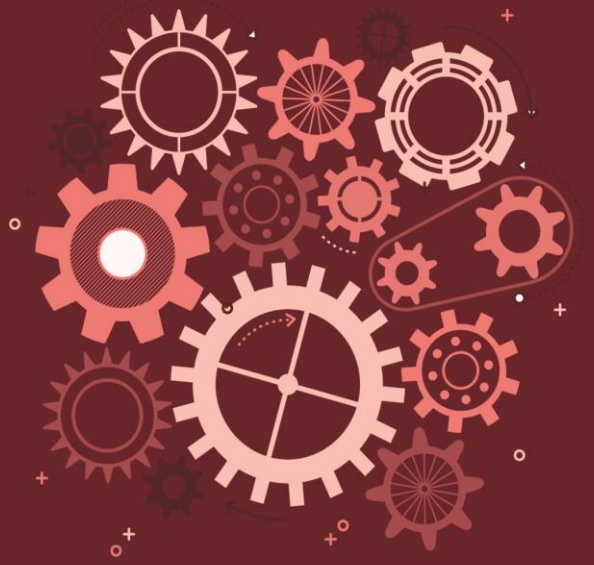
(DEEMED TO BE UNIVERSITY)



MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS

APPLICABLE FOR B.TECH. STUDENTS
ADMITTED IN A.Y. 2017-18

B.Tech Mechanical Engineering 2017-18 Program Structure								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
HUMANITIES & SOCIAL SCIENCES								
1	17EN1201	Building Blocks for Communication Skills	0	0	4	0	2	NIL
2	17EN3102	Instant Communication Skills	0	0	4	0	2	NIL
3	17UC2204	Aptitude Builder – I	0	0	4	0	2	NIL
4	17UC3105	Aptitude Builder – II	0	0	4	0	2	NIL
5	17MB4057	Economics for Engineers	2	0	0	0	2	NIL
6	17GN1001	Ecology And Environment (will be offered Online)	2	0	0	0	2	NIL
7	17UC0010	Universal Human Values & Professional Ethics	0	0	2	0	1	NIL
		Total	**4**	**0**	**18**	**0**	**13**	
AUDIT COURSES								
1	17AC1001	Indian Heritage and Culture	0	0	2	0	0	NIL
2	17AC1002	Indian Constitution	0	0	2	0	0	NIL
3	17AC1003	Environment and Sustainability	2	0	0	0	0	NIL
4	17AC1004	Gender Sensitization	2	0	0	0	0	NIL
		Total	**4**	**0**	**4**	**0**	**0**	
BASIC SCIENCES								
1	17MT1101	Single Variable Calculus and Matrix Algebra	3	0	2	0	4	NIL
2	17MT1102	Foundations of Computational Mathematics	3	0	0	0	3	NIL
3	17MT1203	Multivariate Calculus	3	1	0	0	4	NIL
4	17MT1204	Logic and Reasoning	2	0	0	0	2	NIL
5	17MT2012	Theory of Differential Equations for Engineering and Mechanics	2	0	2	0	3	NIL
6	17PH1001	Engineering Materials	3	0	2	0	4	NIL
7	17CY1001	Engineering Chemistry	3	0	2	0	4	NIL
		Total	**19**	**1**	**8**	**0**	**24**	
ENGINEERING SCIENCES								
1	17CS1101	Problem Solving through Computer Programming	2	2	2	0	5	NIL
2	17GN1204	Coding Skills for Engineers	0	0	10	0	5	17CS1101
3	17ME1001	Engineering Mechanics	3	0	2	0	4	NIL
4	17ME1002	Engineering Graphics and Design	1	0	4	0	3	NIL
5	17ME1003	Workshop Practice	0	0	2	0	1	NIL
6	17ME1104	Introduction to Mechanical Engineering	2	0	2	0	3	NIL
7	17GN1003	Basic Engineering Measurements	2	0	2	0	3	NIL
8	17ME2005	Computational Thinking and Data Sciences	2	0	2	0	3	NIL
9	17ME2206	Numerical Computation for Mechanical Engineers	3	0	2	0	4	NIL
10	17EE2205	Circuits and Electronics	3	0	2	0	4	NIL
		Total	**18**	**2**	**30**	**0**	**35**	
PROFESSIONAL CORE COURSES								
1	17ME2107	Machine drawing	0	0	4	0	2	17ME1002

2	17ME2108	Thermal-Fluids Engineering-I	3	0	2	0	4	NIL
3	17ME2109	Mechanics and Materials-I	3	0	2	0	4	17ME1001
4	17ME2110	Dynamics and Control-I	3	0	2	0	4	17ME1001
5	17ME2211	Dynamics and Control-II	3	0	2	0	4	17ME2110
6	17ME2212	Thermal-Fluids Engineering-II	3	0	2	0	4	17ME2108
7	17ME2213	Mechanics and Materials-II	3	0	2	0	4	17ME2109
8	17ME3114	Design and Manufacturing-I	3	0	2	0	4	17ME2109
9	17ME3115	Engineering Management	3	0	0	0	3	NIL
10	17ME3116	Heat Transfer	3	0	2	0	4	17ME2108
11	17ME3117	Finite Element Analysis of Solids and Fluids	3	0	2	0	4	17ME2108, 17ME2109
12	17ME3118	Introduction to Robotics	3	0	2	0	4	NIL
13	17ME3219	Design and Manufacturing-II	3	0	2	0	4	17ME3114
14	17ME3220	Elements of Mechanical Design	2	0	2	0	3	17ME2213
		Total	**38**	**0**	**28**	**0**	**52**	
TECHNICAL SKILL COURSES								
1	17TS701	Skilling for Engineers-1 (Manufacturing Technologies)	0	0	0	8	2	NIL
2	17TS702	Skilling for Engineers-2 (Artificial Intelligence)	0	0	0	4	1	NIL
3	17TS703	Skilling for Engineers-3 (Problem Solving techniques in Thermal)	0	0	0	4	1	17ME2108
4	17TS704	Skilling for Engineers-4 (Problem Solving techniques in Design)	0	0	0	4	1	17ME2213
5	17TS705	Technical Proficiency & Training-1 (Data Analytics)	0	0	0	4	1	NIL
6	17TS706	Technical Proficiency & Training -2 (Machine Learning)	0	0	0	4	1	NIL
		Total	**0**	**0**	**0**	**28**	**7**	
Counseling & Cocurricular Activities								
1	17GN2103	Counseling -1	0	0	1	0	0	NIL
2	17GN2204	Counseling -2	0	0	1	0	0	NIL
3	17GN3105	Counseling -3	0	0	1	0	0	NIL
4	17GN3206	Counseling -4	0	0	1	0	0	NIL
5	17GN2109	Cocurricular Activity -1	0	0	0	2	0.5	NIL
6	17GN2210	Cocurricular Activity -2	0	0	0	2	0.5	NIL
7	17GN3111	Cocurricular Activity -3	0	0	0	2	0.5	NIL
8	17GN3212	Cocurricular Activity -4	0	0	0	2	0.5	NIL
		Total	**0**	**0**	**4**	**8**	**2**	
PROFESSIONAL ELECTIVES								
1	PE	Professional Elective-1	2	0	2	0	3	NIL
2	PE	Professional Elective-2	2	0	2	0	3	NIL
3	PE	Professional Elective-3	2	0	2	0	3	NIL

4	PE	Professional Elective-4	2	0	2	0	3	NIL
5	PE	Professional Elective-5	2	0	2	0	3	NIL
		Total	**10**	**0**	**10**	**0**	**15**	
OPEN ELECTIVES								
1	OE	Open Elective -1	3	0	0	0	3	NIL
2	OE	Open Elective -2	3	0	0	0	3	NIL
3	OE	Open Elective -3(Foreign Lang.)	3	0	0	0	3	NIL
		Total	**9**	**0**	**0**	**0**	**9**	
PROJECT								
1	17IE2246	Industrial Training	0	0	0	0	2	NIL
2	17IE3247	Term Paper	0	0	4	0	2	NIL
3	17IE4048/ 17IE4050	Project (Part I) / Practice School	0	0	0	24	6	NIL
4	17IE4049/ 17IE4050/ 17IE4051	Project (Part II) / Practice School/ Internship	0	0	0	24	6	NIL
		Total	**0**	**0**	**4**	**48**	**16**	
		GRAND TOTAL	**102**	**3**	**106**	**84**	**173**	

List of Professional Electives							
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Cr**	**Pre-requisite**
Design Specialization							
1	17ME4051	Design of Transmission Elements	2	0	2	3	17ME3220
2	17ME4052	Theory of Elasticity and Plasticity	3	0	0	3	17ME2213
3	17ME4053	Advanced Vibrations and Noise Control	2	0	2	3	17ME2110
4	17ME4054	Computer Aided Design	2	0	2	3	Nil
5	17ME4055	Creep, Fatigue and Fracture Mechanics	3	0	0	3	17ME2213
6	17ME4056	Advanced Strength of Materials	2	0	2	3	17ME2213
7	17ME4057	Mechanics of Composite Materials	2	0	2	3	17ME2213
Strategic Manufacturing Specialization							
8	17ME4061	Modern Manufacturing Processes	2	0	2	3	17ME1003
9	17ME4062	Advanced Materials	3	0	0	3	Nil
10	17ME4063	Additive Manufacturing	2	0	2	3	Nil
11	17ME4064	Tool Engineering and Design	2	0	2	3	17ME3114
12	17ME4065	Flexible Manufacturing Systems	2	0	2	3	17ME3219
13	17ME4066	Geometric Dimensioning and Tolerancing	2	0	2	3	Nil
14	17ME4067	Reverse Engineering and Rapid Prototyping	3	0	0	3	Nil
Automobile Engineering Specialization							
15	17ME4071	Automobile Engineering	2	0	2	3	Nil
16	17ME4072	Automobile Engine Design	2	0	2	3	17ME3220
17	17ME4073	Automotive Transmission	2	0	2	3	Nil
18	17ME4074	Autotronics & Safety	2	0	2	3	Nil
19	17ME4075	Alternative Energy Sources for Automobiles	2	0	2	3	Nil
20	17ME4076	Automotive Electrical and Electronics System	2	0	2	3	Nil
21	17ME4077	Automobile Engine System and Performance	2	0	2	3	Nil

Autotronics Specialization							
22	17ME4081	Automotive Sensor and Applications	2	0	2	3	Nil
23	17ME4082	Autotronics	2	0	2	3	Nil
24	17ME4083	Electronic Engine Management System	2	0	2	3	Nil
25	17ME4084	Instrumentation in Automotive Industries	2	0	2	3	Nil
26	17ME4085	Autotronics and Vehicle Intelligence	2	0	2	3	Nil
27	17ME4086	Automotive Systems	2	0	2	3	Nil
28	17ME4087	Programmable Logic Controller	2	0	2	3	Nil
Robotics and Mechatronics Specialization							
29	17ME4091	Artificial Intelligence for Robotics	2	0	2	3	Nil
30	17ME4092	Automation System Design	2	0	2	3	Nil
31	17ME4093	Industrial Automation and Control	2	0	2	3	Nil
32	17ME4094	Industrial Hydraulic and Pneumatic Systems	2	0	2	3	Nil
33	17ME4095	Industrial Robotics and Material Handling Systems	2	0	2	3	Nil
34	17ME4096	Micro Controllers and PLC	2	0	2	3	Nil
35	17ME4097	Mechatronics System Design	2	0	2	3	Nil
Soft Computing and Data Analytics							
36	17ME4101	Programming Skills	2	0	2	3	Nil
38	17ME4102	Data Analytics	2	0	2	3	Nil
37	17ME4103	Python	2	0	2	3	Nil
39	17ME4104	Machine Learning	2	0	2	3	17ME4102
40	17ME4105	Artificial Intelligence	2	0	2	3	17ME4102
41	17ME4106	Fuzzy Logic and Neural Networks	2	0	2	3	Nil
42	17ME4107	Robotics	2	0	2	3	Nil

