mechanisms in linkages Robotic manipulator	1, 2	3, 4
3	Draw Inflection circle for coupler curves	1, 2	1, 2
4	Synthesize curve based mechanism and Cam mechanisms	1, 2	3, 4

Syllabus:

Introduction: Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms– mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms-Equivalent mechanisms.

Kinematic Analysis: Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters – Forward and inverse kinematics of robot manipulators.

Path Curvature Theory, Coupler Curve: Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp-crunode coupler driven six-bar mechanisms-straight line mechanisms

Synthesis Of Four Bar Mechanisms: Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods-Freudenstein's Equation-Bloch's Synthesis.

Synthesis of Coupler Curve Based Mechanisms & Cam Mechanisms

Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms-determination of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation Soft-ware packages.

Reference Books:

1. Robert L.Norton., "Design of Machinery",Tata McGraw Hill, 2005.
2. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.
3. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2005.
4. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi,1999.
5. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.
6. Ramamurti, V., "Mechanics of Machines", Narosa, 2005.

ADVANCED MECHANICS OF SOLIDS

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Analyze Stress, strain in a deformable bodies	1, 2	3, 4
2	Apply Energy Methods to calculate deflections in members	1, 2	1, 2
3	Analyze Stresses, deflections in Straight and Curved beams	1, 2	3, 4
4	Determine contact stresses and deflection of bodies in contact	1, 2	1, 2

Syllabus:

Theories of stress and strain, Definition of stress at a point, stressnotation, principal stresses, other properties, differential equations of motion of a deformable body, deformation of a deformable body, straintheory, principal strains, strain of a volume element, small displacement theory.

Stress –strain temperature relations: Elastic and non-elastic response of a solid, first law of thermodynamics, Hooke's Law, Anisotropicelasticity, Hooke's Law, Isotropic elasticity, initiation of Yield, Yieldcriteria.

Failure Criteria: Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for number of cycles N > 106), buckling.

Application of energy methods: Elastic deflections and statically indeterminate members and structures: Principle of stationary potentialenergy, Castigliono's theorem on deflections, Castigliono's theoremon deflections for linear load deflection relations, deflections of statically determinate structures.

Unsymmetrical bending: Bending stresses in Beams subjected to unsymmetrical bending; Deflection of straight beams due to unsymmetrical bending.

Curved beam theory: Winkler Bach formula for circumferential stress –Limitations – Correction factors – Radial stress in curved beams – closedring subjected to concentrated and uniform loads-stresses in chainlinks.

Torsion: Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hollow thin wall torsionmembers, multiple connected Cross Sections.

Contact stresses: Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

Reference Books:

1. Advanced Mechanics of materials by Boresi& Sidebottom-Wiley International.
2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition
3. Advanced Mechanics of Solids, L.S Srinath
4. Advanced strength of materials by Den Hortog J.P.
5. Theory of plates – Timoshenko.
6. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
7. Strength of materials by Sadhu Singh

MINOR DEGREE COURSES

INDUSTRIAL ENGINEERING TECHNIQUES

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Apply various work-study techniques to determine the standard time and efficiency.	2	4
2	Analyze various quality control techniques for bringing out the best quality output.	2	4
3	Apply various production scheduling techniques to optimize productivity & Forecast the future demand for the product	2	4
4	Apply various strategies to optimize the Inventory cost	2	4

Syllabus:

Work study: Techniques of work study, basic procedure of work study. **Method study**: Tools for recording techniques – Flow process chart, flow diagram, string diagram, multiple activity chart, Man-machine chart. **Micro motion study**: Therbligs, motion economy principles, SIMO chart. **Work measurement**: Stopwatch time study procedure - breaking the job into elements, timing methods, number of cycles to be timed, rating, allowances, setting standard time. **Work sampling**: Confidence levels, number of observations, use of random number table. **Inspection & Quality Control:** Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems. Acceptance sampling, Single and double sampling, OC curve, **Production Management:** Types of production systems, Mass production, Batch production, Job order production. Productivity and factors influencing productivity, Facility layout – definition, types – product layout, process layout, fixed position layout, cellular layout, introduction to computerized layout. **Scheduling :** Introduction, concept of assembly line balancing, scheduling of batch production, scheduling of job order, loading, sequencing,- definition, sequencing of n jobs through oe machine, n jobs through 2 machines, (Johnsons' algorithm), sequencing of n jobs through 3 machines, n jobs through m machines. **Forecasting:** Definition, approach, types, Methods – Qualitative methods – Judgmental methods, Quantitative methods – times series, regression, Introduction to aggregate planning, Production planning & control: Introduction, definition, functions of PPC. Brief introduction to: JIT, Lean manufacturing, Six sigma, Supply chain management

Text Books:

1. Introduction to work-study -- ILO.
2. Production & Operations Management -- Adam & Ebert

Reference Books:

1. Production & operations Management – S.N. Chari.
2. Production & operations Management -- Panner selvam.

OPERATIONS RESEARCH

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Identify Optimum solutions for various single objective problems using Linear Programming models	2	4
2	Identify Optimum Solutions through Transportation and Assignment models	2	4
3	Identify Optimum Solutions through Game theory, DPP, Queuing theory & Simulation models	2	4
4	Solve project management problems using CPM, PERT and Crashing	2	4

Syllabus:

Introduction to Operation Research: Introduction, Modelling 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 methods, 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, 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. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

ENGINEERING MANAGEMENT

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Apply various management concepts to solve real life problems	2	4
2	Analyze various Economic Evaluation of alternatives and Depreciation methods	2	4
3	Analyze various quality control techniques for bringing out the best quality output.	2	4
4	Apply various strategies to optimize the Inventory cost	2	4

Syllabus:

General Management: Definition, Functions of management, Principles of management, Types of organization structure- line, functional, line & staff.

Forms of business organization: Salient features of sole proprietorship, partnership, joint stock Company – private limited and public limited company.

Human resource management: definition, functions of HRM, staff role in HRD, Job design, Job evaluation. Motivational theories: Maslow's Hierarchy of needs, Hedsberg two factor theory.

Marketing management: Functions of marketing, channels of distribution, advertising and sales promotion, product life cycle, pricing, market research.

Financial management: Concept of interest: simple interest, compound interest, equivalent cash flow diagrams, present and future worth of a single amount, concept of Annuity – uniform series to present and future worth, differed annuities. Economic evaluation of alternatives: Present worth method, future worth method, annual equivalent method, and internal rate of return method. Depreciation: Definition, types, Common methods – straight line, declining balance, sum of year's digits method.

Materials management: Introduction, Purchasing – definition, objectives, source selection, vendor rating, procurement methods, break-even-analysis.

Quality control: Inspection and types, Quality – SQC, control charts for variables, attributes, application and construction of charts, problems, Acceptance sampling, O.C.curve.

Inventory management: definition, types, various costs associated, selective control techniques – A B C analysis. Concept of EOQ model with constant demand & shortages, EPQ model, make or buy decision analysis, quantity discounts.

Text Books:

1. A.R.Aryasri, Management Science, 2nd Edition, 2005, Tata Mc-Graw Hill.
2. R.K.Gupta & Sashi K.Gupta, Industrial Organization & Management, Kalyani Publishers.

References:

1. William G. Sullivan, James A. Bontadelli, Elin M. Wicks, Engineering Economy, 11th Edition, 2001, Pearson Education Asia.
2. Banga T, Sharma Sc, Industrial Organization & Engineering Economics, 2007, Khanna Publications.
3. Philip Kottler, Marketing Management, 13th Edition, 2008, PHI.