List of Open Electives								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	17BT40A1	IPR & Patent Laws	3	0	0	0	3	Nil
2	17CE40A2	Environmental Pollution Control Methods	3	0	0	0	3	Nil
3	17CE40A3	Solid and Hazardous waste management	3	0	0	0	3	Nil
4	17CE40A4	Remote Sensing & GIS	3	0	0	0	3	Nil
5	17CE40A5	Disaster Management	3	0	0	0	3	Nil
6	17CS40A6	Fundamentals of DBMS	3	0	0	0	3	Nil
7	17CS40A7	Fundamentals of Software Engineering	3	0	0	0	3	Nil
8	17CS40A8	Fundamentals of Information Technology	3	0	0	0	3	Nil
9	17EC40A9	Image Processing	3	0	0	0	3	Nil
10	17EM40B1	Linux Programming	3	0	0	0	3	Nil
11	17EM40B2	E-Commerce	3	0	0	0	3	Nil
12	17EE40B3	Renewable Energy Sources	3	0	0	0	3	Nil
13	17ME40B4	Robotics	3	0	0	0	3	Nil
14	17ME40B5	Mechatronics	3	0	0	0	3	Nil
15	17ME40B6	Operations Research	3	0	0	0	3	Nil
16	17PH40B7	Nano Materials & Technology	3	0	0	0	3	Nil
17	17PE40B8	Subsea Engineering	3	0	0	0	3	Nil
18	17PE40B9	Oil and Gas Management	3	0	0	0	3	Nil
19	17GN40C1	Self Development	3	0	0	0	3	Nil
20	17GN40C2	Indian Culture and History	3	0	0	0	3	Nil
21	17GN40C3	Emotional Intelligence	3	0	0	0	3	Nil
22	17GN40C4	Professional Ethics and Values	3	0	0	0	3	Nil
23	17GN40C5	Behavioral Sciences	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	17FL3051	Arabic Language	2	0	0	0	2	Nil
2	17FL3052	Bengali Language	2	0	0	0	2	Nil

3	17FL3053	Chinese Language	2	0	0	0	2	Nil
4	17FL3054	French Language	2	0	0	0	2	Nil
5	17FL3055	German Language	2	0	0	0	2	Nil
6	17FL3056	Hindi Language	2	0	0	0	2	Nil
7	17FL3057	Italian Language	2	0	0	0	2	Nil
8	17FL3058	Japanese Language	2	0	0	0	2	Nil
9	17FL3059	Kannada Language	2	0	0	0	2	Nil
10	17FL3060	Russian Language	2	0	0	0	2	Nil
11	17FL3061	Simhali Language	2	0	0	0	2	Nil
12	17FL3062	Spanish Language	2	0	0	0	2	Nil

List of Management Electives								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	17MB4051	Paradigms in Management thought	3	0	0	0	3	Nil
2	17MB4052	Indian Economy	3	0	0	0	3	Nil
3	17MB4053	Managing Personal Finances	3	0	0	0	3	Nil
4	17MB4054	Basics of Marketing for Engineers	3	0	0	0	3	Nil
5	17MB4055	Organization Management	3	0	0	0	3	Nil
6	17MB4056	Resources Safety and Quality Management	3	0	0	0	3	Nil
7	17MB4057	Economics for Engineers	3	0	0	0	3	Nil

List of Honor Degree Courses								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	17ME5001	Advanced Heat and Mass Transfer	3	0	2	0	4	17ME3116
2	17ME5002	Computational Fluid Dynamics	3	0	2	0	4	17ME2108
3	17ME5003	Incompressible and Compressible flows	3	0	2	0	4	17ME2108
4	17ME5004	Mechanisms Design and Simulation	3	0	2	0	4	Nil
5	17ME5005	Advanced Mechanics of Solids	3	0	2	0	4	17ME2213

Minor in Industrial Engineering								
List of Minor Degree Courses								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	17ME3121	Industrial Engineering Techniques	3	0	2	0	4	Nil
2	17ME3122	Operations Research	3	0	2	0	4	Nil
3	17ME3123	Engineering Management	3	0	2	0	4	Nil
4	17ME3124	Work Study and Ergonomics	3	0	2	0	4	Nil
5	17ME3125	Operations Management	3	0	2	0	4	Nil

HUMANITIES &
SOCIAL SCIENCES

BUILDING BLOCKS FOR COMMUNICATION SKILLS

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

CO No:	CO	PO	BTL
1	Improve pronunciation skills and understand the method of identifying antonyms.	10	2
2	Apply writing strategies for office/ formal communication	10	3
3	Analyze types of reading techniques and improve reading speed.	10	4
4	Analyze different cultures and the importance of empathy in cross-cultural communication.	8	4

Syllabus:

Listening & Speaking Skills: Phonetics symbols- practice- Exercises - Pronunciation- Reading Cum Speaking Practice: Enunciation- Homonyms- Homophones- Homographs: Vocabulary- Root words- Affixes- Identifying meaning from context- Synonyms & Antonyms: Word building: Escatalk**: Speaking** to persuade: Pyramid Discussion**:** Story-Telling and interpretation: End story: Speaking to Explain: Tell me why?

General Writing Skills: Clarity and conciseness in writing: Paragraph Writing: Identifying Topic sentences, writing topic sentence: Linkers, Coordinates:Letter Writing & E- Mail Writing:Netiquette

Reading Skills: Reading comprehension Practice Exercises: Reading for information: Reading for specifics --- theme, attitude: Types of Reading: Vertical Reading: Identifying the central idea**:** Speed Reading --- seven techniques to improve reading speed

Soft Skills: Introduction to soft skills: Verbal and Non-verbal communication: Cultural sensitivity: Empathy and understanding: Diversity and Acculturation

Reference Books:

1. English pronunciation in use: Intermediate, 2nd edition, Mark Hancock and Sylvie Donna, Cambridge publication.
2. Speaking English Effective (English) 2nd Edition, Krishna Mohan & N P Singh, Laxmi Publications-New Delhi, 2005 print.
3. The Ace of Soft Skills, Mr. Gopalaswamy Ramesh et al, Pearson publishers, 2010 print.
4. Effective speech, Richard W.Clark, Glencoe Pub. Co., 1988 Print.
5. Effective Business Communication, Asha Kaul, PHI Learning Private Limited, New Delhi,2011

INSTANT COMMUNICATION SKILLS

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

CO No	Course Outcome	PO	BTL
1	Analyse the concept of Group Discussion and speak effectively during the discussion.	10	**4**
2	Apply and analyze various concepts of writing strategies in professional communication skills like, reports, proposals and minutes of the meeting.	10	**3**
3	Analyse vocabulary and apply the types of reasoning in comprehending the information.	10	**4**
4	Apply the mechanics and application of presentation skills and apply people skills in various social organizational and corporate ambiences.	10	**3**

Syllabus:

Speaking & Listening Skills: Group Discussions: Know yourself as a Communicator**:** Communicating with others**:** Format of GD as used in national level recruitment boards**:** Rules, ambience and normal practices**:** Do s and Don't s in Group Discussions: Helping to build confidence, improve on content and clarity**:** Practicing skills like Initiating, developing and concluding discussions

Structures and Written Expression: Sentence Completion: Writing Proposals: Product and process description: Agenda, Minutes and Scheduling meetings: Technical Writing Skills: Report Writing: Types of reports, Formats and how to write good reports.

Reading Skills: Reasoning Skills: Analytical Reasoning: Critical Reasoning: Language Specific Reasoning: Vocabulary in context: Signpost words: Pejorative Signals and Complimentary Signals: Continuation Signals: Contrast signals: Sentence Completion: Text completion: Sentence Equivalence.

Soft Skills: Seminars & Presentations: People Skills: Initiating and ending conversations: Expressing and creating interest: Initiating and ending conversations: Breaking good/bad news

Text Books:

1. Professional Communication, Aruna Koneru, Tata Mc Graw- Hill Publishing Company, New Delhi, 2008 Print.
2. Technical Writing Process and Product (third edition), Sharon J. Gerson, Steven M Gerson, Pearson Education, Asia.

Reference Books:

1. Developing Reading Skills: A Practical Guide to Reading Comprehension Exercises, Frangoise Grelle.Cambridge University Press, 1981.
2. Study Reading: A Course in Reading Skills for Academic Purposes, Eric H. Glendinning, Beverly Holmström, Cambridge University Press, 2004.
3. Reasoning and Reading Level 1, Joanne Carlisle, School Specialty Intervention, 1999Presentation skills.

4. The essential guide for students, Patsy Mc Carthy & Caroline Hatcher, Sage publications, 2002.
5. Business Communication : Connecting in a Digital World, Raymond V.Leisikar, Marie. E. Flatley et al. Mc Graw Hill Education, 13 Edition, 2015 print.

APTITUDE BUILDER –I

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

CO No	Course outcome's	PO No	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.	5, 6	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.	7, 10	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.	1, 5	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.	1, 5	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

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

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.	8, 10	3
2	Analyse the concepts of critical and analytical reading skills. Apply the strategies and techniques learnt in handling interviews in different contexts.	8, 10	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.	1, 5	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.	1	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.

ECONOMICS FOR ENGINEERS

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

CO No	Course outcome	PO	BTL
1	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio	11	4
2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions	11	4
3	Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value	11	4
4	Apply all mathematical approach models covered in solving engineering economics problems	11	4

Syllabus:

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

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

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

Unit IV: Replacement and Maintenance Analysis: Introduction-Types of maintenance – types of replacement Problem-Determination of economic life of an asset-Replacement of existing asset with a new asset. Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction.

Text Books:

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

Reference Books:

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

ECOLOGY AND ENVIRONMENT

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

CO No:	Course Outcome	PO	BTL
1	Understand the importance of Environmental education and conservation of natural resources.	6	2
2	Understand the importance of ecosystems and biodiversity.	12	2
3	Apply the environmental science knowledge on solid waste management, disaster management and EIA process.	6	3

Syllabus:

The Multidisciplinary nature of Environmental Studies - Introduction to Environment, definition,scope,importance,Multidisciplinary nature of Environmental Studies, Need for public awareness. Institutions and people in Environment.**Natural Resources**- Renewable and Non Renewable Resources **Forest resources** - Benifits,Deforestation,causes, effects and impacts, Afforestation programmes, Socio-forestry, Agro-forestry, Vanasamrakshana programmes, **Mining its impact on environment** - mining, dams and their effects on forests and tribal people. **Water resources**- Distribution of surface and ground water, Aquifers, floods, drought, conflicts over water, dams, benefits and problems, Water conservation, rain water harvesting, watershed management, Cloud seeding **Mineral resources**- Use, exploitation, environmental effects. **Food resources**- Changes in agricultural methodologies, comparison between old and new methods of farming, Green Revolution, Environmental

Impact Assessment of conversion of agricultural lands, effects of modern agriculture, Drip Irrigation, fertilizer, pesticide problems, Eutrophication, Vermicompost, water logging, Blue baby syndrome. **Energy resources** - Growing energy needs, renewable and non-renewable energy sources. **Land resources**-.**Soil erosion**- Importance of soil, Types of soil erosion, Causes and effects of soil erosion.How to control soil erosion.Role of an individual in conservation of natural resources.**Ecosystems -** Concept of an ecosystem, Structure and function of an ecosystem, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Types of ecosystem.**Biodiversity and its Conservation**-Introduction, Definition, Levels, Values of biodiversity, India as a mega diversity nation.Hotspots of biodiversity.Threats to biodiversity- Endangered and endemic species of India.Conservation of biodiversity- Assessment of Biodiversity and its impact on Environment.**Environnemental Pollution-** Définition, Causes, effects, control measures of Air pollution, Water pollution, oïl pollution, Marine pollution, Noise pollution, Thermal pollution,Nuclear hazards. **Soil waste management**.**Electronic waste management**, **Biomedical waste management -** Role of an individual in prevention of pollution. **Disaster management**–.Climate change, global warming, acid rain, ozone layer depletion. **Environmental Legislation** and objectives of Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife protection Act, Forest conservation Act, Biodiversity Act, Public awareness. **Environmental Impact Assessment Process.**

Text Book:

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

Mapping of Course Outcomes (CO) to Program outcomes:

CO No.	Course Outcome	PO	BTL
1	Understand and identify the basic aspiration of human beings	8	2
2	Envisage the roadmap to fulfill the basic aspiration of human beings.	8	4
3	Analyze the profession and his role in this existence.	8	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.

AUDIT

COURSES

INDIAN HERITAGE AND CULTURE

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

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.

Text Books:

1. The Cultural Heritage of India, Vol. 1 To 7, Priyadaranjan Ray & S. N. Sen, The Ramakrishna Mission Institute of Culture, Calcutta.
2. Cultural History of India, Om Prakash, New Age International publishers.
3. Cultural History of India, AL Basham, Oxford India.

INDIAN CONSTITUTION

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

CO No.	Course outcome	PO	BTL
1	To understand Constitutional development after Independence	12	2
2	To learn the fundamental features of the Indian Constitution	12	2
3	To get a brief idea of the powers and functions of Union and State Governments	12	2
4	To understand the basics of working of Indian Judiciary and the Election Commission	12	2

Syllabus:

Making of the Constitution: A brief analysis of National Movement – Constitutional Development with reference to Government of India Act 1909, 1919, 1935 – 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

ENVIRONMENT AND SUSTAINABILITY

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

CO No.	Course outcome	PO	BTL
1	Able to think critically about the environmental, societal, and economic impacts of human activities and systems	7	2
2	Familiar with emissions quantification methods and sustainability reporting tools, including certification programs for individuals and businesses	7	2
3	Understand about various Cross-Disciplinary Considerations	7	2
4	Learn various strategies for service organizations to decrease their environmental footprint and to market those activities to meet the demands of an emerging consumer base.	7	2

Syllabus:

The Environmental Movement & the Services Provided by Nature.

Specific Environmental Concerns of Today: Climate change, Air pollution, Water pollution, Waste, Human health, Diversity of life.

Human Infrastructure Systems and their Impacts.

Sustainability Measurement and Reporting Tools: ISO standards, Life Cycle Assessments and Environmental Product Declarations, Certification programs for your organization and you.

Cross-Disciplinary Considerations: Environmental justice, Global supply chains, Misaligned/Misguided environmental policies.

Strategies for Environmental Sustainability in Organizations.

Sustainability in Policy

Reference Books:

1. The Sustainability Edge – how to drive top-line growth with triple-bottom-line thinking. Apte & Sheth. 2016. University of Toronto Press.
2. Fostering Sustainable Behavior- an introduction to community-based social marketing. McKenzie-Mohr. 2015. New Society Publishers.
3. The Responsible Company – what we've learned from Patagonia's first 40 years. Chouinard & Stanley. 2012. Patagonia Books.

GENDER SENSITIZATION

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

CO No.	Course outcome	PO	BTL
1	Students will have developed a better understanding of important issues related to gender in contemporary India	7	2
2	Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials	7	2
3	Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.	7	2
4	Students will acquire insight into the gendered division of labour and its relation to politics and economics.	7	2

Syllabus:

UNDERSTANDING GENDER:

Socialization: Making Women, Making Men, Preparing for Womanhood, Growing up Male, First lessons in Caste, Different Masculinities.

GENDER AND BIOLOGY:

Missing Women: Sex Selection and Its Consequences, Declining Sex Ratio. Demographic Consequences. Gender Spectrum: Beyond the Binary Two or Many? Struggles with Discrimination.

GENDER AND LABOUR:

Housework: the Invisible Labour, Women's work: Its politics and Economics, Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

ISSUES OF VIOLENCE:

Sexual Harassment: Say No! Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment, Domestic Violence: Speaking Out, Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice. Thinking about Sexual Violence.

Text Books:

1. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote,Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu "Towards A World of Equals A Bilingual Textbook on Gender", Telugu Akademi, Hyderabad, 2015

Reference Books:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012

BASIC SCIENCES

SINGLE VARIABLE CALCULUSAND MATRIX ALGEBRA

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

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.	1	4
2	Model physical laws and relations mathematically as second/higher order differential equations, solve by analytical method and interpret the solution.	1	4
3	Obtain the Fourier series expansions of periodic functions and use the series to solve ordinary differential equations.	1	4
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.	1	4
5	Verify the solution of problems through MATLAB.	5	4

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

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

CO No	Course out come	PO	BTL
1	Evaluate mathematical expressions by using different types of operations on numbers.	1	4
2	Simplify expressions and solve equations & inequations.	1	4
3	Apply different types of arithmetic expressions to solve given problems.	1	4
4	Apply methods to find areas, volumes and use graphs to reduce non-linear to linear forms.	1	4

Syllabus:

Numbers: Bodmas Rule, Fractions & Decimals, Classification of numbers, Divisibility rules, factorization, Division & Successive division, Remainders in divisions involving higher powers, LCM and HCF and Number systems.

Algebra: Powers, roots and Indices, Venn diagrams, Surds, Logarithms, Quadratic Equations & Inequalities, Progressions, Simple Equations. Transposing formulae and solving simultaneous equations.

Arithmetic: Ratios, Proportion, Variation, Percentages, Profit & Loss, Simple & Compound Interest, Averages, Mixtures and Allegations,Time and Distance, Time and Work, Clocks, Calendars and Blood relations

Geometry and Mensuration: Lines & angles, triangles, quadrilaterals, polygons, circles, surface areas, volumes of 3D figures, graphs reducing non-linear laws to linear form and graphs of exponential functions.

Text Books:

1. Basic Engineering Mathematics**,** John Bird, Fourth Edition, Elsevier.

Reference Books:

1. Quantitative Aptitude, R. S. Aggarwal, Schand Publications.
2. Quantitative Aptitude - G. L. Barrons.
3. Quantitative Aptitude - Abhijit Guha, Mc Graw Hills.

MULTIVARIATE CALCULUS

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

CO No	Course out come	PO	BTL
1	Determine extreme values for functions of several variables	1	4
2	Determine area, volume moment of inertia through multiple integrals in Cartesian or polar co ordinates.	1	4
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	1	4
4	Obtain analytical and numerical solutions of Heat and wave equations	1	4
5	Verify the solution of problems through MATLAB	5	4

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, New York .
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

LOGIC AND REASONING

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

CO No	Course Outcome (CO)	PO	BTL
1	Apply the fundamental principle of counting and use them to measure the uncertainty in random experiments.	1	4
2	Apply Venn diagrams to find the conclusion of statements, solve puzzles using binary logic and problems relating to cubes.	1	4
3	Apply the available models for Data sufficiency & redundancy and interpret it , when given, in tabular and graphical forms.	1	4
4	Apply the Reasoning techniques to solve problems on arrangements, series, analogies, coding and decoding.	1	4

Syllabus:

Permutation and Combinations : Fundamental Principle of Counting, Counting Methods, Definition of permutation, Linear Permutations, Rank of a word, Circular Permutations, Definition of Combinations, Problems on Combinations

Probability: Definitions of Probability, Addition and Multiplication Theorems.

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

Logical Connectives: Definition of simple statement, Definition of compound statement, Finding the implications for compound statements, Finding the negations for compound statements.

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

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, Problems on cuboids, Problems on painted cuboids, Problems on Dice.

Data Sufficiency: Different models in Data Sufficiency, Problems on Data sufficiency, Problems on data redundancy.

Data Interpretation : Problems on tabular form, Problems on Line Graphs, Problems on Bar Graphs, Problems on Pie Charts.

Analytical Reasoning puzzles: Problems on Linear arrangement, Problems on Circular arrangement, Problems on Double line-up, Problems on Selections, Problems on Comparisons.

Number and letter series: Difference series, Product series, Squares series, Cubes series, Alternate series, Combination series, Miscellaneous series, Place values of letters.

Number and Letter Analogies: Definition of Analogy, Problems on number analogy, Problems on letter analogy, Problems on verbal analogy.

Odd man out: Problems on number Odd man out, Problems on letter Odd man out, Problems on verbal Odd man out.

Coding and decoding: Coding using same set of letters, Coding using different set of letters, Coding into a number

Comparison & Elimination

Text Books:

1. A modern approach to Logical reasoning, R S Agarwal, S. Chand Publications.

Reference Books:

1. Logical Reasoning, Arun Sharma, Mc Graw Hill.
2. Analytical & Logical Reasoning, Peeyush Bhardwaj, Arihant Publications.

THEORY OF DIFFERENTIAL EQUATIONS IN ENGINEERING AND MECHANICS

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

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.	1	3
2	Model and solve free and forced vibrations of a two- degree-of-freedom system through system of linear differential equations.	1	3
3	Obtain canonical forms of linear second order PDEs and Demonstrate the nature of the incompressible fluid flow using Euler and Bernoulli equations.	1	3
4	Identify the heat and wave equations in different forms, obtain their responses and develop empirical relations.	1	3
5	Determine the response of mechanical vibrating systems and heat equations which are modelled by ordinary or partial differential equations using MATLAB.	11	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", 10th 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)

ENGINEERING MATERIALS

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

CO No	Course out come	PO	BTL
1	Understands structure of crystalline solids, kinds of crystal imperfections and appreciates structure-property relationship in crystals.	1	2
2	Understands magnetic properties of materials and identifies their role in classification soft & hard magnetic materials having specific engineering applications.	1	2
3	Understands thermal and mechanical properties of materials, heat treatment methods for changing the microstructure of materials and responses of materials subjected to load.	1	2
4	Understands the role of electronic energy band structures of solids in governing various electrical and optical properties of materials.	1	2
5	Apply the knowledge on structure and properties of materials while executing experiments and develop inter disciplinary projects.	4	3

Syllabus:

Crystallography: Bonding in materials, Space lattice, basis, unit cell, Seven Crystal systems, Bravais lattice system, Reciprocal lattice, Crystal directions, Miller Indices, problems, Diffraction of Crystals, Bragg's Law, XRD, Laue, Rotating Crystal and powder XRD Techniques, Problems.