WORK STUDY & ERGONOMICS

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Calculate the basic work content of a specific job for employees of an organization. Thereby they will be able to calculate the production capacity of man power of an	2	4
2	Analyze the existing methods of working for a particular job and develop an improved method through questioning technique by using various recording techniques	2	4
3	Apply ergonomic principles in the workplace or other environment	2	4
4	Apply various plant layout and production systems to optimize productivity.	2	4

Syllabus:

Productivity: Meaning and Importance of Productivity, Factors Affecting Productivity. Productivity and Living Standards, Productivity Measurements, Work Design and Productivity, **Operations Analysis**: Total Time for A Job Or Operation, Total Work Content And In-Effective Time, Methods And Motions, Graphic Tools. **Work Study**: Techniques of Work Study, Basic Procedure of Work Study. METHOD STUDY: Tools for Recording Techniques – Flow Process Chart, Flow Diagram, String Diagram, Multiple Activity Chart, Man-Machine Chart. MICRO MOTION STUDY: Therbligs, Motion Economy Principles, SIMO Chart. **Work Measurement**: Stopwatch Time Study Procedure - Breaking The Job Into Elements, Timing Methods, Number Of Cycles To Be Timed, Rating, Allowances, Setting Standard Time. **WORK SAMPLING**: Confidence Levels, Number Of Observations, Use Of Random Number Table. **Human Factors in Work system Design**: Human Factors Engineering/Ergonomics, Human Performance in Physical Work, Anthropometry, Design of Workstation, Design of Displays and Controls, Job Enrichment, Job Enlargement. **Types of Production Systems**: Mass Production, Batch Production, Job Order Production. Production Planning & Control Functions, **Facility Layout**: Types of Layout - Line Layout for Product

Focused System, Functional Layout for Process Focused System, Fixed Position Layout, Introduction to Computerized Layout Methods, **Material Handling**: Material Handling Objectives And Principles - Unit Load Concept. Factors Affecting Choice of Handling Equipment, Classification of Material Handling

Text Books

1. Introduction to Work study by I.L.O. Geneva.
2. Motion & time study by Barnes, R.M.

Reference Books

1. Industrial Management by Ahuja, vol.1 and 2.
2. Industrial Engineering & Management by Dr. R. Ravisankar

OPERATIONS MANAGEMENT

Mapping of Course Outcomes to Program Outcomes: The students will be able to

CO No:	Course Outcome	PO	BTL
1	Calculate future demand for the product in the market by applying appropriate forecasting technique.	2	4
2	Apply various plant layout and production scheduling techniques to optimize productivity.	2	4
3	Apply various production scheduling techniques to improve productivity.	2	4
4	Analyze various quality control techniques for bringing out the best quality output.	2	4

Syllabus:

Operations Management: definition, historical development, evolution, functions, **Forecasting**: definition, approaches, types, qualitative approach, judgmental methods, quantitative approach, time series, regression, multiple regression, forecasting error estimation techniques, Introduction to aggregate planning, **Production Management**: Types of production systems, Mass production, Batch production, Job order production. Productivity and factors influencing productivity, **Facility layout**: definition, types – product layout, process layout, fixed position layout, cellular layout, introduction to computerized layout, **Material handling**: definition, objectives, principles, unit load concept, factors affecting choice of MH equipment, classification, benefits, **Scheduling**: Introduction, concept of assembly line balancing, scheduling of batch production, scheduling of job order, loading, sequencing,- definition, sequencing of n jobs through one machine, n jobs through 2 machines, (Johnsons' algorithm), sequencing of n jobs through 3 machines, n jobs through m machines. **Inspection & Quality Control**: Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems. **Acceptance sampling**, Single and double sampling, OC curve, **Reliability**: definition, failure rate diagram, reliability computation, **Production planning & control**: Introduction, definition, functions of PPC. **Brief introduction to**: JIT, Lean manufacturing, Six sigma, Supply chain management.

Text Books:

1. Production & Operations Management -- G.J. Monks
2. Production & Operations Management -- Adam & Ebert

Reference Books:

1. Production & operations Management – S.N. Chari.
2. Production & operations Management -- Panner selvam.