Crystal Imperfections: Point Defects, Line Defects, Surface Defects, Volume Defects, and Effects of Defects on Crystalline Properties.

Magnetic properties: Origin of Magnetic Moment, Dia, Para, Ferro, Antiferro and Ferri Magnetism, Domain theory and Hysteresis Effect of Ferro and Ferri Magnetism, Soft and Hard Magnetic Materials.

Thermal properties: Iron-Carbon Diagram, Heat capacity, Thermal Expansion and Thermal Conductivity in Metals, Ceramics and Polymers, Heat treatment of Materials, Hardening, Tempering, Quenching and Nitriding.

Mechanical Properties: Stress, Strain, Hooke's Law, Elasticity, Plasticity, Creep, Ductility, Brittle, Hardness, Strength, Modulus of Elasticity, Fracture, Fatigue, Stress- Strain Behavior of Ductile and Brittle Materials, Hardness Tests- Vickers, Rockwell and Brinell.

Electrical Properties: Energy band theory, Band structures in Conductors, Semi conductors and Insulators, Electrical properties of conductors- Ohms, Mathiessen rule, conductivity, Mobility, Electrical properties of Semi conductors, Factors effecting the carrier concentration, Conductivity and Mobility of charge carriers. Electric properties of Insulator- Dielectrics- Types of Dielectrics, Dielectric Constant, Polarization, Types of Polarizations, Frequency Dependence of Polarization, Ferro, Piezo Electrics.

Optical properties: Optical reflectance, Optical Absorption, snell's law, Total Internal reflection in optical fibers.

Text books:

1. William D. Callister,Jr. "Materials Science and Engineering: An Introduction" 6th edition, 2007, Wiley India Pvt.Ltd.
2. Charles Kittel, "Introduction to Solid State Physics" 8th edition, 2012, Wiley India Pvt.Ltd.

Reference Books:

1. Adrianus J. Dekker, "*Solid State Physics"* 1st Edition *2002*, Macmillan India Ltd.
2. S. O. Pillai, "Solid state physics" Revised 6th edition, New Age International Publishers.
3. Rangwala, Engineering Materials (Material Science)**,** Charotar Publishing House PVT. LTD.

ENGINEERING CHEMISTRY

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

CO No	Course out come	PO	BTL
1	Predict potential complications from combining various chemicals or metals in an engineering setting	3,4	4
2	Discuss fundamental aspects of electrochemistry and materials science relevant to corrosion phenomena	3, 4	4
3	Examine water quality and select appropriate purification technique for intended problem	3, 4	4
4	Apply polymers, conducting polymers ,green chemistry and nano chemistry to engineering processes	3	4
5	An ability to analyze & generate experimental skills	3, 4	4

Syllabus:

ELECTRO CHEMISTRY*:* Single electrode potential and its measurement, Electrochemical cells, EMF series, Nernst equation, Cell emf measurement, Reversible and irreversible cells, Concentration cells, Reference electrodes--Determination of pH using glass electrode. **Storage devices :**Chemistry, construction and engineering aspects of Primary (mercury battery) and secondary (lead-Acid cell, Ni-Metal hydride cell, Lithium cells) and fuel cells– Hydrogen–Oxygen fuel cell, advantages of fuel cell. , **Fuels–** Types of fuels, Calorific value, Determination of Calorific value; **CORROSION & ITS CONTROL:**Causes and different types of corrosion and effects of corrosion. Theories of corrosion– Chemical, Electrochemical corrosion, Pitting corrosion, stress corrosion, Galvanic corrosion.Factors affecting corrosion– Nature of metal, galvanic series, over voltage, purity of metal, nature of oxide film, nature of corrosion product. Nature of environment- effect of temperature, effect of pH, Humidity, effect of oxidant. Cathodic protection, sacrificial anode, impressed current cathode, electroplating; ***METAL ALLOYS:*** Types of Alloys- ferrous and nonferrous alloys, Carbon steel, Alloy steel, Alloys of Cu, Al, Pb.**PHASE RULE:** phase rule applications to one and multiple component systems phase diagram. **WATER Technology**: Introduction, *Hardness:*Causes, expression of hardness – units – types of hardness, estimation of temporary and permanent hardness of water, numerical problems. Alkalinity and estimation of alkalinity of water, numerical problems.***Boiler troubles*** – Scale & sludge formation, caustic embrittlement, Boiler corrosion, priming & foaming. ***Softening of water***: Internal and external treatments -Lime soda, Ion exchange process. ***Desalination***-reverse osmosis and electro dialysis.**POLYMERS AND PLASTICS: Basic concepts of polymers**-Types of polymerization-Plastics – Thermoplastic resins and Thermosetting resins - Compounding of plastics – Fabrication of plastics. Preparation, properties and engineering applications of: polyethylene, PVC, Teflon, Bakelite, Urea Formaldehyde. **Conducting Polymers**: Polyacetylene,polyaniline, conduction, doping and applications. **Polymer composites:** Physico Chemical properties of polymer composites and Applications.**NANO TECHNOLOGY:** Introduction, Fullerenes, Carbon nanotubes, Nanowires; properties; Synthesis of nanomaterials; Topdown & bottom up approach; Applications of nanomaterials.**GREEN CHEMISTRY: Introduction,** Green technology- Latest green

laboratory technology for saving experimental resources and infrastructural framework; R4M4 (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking;) model with special reference of survismeter, econoburette.

Text books:

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

Reference Books:

1. ChemistryinEngineeringandTechnology,Volume2,JCKuriacose&JRajaram,TataMcGra wHill,NewDelhi.
2. Chemistry for Engineers,Dr Rajesh Agnihotri, Wiley, NewDelhi.
3. EngineeringChemistry,B.Sivasankar,TheTataMcGrawHill,NewDelhi.
4. AtextbookofEngineeringChemistry,ShashiChawla,DhanpatRai&Co.NewDelhi.
5. Engineering Chemistry, C Parameswara Murthy, C V Agarwal and Andra Naidu, B S Publications,Hyderabad.
6. Engineering Chemistry, Shikha Agarwal, Cambridge University Press.

LIST OF EXPERIMENTS:

1. Total Hardness of Water; Determination of carbonate and non carbonate hardness of water sample
2. Determination of Alkalinity of water sample
3. Chloride Content in Water; Residual Chlorine in Tap water
4. Determination of Dissolved oxygen
5. Potentiometry
6. Conductometry
7. P^H Metry
8. Rate of Corrosion
9. Estimation of iron by redox titration
10. Saponification value of oil
11. Preparation of Urea-Formaldehyde and Bakelite resins
12. Determination of Viscosity of polymer solution using survismeter
13. Flash Point by Pensky-Marten`s Apparatus
14. Green Tech titration for experimental resource saving in analytical lab using econo burette

ENGINEERING SCIENCES

PROBLEM SOLVING AND COMPUTER PROGRAMMING

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

CO No	Course Outcome	PO	BTL
1	Illustrate how problems are solved using computers and programming.	1, 2	4
2	Illustrate and use Control Flow Statements in C.	1, 2	4
3	Interpret & Illustrate user defined C functions and different operations on list of data.	1, 2	4
4	Implement Linear Data Structures and compare them.	4	4
5	Apply the knowledge obtained by the course to solve real world problems.	1, 2, 4	4

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, Introduction to **Trees**- Binary tree, Definition, Terminology.

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 Datastructures 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.

CODING SKILLS FOR ENGINEERS

Mapping of Course Outcomes (CO) to Program Outcomes:

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

INTRODUCTION TO MECHANICAL ENGINEERING

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

CO No	Course out come	PO	BTL
1	Possess basic understanding and knowledge about the scope, current and future trends in mechanical engineering	1, 5	2
2	Understand concept of Engineering design and stages in product design cycle	1, 5	2

Course Objective:

This course introduces students to mechanical engineering and its sub-domains including engineering Design. Students are expected to learn about scope, current and future trends, jobs, innovations & research opportunities in the field of mechanical engineering. Course content will be covered through lectures, assignments, case-studies, presentations, documentaries and field visits.

Syllabus:

What is Engineering, Who are Mechanical Engineers, Overview of Mechanical Engineering, its domains, scope and its utility in different areas; Specializations available with in mechanical Engineering and job opportunities in mechanical Engineering. Career Paths, skills and knowledge that are required to be a Mechanical Engineer; Typical Program of Study.

Brief treatment of **Measurements, Units, andConversions**

Introduction to engineering Design process: Its importance, types of designs, various ways to think about design like visualization, photography etc, simplified iteration model, design versus scientific method, a problem solving methodology.
Considerations of a good design Achievement of performance requirements, Total life cycle, Regulatory and social issues in Indian context

Description of Design Process Conceptual Design, Embodiment Design, Detail Design, Planning for Manufacture, Planning for distribution, Planning for Use, Planning for the retirement of the product.

Product Design Cycle, Identification of customer needs and market research essentials, concept generation, technology and market assessment

An exposure to various aspects of design including visual, creative and user-centric design (Visual merchandising, trends, materials, technology and techniques). Evolution in Transportation and Communication Technology, Bullock Cart to Lear Jets, Personal messengers to Cell Phones, Fighter planes.
Case study on any topic from Manufacturing Engineering Magazine Published by Society of Manufacturing Engineers (USA), Machinist Magazine, Technorama published by Institution of Engineers (India) and Manufacturing Today and any other magazine related to mechanical engineering.

Overview of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Society of Automotive Engineers, American Society of Mechanical Engineers (ASME); Indian Society of Mechanical Engineers (ISME) etc; Emerging areas and new technologies in the field of mechanical engineering (3D Printing)

Evaluation:
Evaluation will be continuous an integral part of the class only through internal assessment

References:

1. Jonathan Wickert, Kemper Lewis, An Introduction to Mechanical Engineering, CENGAGE Learning.
2. Michael Clifford, Kathy Simmons, Philip Shipway, An Introduction to Mechanical Engineering: Part 1 and Part 2, Taylor and Francis
3. George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw Hill Education (India) Pvt. Ltd.
4. Arvid Eide, Introduction to Engineering Design, McGraw Hill.
5. Otto. K and Wood, K, Product Design, Pearson Education

ENGINEERING MECHANICS

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

CO No	Course Outcome	PO	BTL
1	Understand the concept of forces and apply the static equilibrium equations.	1,2	4
2	Analyze co-planar and non co-planar system of forces.	1,2	4
3	Apply the concept of centroid & centre of gravity to determine moment of inertia.	1,2	4
4	Analyze the rigid bodies under translation and rotation with and without considering forces.	2	4
5	Understand and analyze the engineering systems with the help of mechanics concept to solve the engineering problems.	4	4

Syllabus:

STATICS:

Two Dimensional Force systems- Introduction, Basic concepts, Laws of motion, Principle of Transmissibility of forces, Resultant of a force system, force laws, Resultant of two dimensional concurrent and Non-concurrent Force systems, Free body diagrams, Applications.

Equilibrium of Rigid bodies–Equilibrium and Equations of Equilibrium, Lame's theorem,Type of supports and their reactions**,** Moments and couples, Varignon's theorem, Resultant moment and applications.

SPATIAL FORCE SYSTEMS AND TRUSSES

Spatial force systems – Forces in space, resultant and equilibrium of spatial force system.

Truss Analysis-Trusses-Assumptions involved in the Method of joints and sections.

FRICTION AND PROPERTIES OF AREAS

Friction: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Applications-ladder friction, wedge friction.

Centriod and Moment of Inertia: Centroids, centre of gravity, Moment of inertia- Area and Mass- polar moment of inertia, Parallel axis theorem.

DYNAMICS

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

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

Text Books:

2. Engineering Mechanics (in SI Units) / S. Timoshenko, D. H. Young, J.V. Rao/ Tata McGraw Hill.

Reference Books:

2. Engineering Mechanics / S. S. Bhavikatti/ New Age.
3. Vector Mechanics for Engineers -Statics &Dynamics / F.P. Beer and E.R. Johnston/ Tata McGraw Hill.
4. Engineering Mechanics-Statics and Dynamics by R. C. Hibbler, Prentice.
5. Engineering Mechanics- NH Dubey/ New Age

LIST OF EXPERIMENTS

1. Calculation of Moment of Force using weight balancing technique.
2. Determination of angle of deflection due to eccentric loading on T bar
3. Determination of Centroid for Plane laminas of straight edges
4. Determination of Centroid for Plane laminas of curved edges
5. Determination of axial forces in Trapezoidal Truss
6. Determination of axial forces in Triangular Truss
7. Understanding vectors and vector quantities
8. Calculation of Moment of Force using weight balancing technique and system of pulleys.
9. Verification of Lamie's Theorem
10. Determination of coefficient of static friction between two surfaces.
11. Determination of motion parameters using work-energy principle
12. Determination of moment of inertia of a flywheel.

ENGINEERING GRAPHICS AND DESIGN

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

CO NO	Course Outcome	PO	B T L
1	Understand the principles of drawing and use of drafting instruments	1, 10, 12	4
2	Draw engineering curves and scales.	1, 10, 12	4
3	Draw the projections of points, lines, planes and solids	1, 10, 12	4
4	Draw the surface sheath of solids by development of surfaces and the sections of Solids.	1, 10, 12	4
5	Prepare 2D & 3D drawings of solids and their transformations.	1, 10, 12	4

Syllabus:

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance- Drawing Instruments and their Use - Conventions in Drawing -Lettering - BIS Conventions.

Geometrical Constructions-Divion of Lines, Angles, Polygons

Engineering Curves used in Engineering Practice & their Constructions:

Conic Sections: Ellipse, Parabola, Hyperbola and Rectangular Hyperbola – Gneral and other methods.

Special Curves: Cycloid, Epicycloid, Hypocycloid and Involute.

Scales: Different types of Scales, Plane scales comparative scales, scales of chords.

Orthographic Projection In First Angle Projection: Principles of Orthographic Projections - Conventions - First and Third Angle, Projections of Points and Lines inclined to both planes, True lengths, traces .

Projections Of Planes & Solids: Projections of regular Planes, auxiliary planes and Auxiliary projection inclined to both planes. Projections of Regular Solids inclined to both planes - Auxiliary Views

Sections and Sectional Views:-Right Regular Solids - Prism, Cylinder, Pyramid, Cone – Auxiliary views.

Development Solids: Development of Surfaces of Right, Regular Solids -Prisms, Cylinder, Pyramid Cone and their parts.

Isometric Projections: Principles of Isometric Projection - Isometric Scale - Isometric ViewsConventions - Isometric Views of Lines, Plane Figures, Simple and Compound Solids - Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts

Transformation of Projections: Conversion of Isometric Views to Orthographic Views - Conventions

Text Books:

1. Engineering Drawing, N.D. Bhat / Charotar

Reference Books:

1. Engineering Drawing and Graphics, Venugopal / New age
2. Engineering Drawing, Narayana and Kannaiah / Scitech publishers

WORKSHOP PRACTICE

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

CO No	Course Outcome	PO	BTL
1	Prepare the different joints using carpentary trade by using wood as raw material	5	4
2	Prepare the different fits using fitting trade with Ms plates as raw material	5	4
3	Prepare the different components using Tinsmithy trade by using GI sheet as raw material	5	4
4	Apply basic electrical engineering knowledge for house wiring practice.	5	4
5	Install operating system in CPU and Assemble & Disassemble the CPU	5	4

CARPENTRY : Hands on practice on wood working operation using hand tools

FITTING : Hands on practice on preparing fits.

TIN SMITHY : Hands on practice on sheet metal working.

HOUSE WIRING: Hands on practice on House wiring connections Electrical

IT WORKSHOP : Identify the peripherals of a computer components inCPU and its functions

TRADES FOR DEMONSTRATION
1) Demonstration on drilling machine, power hacksaw machine, griding machine.
2) Demonstration on welding machine.

Text Books:

1. P.Kannaiah and K. L. Narayana "Engineering Practices Laboratory",2009,SciTech Publications, Chennai
2. Anfinson, David and Ken Quamme(2008), IT Essentials PC Hard ware and Soft ware Companion Guide, CISCO Press, Pearson Education

Reference Books:

1. K. Venkata Reddy, "Workshop Practice Manual", Sixth edition, 2011 print, BS Publications, Hyderabad.
2. B S Nagendra Parashar and R K Mittal, "Elements of Manufacturing Process", 2010 print, Prentice Hall of India, New Delhi
3. Gupta , Vikas (2010),Comdex Information Technology Course Tool Kit – WILEY Dream tech

LIST OF EXPERIMENTS:

A. WORKSHOP PRACTICE

1. Preparation of lap tee joint using Carpentary trade
2. Preparation of Martise and Tenon joint using Carpentarytrade
3. Preparation of square fit using fitting trade
4. Preparation of l –fit using fitting trade
5. Preparation of rectangular tray using Tinsmithy trade
6. Preparation of pipe- t- joint using Tinsmithy trade
7. Preparation of stair case connection using house wiring trade
8. Preparation of Godown connection using house wiring trade
9. Disassemble and assemble the pc back to working condition
10. Loading of operating system
11. Demonstration on powerhack saw,grinding machine,drilling machine
12. Demonstration on welding machine

B. IT PRACTICE

13. Disassemble and assemble the PC back to working condition
14. Installation of operating system

BASIC ENGINEERING MEASUREMENTS

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

CO No	Course Outcome	PO	BTL
1	Understand the Basic fundamentals of a measurement system.	3	2
2	Understand various Mechanical measuring parameters, and apply different measuring techniques on various mechanical parameters using simulation and experimentation tools.	1,4	2
3	Understand various Electrical measuring parameters, and apply different measuring techniques on various Electrical parameters using simulation and experimentation tools.	1,4	2
4	Understand various Electronic measuring parameters, and apply different measuring techniques on various Electronic parameters using simulation and experimentation tools.	1,4	2
5	Apply the theoretical concepts to measure different parameters.	4	3

Syllabus:

Basic Fundamental Measuring Units: Definition and representation of Displacement (Linear/Angular), Time, Temperature. Speed, Humidity. **Measurement of Mechanical parameters:** Force, Stress, Strain, Pressure, Velocity, Acceleration, Mass and Weight. **Measurement of Electrical parameters:** Current, Voltage, Power, Energy, Power factor, Resistance, Inductance, Capacitance. **Measurement of Electronic parameters:** Oscilloscope: Amplitude, Frequency, Time period, Phase.

Text Books:

1. Experimental methods for engineers, JP Holman, McGraw Hill Ltd.
2. Mechanical measurements, 6/E, Thomas G Beckwith, Pearson

Reference Books:

1. Electrical measurements, Martin U Reissland, New Age Int.
2. A course in Electrical, Electronic Measurement, AK Sawhney, Dhanpat Rai & Co.

LIST OF EXPERIMENTS:

1. Measurement of Linear displacement using LVDT.
2. Measurement of Strain using Strain Gauge Bridge.
3. Measurement of Voltage using MyDAQ.
4. Measurement of Current using MyDAQ.
5. Measurement of Signal parameters (Amplitude, Time period and Frequency) using DSO.
6. Measurement of Unknown resistance using Wheatstone bridge.
7. Measurement of 1 phase Power, Energy of a R-L load.

8. Measurements of Inductance using Anderson Bridge.
9. Measurement of capacitance using Schering's Bridge
10. Measurement of Angular Displacement using Potentiometer.
11. Calibration of Pressure gauge using Dead Weight Pressure Tester.
12. Characterization of Temperature Sensor (RTD,TC,Thermistor).

CIRCUITS AND ELECTRONICS

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

CO No	Course Outcome	PO	BTL
1	Understand the Basic of Electrical network elements	1, 5	2
2	Understand the behavior of semiconductor switches and its applications	1, 5	2
3	Apply Time & frequency domain analysis of first & second order networks	1, 5	3
4	Understand the Applications of Analog & Digital circuits	1, 5	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.

NUMERICAL COMPUTATION FOR MECHANICAL ENGINEERS

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

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

Syllabus:

Covers elementary programming concepts, including variable types, data structures and flow control. 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.

COMPUTATIONAL THINKING AND DATA SCIENCES

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

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

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

PROFESSIONAL CORE

MACHINE DRAWING

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

CO No.	Course Outcome	PO	PSO	BTL
1	Draw different line types and various dimensioning, conventional representation of materials and machine components, sectioning, limits, fits and tolerances.	1	1	2
2	Draft various types of screws, bolts and nuts, bolted joints, locking arrangements and also draft various types of couplings and their arrangements and model the same using Solid works	1, 3, 5	2	2
3	Prepare the assembly drawing of engine parts, machine Components both in conventional form and then by using software.	1, 3, 5	2	2
4	Generate detail drawings of individual parts of an assembled machine Component both in conventional form and then by using software.	1, 3, 5	1	2

SYLLABUS

MACHINE DRAWING CONVENTIONS:

Need for drawing – Principles of Drawing

a) Title boxes, their size, location and details.
b) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and principle of dimensioning, counter sink, counter bores, spot faces, chamfers, screw threads, tapered features.
c) Types of Machine drawings – Production Drawing- Part and Assembly.
d) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs
e) Types of sections – selection planes and drawing of sections, cutting planes and section, hatching lines, half sections, aligned sections, offset sections and auxiliary sectional views. Parts not usually sectioned.
f) Limits, Fits and Tolerance- Definitions, geometrical representation of fits and tolerances, classification of fits, system of fits, selection of fits, method of indicating fits on drawings.

DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS:

Screwed Fasteners: Introduction, Screw thread nomenclature, Forms of screw threads, Thread designation, Multi-start threads, Right- and left-hand threads.

Bolts and nuts: Methods of drawing hexagonal and square bolts and nuts, T-headed bolt, Hook bolt, Eye-bolt, Stud, Flanged nut, Cap nut, Dome nut, bolted joint, Stud joint, locking arrangement for nuts – Locking by Locknut, Split pin, Castle nut.

Joints: Riveted Joints-Single and Double Riveted Lap and Butt Joints

Shaft Coupling: Introduction, Rigid couplings – Split-muff coupling, protected flange coupling. Flexible couplings-Bush pin type flanged coupling. Non-aligned Couplings-Universal coupling (Hook's joint)

ASSEMBLY DRAWINGS: Introduction, Stuffing box, Eccentric, Screw jack, Lathe tail stock.

PART DRAWINGS: Introduction, Single tool post, Plummer Block, I C Engine connecting rod

Text books:

1. Machine Drawing – Siddeswar, Kannaiah and V V S Sastry
2. Machine Drawing – N D Bhatt

Reference books:

3. Machine Drawing – K L Narayana, P Kannaiah & K Venkat Reddy, New Age
4. Machine Drawing – P S Gill

THERMAL-FLUIDS ENGINEERING-I

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

CO No	Course Outcome	PO	PSO	BTL
1	Understand and apply the fundamental principles and definitions of thermodynamics, fluid mechanics, and heat transfer.	1	1	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.	1	2	3
3	Elucidate the basic properties, principles and applications of fluids, fluid components, fluid statics and different types of fluid flows.	1	1	2
4	Describe fluid boundary layers, turbulence and their implementation in flow of fluid in engineering systems.	1	1	2
5	Apply the theoretical concepts to conduct various experiments of thermodynamics, fluid mechanics practically.	1	2	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-I

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

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

DYNAMICS AND CONTROL-I

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

CO No	Course Outcome	PO	PSO	BTL
1	Understand the need and significance of vibration analysis in mechanical systems	2	1	2
2	Analyze the mathematical model of a linear vibratory system to determine its response	2	1	4
3	Apply the linear mathematical models for real world engineering systems	2	1	3
4	Analyze Lagrange's equations for linear and nonlinear vibratory systems	2	1	4
5	Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation	5	1	3

Syllabus:

Introduction to the dynamics and vibrations of lumped-parameter models of mechanical systems.Kinematics.Force-momentum formulation for systems of particles and rigid bodies in planar motion.Work-energy concepts.Virtual displacements and virtual work.Lagrange's equations for systems of particles and rigid bodies in planar motion.Linearization of equations of motion.Linear stability analysis of mechanical systems.Free and forced vibration of linear multi-degree of freedom models of mechanical systems; matrix eigenvalue problems.

Text books:

1. Leonard Meirovitch, Fundamentals Of Vibrations, 1st edition , TataMcGrawHill, 2001
2. G.K.Grover, Mechanical Vibrations, Neem Chand & Bros. 7th Edition
3. Beer and Jhonston, Vector Mechanics for Engineers Statics and Dynamics, TataMcGrawHill

Reference Books:

1. R C Hibbeler, Engienering Mechanics, Pearson
2. W.T.Thomson Mechanical Vibrations, Pearson education ,2nd Edition
3. S.S.Rao , Mechanical Vibrations, Pearson education, 4th edition

List of Experiments

1. Find the natural frequency and mode shape of a cantilever beam
2. Find the natural frequency and mode shape of a simply supported beam
3. Find the natural frequency and mode shape of a fixed fixed beam.
4. Find the natural frequency and mode shape of one edge fixed plate
5. Find the natural frequency and mode shape of all edge fixed plate.
6. Find the forced vibration response of a cantilever beam
7. Find the forced vibration response of simply supported beam
8. Find the forced vibration response of a fixed beam
9. Find the forced vibration response of a one edge fixed plate
10. Find the forced vibration response of all edge fixed plate.

DYNAMICS AND CONTROL-II

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

CO No	Course Outcome	PO	PSO	BTL
1	Acquire the ability to use the appropriate elements and interconnection laws to obtain a mathematical model of a dynamic system generally consisting of ordinary differential equations	1	1	2
2	Acquire the ability to linearize nonlinear systems and arrange the equations that make up the model in a form suitable for solution, and use them to construct and simplify block diagrams.	2	1	3
3	Able to determine the transfer function and system response and its poles and zeros, analyze stability etc.,	2	1	3
4	Understand different control techniques to achieve the system stability.	2	1	2
5	Apply Matlab knowledge to Obtain the response of a system to arbitrary inputs. Study the influence of changing system parameters on the system response, and predict the response. Create root-locus plots, bode diagrams, etc. as aids in analyzing and designing feedback systems	5	1	3

Syllabus:

Modeling, analysis and control of dynamic systems. System modeling: lumped parameter models of mechanical, electrical, and electromechanical systems; interconnection laws; actuators and sensors. Linear systems theory: linear algebra; Laplace transform; transfer functions, time response and frequency response, poles and zeros; block diagrams; solutions via analytical and numerical techniques; stability. Introduction to feedback control: closed-loop response; PID compensation; steady-state characteristics, root-locus design concepts, frequency-domain design concepts. Laboratory experiments and control design projects.

Text Books:

1. Rowell and Wormley. *System Dynamics: An Introduction*. Upper Saddle River, NJ: Prentice Hall, 1996.
2. Dorf and Bishop. *Modern Control Systems*. 7th ed. Reading, MA: Addison-Wesley, 1995.
3. Ogata. *Modern Control Engineering*. 3rd ed. Upper Saddle River, NJ: Prentice Hall, 1996.
4. Nise, Norman S. *Control Systems Engineering*. 5th ed. New York, NY: John Wiley & Sons, 2007. ISBN: 9780471794752. (The 4th ed. will work just as well.

List of Experiments:

1. Modeling of first order Mechatronic system
2. Modeling of second order Mechatronic system
3. Modeling of higher order Mechatronic system
4. Response analysis of first order Mechatronic system
5. Response analysis of second order Mechatronic system
6. Response analysis of higher order Mechatronic system
7. controlling of second order Mechatronic system using different control techniques
8. controlling of higher order Mechatronic system using different control techniques

THERMAL-FLUIDS ENGINEERING - II

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

CO No.	Course Outcome	PO	PSO	BTL
1	Apply the principles of thermodynamics, heat transfer, and fluid mechanics to the design and analysis of engineering systems.	1	1	3
2	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.	1	1	2
3	Identify thermodynamic state of a pure substance and determine the thermodynamic properties and explain the design approach to thermodynamic plants.	1	1	2
4	Analyze Rankine, power cycles and explain refrigeration and air conditioning systems.	1	1	2
5	Apply analytical cognitive skills of the theoretical concepts to conduct various experiments of thermodynamics and fluid mechanics practically.	1	2	3

Syllabus:

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

Text Books:

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

Reference Books:

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

Note: Use of Steam tables book by C. P. Kothandaraman and psychrometric chart is permitted in University Examinations.

MECHANICS AND MATERIALS - II

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

CO No.	Course Outcome	PO	PSO	BTL
1	Apply materials in mechanical design based on mechanical behavior of engineering materials.	1, 3	2	2
2	Emphasize the fundamentals of mechanical behavior of materials	2	2	2
3	Determine the mechanical properties of materials to design.	2	1	3
4	Select the material for mechanical application.	2	1	3
5	Determine the properties of materials experimentally	2	1	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. Gere & Goodno “Mechanics of Materials” Cenage Learning India Pvt Ltd

Reference Books:

1. S.S. Rattan “Strength of Materials” Tata McGraw Hill
2. E.P.Papov “Mechanics of Materials” Prentice Hall Publications
3. B.C.Punmia, Ashok Kr. Jain Arun kumar Jain”Mechanics of Materials” Laxmi Publications
4. Pytel A H and Singer F L, Harper Collins “Strength of Materials”, New Delhi.

DESIGN AND MANUFACTURING – I

CO No	Course Outcome	PO	PSO	BTL
1	Understand and apply the casting processes	1	2	2
2	Apply the welding processes and identify the faults in welding processes	3	1	2
3	Apply principles of cold/hot forming processes	3	2	4
4	Apply sheet metal processes and design sheet metal dies.	3	1	3
5	Fabricate the parts using machine tools	2	2	3

Syllabus:

Casting 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, Co2 Moulding, continuous casting-squeeze casting, electro slag casting, Fettling and finishing, casting defects and Inspection of castings.

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

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

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

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

Text books:

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

ENGINEERING MANAGEMENT

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

CO No.	Course Outcome	PO	PSO	BTL
1	Illustrate the primary concepts about management, its principles and functions and the types of business organizations and Demonstrate the knowledge to solve complex engineering problems in industrial scenario.	11	2	2
2	Analyze the concepts of financial management includes present worth and future worth of invested money through cash flow diagram and differed annuities.	7	2	4
3	Acquire knowledge in economic analysis and cost accountancy.	7	2	2
4	Demonstrate the principles of business innovation and entrepreneurship for establishing industrial ventures	11	2	2

Syllabus:

Introduction
Overview of engineering management.
Financial principles.
Management of innovation.
Technical strategy and best management practices.

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
3. Vinnie Jauhari, Sudhanshu Bhushan, Innovation Management, Oxford University Press, 1st Edition, 2014

HEAT TRANSFER

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

CO No.	Course Outcome	PO	PSO	BTL
1	Apply Fourier law of conduction and combined conduction convection concepts to 1-D heat transfer problems.	1	1	3
2	Analyze heat transfer using extended surfaces , unsteady state heat transfer and 2-D conduction mode of heat transfer	1	2	4
3	Understand convection mode of heat transfer and heat transfer during phase change by applying the empirical correlations to solve convection problems	1	1	3
4	Apply the principles of heat transfer to analyze and design different heat exchangers. Understand the fundamentals of radiation and estimate the radiation heat exchange between two bodies.	1	2	4
5	Experimental verification of various heat transfer parameters	1	2	3

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.

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. Necati Ozisik, McGraw-Hill Pub Co., New York.

Note: Use of Heat and Mass Transfer Data Book by C. P. Kothandaraman is permitted in University Examinations.

FINITE ELEMENT ANALYSIS OF SOLIDS AND FLUIDS

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

CO No.	Course Outcome	PO	PSO	BTL
1	Understand the general procedure of Finite Element Method and apply the knowledge of stresses & strains for general case of loading in solving simple engineering problems	2	1	3
2	Apply FEM to solve the Solid Mechanics problems	2	2	3
3	Apply FEM to solve the Heat Transfer problems	2	2	3
4	Apply FEM to solve the Fluid Mechanics problems	2	2	3
5	Analyze beams, bars, Fluid flow using ANSYS software	2, 5	2	4

Syllabus:

FINITE ELEMENT ANALYSIS:

Introduction, Basic Concepts of Finite Element Analysis, Theory of Elasticity, General Procedure of Finite Element Analysis; **Finite Element Formulation Techniques** - Virtual work and Variation Principles, Finite Element Method-Displacement Approach, Stiffness Matrix and Boundary Conditions

APPLICATIONS IN SOLID MECHANICS:

Analysis of 1-D problems: Finite Element modeling, Formulation of Bar element- Stiffness matrix, Load vector, Shape functions and its characteristics, Treatment of boundary conditions, Problems of Axially Loaded Member. **Analysis of Plane trusses**: Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, and Problems of plane Trusses. **Analysis of 2-D problems**: Finite Element Modeling, Formulation of CST element, Axisymmetric Formulation, Load Vector, Stress Calculations, Problem modeling and Boundary Conditions. **Dynamic Analysis**: Formulation, Element Mass Matrices, Evaluation of Eigen values and Eigen vectors; properties of Eigen vectors, Eigen value and Eigenvector Evaluation for line elements only

APPLICAIONS IN HEAT TRANSFER:

Introduction, Steady-state heat transfer, One dimensional heat conduction-governing equation, Boundary conditions, Formulation of one dimensional conduction element, Problems of Composite slabs, Heat flux boundary condition, 1D heat transfer in thin Fins

APPLICATIONS IN FLUID MECHANICS:

Introduction, Basic characteristics of Fluids, Methods for describing the motion of a Fluid, Continuity equation, Equation of motion or momentum equation, Formulation of 1D-Fluid flow, Problems on 1D flow, Governing equations for Incompressible flow, 2D flow- Stream function, Velocity Potential function, Incompressible viscous flow

Text Books:

1. Tirupathi R.Chandrupatla, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice hall of India Pvt. Ltd,

Reference Books:

1. S S Bhavikatti, “Finite Element Analysis”, New Age International (P) Ltd. 2005
2. S.S.Rao “Finite Element Method” 4st Edition , ELSEVIER Ltd,
3. C.Krishna Murthy “Finite Element Method”, 2nd Edition TMH,.
4. David V Hutton, “Fundamentals of Finite Element Analysis” McGraw-Hill Int. Ed.
5. Logan D.L., “A First course in the Finite Element Method”, Third Edition, Thomson Learning,
6. Robert D.Cook., David.S, Malkucs Michael E Plesha , “Concepts and Applications of Finite Element Analysis”.
7. Reddy J.N, “An Introduction to Finite Element Method”, McGraw-Hill International Student Edition
8. O.C.Zienkiewicz and R.L.Taylor, “The Finite Element Methods”, Vol.1. The basic formulation and linear problems, Vol.1, Butterworth Heinemann

INTRODUCTION TO ROBOTICS

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

CO No.	Course Outcome	PO	PSO	BTL
1	Understand the Basic fundamentals of a robot system, mechanisms, dynamics and control	2	1	2
2	Understand various Planar and spatial kinematic equations, differential motion, energy method for robot mechanics; mechanism design for manipulation and locomotion; multi-rigid-body dynamics; force and compliance control, balancing control of a robot.	2	1	3
3	Understand various visual feedback, human-machine interface; actuators, sensors, wireless networking, and embedded software in designing a robot.	2	1	2
4	Understand and apply various real-time control schemes, vehicle navigation, arm and end-effector design, and balance concepts.	2	1	3
5	Apply the theoretical concepts to develop a capstone project.	1	1	5

Syllabus:

Presents the fundamentals of robot mechanisms, dynamics, and controls. Planar and spatial kinematics, differential motion, energy method for robot mechanics; mechanism design for manipulation and locomotion; multi-rigid-body dynamics; force and compliance control, balancing control, visual feedback, human-machine interface; actuators, sensors, wireless networking, and embedded software. Weekly laboratories include real-time control, vehicle navigation, arm and end-effector design, and balancing robot control

Text Books:

1. Asada, H., and J. J. Slotine. *Robot Analysis and Control*. New York, NY: Wiley, 1986. ISBN: 9780471830290.

Reference Books:

1. Richard D Klafter, Robotics Engineering – An Integrated Approach, Prentice Hall of India P Ltd., 2006
2. Yoram Koren, Computer Control of Manufacturing Systems, Tata McGraw-Hill, 1983
3. John J.Craig , “Introduction to Robotics”, Pearson Edu., 2009

DESIGN AND MANUFACTURING – II

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

CO No	Course Outcome	PO	PSO	BTL
1	Understand and analyze the working of various machining processes.	2	1	3
2	Implement NC and CNC programing for machining simple components	1	2	3
3	Apply the automation of production lines.	3	1	3
4	Design of various manufacturing processes.	3	2	3
5	Implement modern manufacturing techniques	5	2	3

Syllabus:

Lathe, milling and drilling machine, boring, shaper, slotter, planer, broaching,
Forces, power consumption in machinery, MECHANICS OF METAL CUTTING: Orthogonal Vs oblique cutting- merchant's force circle diagram. Force and velocity relationship
Historical development and future trends of NC Machines. CNC Machine outline, Selection of parts for NC machining. Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity, Tooling for NC. NC Part Programming: Manual (word address format) programming. Examples Drilling and Milling. (b) APT programming. Geometry, Motion and Additional statements, Macro statement
Control of NC Systems: Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control.
AUTOMATION: Reasons for Automation: Strategies of Automation, Detroit type of Automation, Flow lines, Transform Mechanisms, work part transfer, Different Methods, Problems. Automation for machining operations design & Fabrication consideration, machining center.
Design for Manufacturing: Selection of Manufacturing Processes, Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Assembly, Design for Welding, Design for Heat Treatment, Design for Reliability and Quality Failure Mode and Effect Analysis, Design for Quality, Design for Reliability, Approach to Robust Design Design for Optimization

Text Books:

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

Reference Books:

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

ELEMENTS OF MECHANICAL DESIGN

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

CO No	Course Outcome	PO	PSO	BTL
1	Model the machine elements such as bearings, bolts, belts and gears	3	1	2
2	Analyze the machine elements to design a new component	4	1	3
3	Characterize the mechanical system to a real world application	2	1	3
4	Synthesize the modal to design a mechanical system	2	1	3
5	Fabricate the design subject to engineering Constraints	5	2	3

Syllabus:

Advanced study of modeling, design, integration and best practices for use of machine elements such as bearings, bolts, belts, flexures and gears. Modeling and analysis is based upon rigorous application of physics, mathematics, and core mechanical engineering principles, which are reinforced via laboratory experiences and a design project in which students model, design, fabricate, and characterize a mechanical system that is relevant to a real-world application. Activities and quizzes are directly related to, and coordinated with, the project deliverables. Develops the ability to synthesize, model and fabricate a design subject to engineering constraints (e.g., cost, time, schedule)

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

TECHNICAL SKILL COURSES

SKILLING FOR ENGINEERS-1

(MANUFACTURING TECHNOLOGIES)

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

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)

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

CO. No	Course Outcome	PO	BTL
1	Problem solving by Search, Heuristic Search, Randomized search techniques and Finding Optimal paths	2, 5	3
2	Analyze the appropriate methodologies for problem decompositions, planning and constraint data constraint satisfactions.	1, 5	3
3	Understand Knowledge Representation using Predicate Logic, Representing Knowledge using Rules, Semantic Nets, Frames and Conceptual dependencies.	1, 2	2
4	Apply the theoretical concepts to conduct various experiments on Search Techniques and Language Representation using AI	1	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)

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

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

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

CO No.	Course Outcome	PO	PSO	BTL
1	Understand the stages and importance of engineering design process	3		3
2	Design and modelling of various mechanical assemblies	3, 5		4
3	Analyze the different problems solving techniques of mechanical components	3, 5		4
4	Identifying and solving the real complex engineering problems	4	1	4

Syllabus:

Engineering design process: Introduction, Importance, ways to think about engineering design process, Description of Design process, Types of Design, Considerations of Good Design. Problem Definition and Need identification, Gathering Information, Concept Generation, Decision Making and Concept Selection; Embodiment Design; Detail Design; Modeling and Simulation.
Design & Modelling of Joints/Systems: Plane truss, Hydraulic cylinder, Socket and spigot joints, Knuckle joint Coupling- flange couplings, Universal couplings,
Analysis of Machine elements: Shaft subjected to Complex loading, stress concentration of shafts and plates, Shafts subjected to Fatigue loads, buckling of a Shaft, Dynamic analysis of a beam/shaft

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

Text Books:

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

TECHNICAL PROFICIENCY & TRAINING-1

(DATA ANALYTICS)

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

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.	3	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.	3	3
3	Use advanced techniques to conduct thorough and insightful analysis and interpret the results correctly with detailed and useful information.	3	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	3	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)

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

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

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

CO No	Course Outcome	PO	BTL
1	Design and selection of various belt and chain drives	3	6
2	Design and Selection of the suitable bearing for the given loading condition	3	6
3	Analyze kinematic and dynamic aspects in design of brakes, clutches	3	6
4	Design and analysis of different types of gear drives	3	6
5	Analyze machine elements using analysis software	5	4

Syllabus:

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

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

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

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

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

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

Bevel Gears: Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears, Selection of materials for bevel gears, comparison of spiral bevel gears and hypoid gears and straight tooth bevel gears.

Worm Gears: Design and analysis of worm gear drive

Text Books:

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

Reference books:

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

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

THEORY OF ELASTICITY AND PLASTICITY

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

CO No	Course outcome	PO	BTL
1	Analyze stresses and strains in planes in elastic or plastic region	1, 2	4
2	Solve 2-D problems in rectangular Components	1, 2	4
3	Analyze stresses and strains in 3-D problems	1, 2	4
4	Analyze Beams and frames in plasticity applications	1, 2	4

Syllabus:

Introduction:

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

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

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

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

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

CO No	Course Outcome	PO	B T L
1	Understand the concepts of acoustics and vibrations	1,2	4
2	Determine the sources of vibrations	1, 2	4
3	Measure the level of vibration and control the vibrations	1, 2	4
4	Measure and control the noise observed from vehicles.	1, 2	4

Syllabus:

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

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

Types of Vibrations: Free & Forced Vibrations induced for Single degree of freedom & Multi degrees of freedom. Basic Concepts of Noise: Fundamentals of Acoustics. General Types of sound wave propagations- wave equation, specific acoustic impedance, Plane wave & Spherical waves. Structure borne sound and air borne sound.Interior noise sources and levels of noise.

Anatomy of human ear and mechanism of hearing.Sound intensity, summation of pure tones (decibel addition), subtraction & averaging.Octave and Octave bands.

CHARACTERISTICS & SOURCES OF VIBRATIONS:

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

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

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

VIBRATIONS MEASUREMENT TECHNICS AND CONTROL:

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

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

SOURCES OF NOISE, NOISE MEASUREMENT TECHNICS AND CONTROL:

Noise specifications and mandatory standards regulations.Brake Squeal noise, Pass-by Noise, wind noise, squeak noise and rattle, interior noise (including noise emitted by running of accessories, indicators and all buzzers). Power train, Engine Air Intake & Exhaust noise, Engine accessories, cooling system and vehicle body protrusion noise, under body protrusion noise. Noise due to Tyre-Road friction and slip characteristics.

Noise Measuring Instruments: Microphone, Sound intensity probes.

Noise Control: Damping treatment methods, Control through isolations and noise absorbing materials and structure. Active and semi-active control of noise.Study of anechoic chamber.
Harshness: Definition. Its effect and acceptable degree of Harshness. Perception of Ride comfort i.e. psychological effects of Noise & Vibrations.
Study of **NVH - Legislations** applicable for vehicles in India
Safety: Passive safety Active safety. Study of Safety Regulations for vehicular application
Introduction to software applications (Capabilities & Limitations of different software's) for analysis of NVH

Text Books:

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

Reference Books:

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

COMPUTER AIDED DESIGN

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

CO No	Course Outcome	PO	BTL
1	Understand the Fundamentals of CAD and display devices	1,5	2
2	Apply the concept of geometric modelling	1,5	3
3	Able to apply concept of Surface and solid modelling	1,5	3
4	Application of various Geometric transformations	1,5	3

Syllabus:

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

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

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

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

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

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

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

Case Study: Design and optimisation 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

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

CO No	Course Outcome	PO	BTL
1	Assess the failure of unflawed structural components	4, 2	4
2	Assess the fatigue life of structural components under the specified load spectrum	4, 2	4
3	Evaluate the fracture toughness and assess the life of flawed structural components	4, 2	4
4	Assess the life of structural components under creep	4, 2	4

Syllabus:

Analysis of stresses and strains in three-dimensions: Principal stresses and strains. Stress / strain invariants, Octahedral stresses, Theories of failure, various yield criteria. **Repeated Stresses and fatigue in metals:** Fatigue tests, endurance limit, Fatigue under combined loadings. Fatigue design theory: Goodman, Gerber and Soderberg criteria. **Factors influencing fatigue behaviour of metals:** Frequency, temperature, size, form, surface conditions, residual stress, etc. influence of stress concentration, notch sensitivity. Various mechanical and metallurgical methods used for improving fatigue strength of metals. Effects of corrosion; Corrosion fatigue and fretting; Cumulative fatigue damage and life estimation of components; **Fracture Mechanics:** Basic modes of fracture; Griffith theory of brittle fracture and Orwan modifications; **Linear Elastic Fracture Mechanics (LEFM):** Stress field ahead of crack-tip; stress intensity factors; critical SIF; Fracture toughness testing and evaluation of KIC. **Elasto-plastic fracture mechanics:** Plane stress and plane strain plastic zone sizes; J-integral method; SERR computation and evaluation of structural integrity. **Creep behaviour of metals:** Creep-stress-time-temperature relations; creep testing methods; Mechanics of creep; creep in tension, bending and torsion; strain-hardening effects on creep; creep buckling; members subjected to combined stresses and creep.

Text books:

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

Reference Books:

1. Engineering Fracture Mechanics – S.A. Meguid (Springer)
2. Fracture Mechanics – C.T. Sun and Z.H. Jin (Elsevier)
3. Elements of Fracture Mechanics – Prashant Kumar (Tata McGraw-Hill)
4. Fundamentals of Fracture Mechanics – TribikramKundu (CRC Press)
5. Mechanical Behavior of Materials – Norman E. Dowling (Prentice Hall)
6. Metal Fatigue in Engineering – R.I. Stephens (Wiley)
7. Creep of Engineering Materials – I. Finnie and W.R. Heller (McGraw-Hill Book Co.)

ADVANCED STRENGTH OF MATERIALS

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

CO No	Course Outcome	PO	B T L
1	Analyze statically indeterminate beams	1, 2	4
2	Analyze stresses in curved beams and Examine the Shear Centre for various cross sections of beams	1, 2	4
3	Apply unit load method to find deflections in beams and structures	1, 2	3
4	Analyze stresses in rotating members and thick cylinders	1, 2	4
5	To simulate the structural members using ANSYS and validate the results with analytical methods	4	4

Syllabus:

Statically Indeterminate Beams: Introduction toStatically indeterminate Beams, apply the Moment Area Method to analyze the fixed beams. Introduction to Continuous beams, apply Clapeyron's theorem of three moments to analyze continuous beams.

Curved Beams: Stresses in Beams of small and large initial curvature, Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections.

Shear Center: Importance of Shear Centre, Locate the shear center for different cross-sections.

Energy Methods: Introduction, Principles of virtual work, Apply Unit load Method to determine displacements and slope in Beams and to analyze simple structures and trusses.

Centrifugal Stresses: Introduction, Stresses in Rotating Ring, Disc of uniform thickness.

Thick Cylinders: Stresses in Thick cylinders, Apply Lame's theory to determine radial and circumferential stresses in thick cylinders. Stresses in Compound Cylinders.

Text books:

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

Reference Books:

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

List of Experiments:

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

MECHANICS OF COMPOSITE MATERIALS

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

CO No	Course outcome	PO	BTL
1	Know the composite materials and manufacturing methods	1	2
2	Understand the behaviour of composite Lamina	1	2
3	Know the properties of various types composite materials	1	2
4	Apply Failure theories to calculate stresses in composite materials	1	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

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

CO No	Course Outcome	PO	BTL
1	To classify and understand the need of Non-Traditional Manufacturing Processes.	2	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.	2	2
3	To understand the working principle and the effect of various process parameters on its performance of various Non-Traditional Welding Processes.	2	2
4	To understand the working principle of various Non-Traditional Forming Processes.	2	2
5	Apply the modern manufacturing techniques	5	3

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

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

CO No	Course Outcome	PO	BTL
1	Ability to identify different types of optimization problems	2	2
2	Understand basic concepts in solving nonlinear optimization problems	2	2
3	Understand optimality conditions for unconstrained and constrained optimization problems and be able to apply them in verifying the optimality of a solution	2	2
4	Understand basics of choosing and implementing optimization methods	2	2

Syllabus:

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

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

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

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

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

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

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

Text Book:

1. Nano material by A.K. Bandyopadyay, New age Publishers.
2. Material science and Technology- Cahan.
3. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press.

Reference Books:

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

ADDITIVE MANUFACTURING

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

CO No.	Course Outcome	PO	BTL
1	To be able to properly distinguish between the hype and realities of additive manufacturing	2	2
2	To understand the basic AM processes, and the limitations and advantages of each.	2	2
3	To understand the differences between traditional processes and additive manufacturing production, including the differences in design methodology.	2	2
4	To use AM terminology properly and understand the role and importance of standards in the additive manufacturing industry.	2	2

Syllabus:

Additive Manufacturing Process: Basic Principles of the AdditiveManufacturing 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 of Polymerization: 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

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

CO No.	Course Outcome	PO	BTL
1	Develop the ability to design cutting tools for given single component.	1, 6	2
2	Design and development of various die configurations.	1, 7	2
3	Design and development of jigs for given component.	1, 8	2
4	Design and development of fixtures for given component.	1, 8	2
5	Gain practice on designing the tools and dies using a software package.	11	4

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

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

CO No.	Course Outcome	PO	BTL
1	Analyze various production schedules and plant layouts.	2	2
2	Apply the concept of group technology to the development of FMS.	2	2
3	Identify hardware and software components of FMS.	2	2
4	Analyze materials handling and storage system in FMS.	2	2
5	Conduct experiments & hands on experience related to NC part programming	4	3

Syllabus:

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

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

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

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

Text Books:

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

Reference Books:

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

5. Taiichi Ohno, “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd. 1992.

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

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

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

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

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

CO	Course outcome	PO	BTL
1	Understand the need of reverse engineering	1	2
2	Understand working principles of RP techniques	3	2
3	Understand Rapid tooling and RP case studies	3	2
4	Understand applications of RP techniques	3	2

Syllabus:

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

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

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

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

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

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

Text Books:

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

AUTOMOBILE ENGINEERING

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

CO No.	Course Outcome	PO	BTL
1	Understand various principles, components, classification of automobiles.	3	2
2	Understand working of Engine cooling system, coolant properties and combustion chambers.	3	2
3	Understand various lubricating systems, its properties and Transmission systems of an Automobile.	3	2
4	Understand the concepts of Suspension system and Vehicle control in an Automobile.	3	2
5	Able to apply the various concepts of Automobile engineering using simulation and analysis through suitable software	3	3

Syllabus:

Introduction: Classification of Vehicles – applications, Components of an automobile.

Engine and cooling system: Engine Classification, types of combustion chambers and components of engine. Coolants and its properties, Air and water cooling systems.

Lubrication and transmission Systems: Lubricants, Properties, Splash, semi-pressure and full pressure Lubricating systems. Clutches, Gear Box, Automatic transmission, propeller shaft, differential.

Suspension systems 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

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

CO No.	Course outcome	PO	BTL
1	Understand the basic knowledge on automobile engine nomenclatures and its performance parameters involved in developing an engine	1, 2	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.	1, 2, 3	3
3	Comprehend different functional aspects for good performance of an engine and factors causing failure of an engine	1, 2	2
4	Understand different types of maintenance activities involved and study of faultfinding equipment in detail.	1, 2	2
5	Modeling and analysis of engine components of an automobile using CAD software tools- Laboratory	1, 4	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

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

CO No.	Course outcome	PO	BTL
1	Understand the importance of construction and working of a clutch in automobile industry and troubleshooting of clutch	5	2
2	Understand the importance of construction and working of gear box and total resistance to motions	5	2
3	Understand different mechanisms used while adopting a torque converter and various Automotive Transmission mechanisms	5	2
4	Understand working principle of drive line system components	5	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	5	3

Syllabus:

CLUTCHES: Principle, Functions, Requirements, Torque capacity, lining materials,

GEAR BOX: Necessity, Types, Sliding mesh, Constant mesh, Synchromesh, Synchronizing unit, Helical gears, Gear selector mechanism, Overdrive gears, Compensation for wear, Performance characteristics.

DRIVE LINES: Effect of driving thrust and torque reaction, Propeller shaft-universal joints, Drive line arrangements, i. e. Hotchkiss drive & torque tube drive, Rear & front wheel drive layouts.

FINAL DRIVE & REAR AXLE: Final drive & drive ratio, Types, Need of differential and differential unit, Rear axle, Axle types, Axle shafts, Final drive.

TRANSMISSION WITH FLUID FLYWHEEL & TORQUE CONVERTOR: Operating principle, Fluid flywheel, Characteristics, Advantages & limitations of fluid coupling.

CONTINUOUS VARIABLE TRANSMISSION (CVT), Applications, Advantages and disadvantages.

Text Books:

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

Reference Books:

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

List of Experiments:

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

AUTOTRONICS & SAFETY

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

CO No.	Course outcome	PO	BTL
1	Understand various principles, characteristics, testing, maintenance, and servicing of batteries.	1, 2	2
2	Understand working of ignition system of an S I engine, its maintenance and service.	1, 2	2
3	Understand wiring for Auto electrical systems for I C Engines	1, 2	2
4	Understand the concepts of safety for various domains in automobiles.	1, 2	2
5	Apply the various concepts of Automobile engineering using electronics through suitable software	4	3

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

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

CO No.	Course Outcome	PO	BTL
1	Acquire comprehensive knowledge on Electric Vehicles and Hybridization of automobiles with applications.	1, 2	2
2	Understand the technology of Hydrogen driven vehicles and fuel properties along with application in engine performance.	1, 2	2
3	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).	1, 2	2
4	Explore and conjecture the emerging technologies and future source of alternative fuels in automobiles.	1, 2	2
5	Practically study the various technologies of alternative energy sources applied in the advanced scenario of automobile engineering.	1, 5	3

SYLLABUS:

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

Text Books:

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

Reference books:

1. Solar Energy Fundamentals and Applications, H P Garg, Tata McGraw Hill Publishing Co.
2. Fuel Cells Principles and Applications, B. Viswanathan and Aulice Scibioh, Universities Press, Hyderabad.
3. Energy Management in Hybrid Electric Vehicles Using Co-Simulation by Christian Paar, 2011.

4. Electric and Hybrid Vehicles by Tom Denton, 2016.
5. Electric Vehicle Technology Explained, 2ed (WSE) byJames Larminie, 2015

List of Experiments:

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

AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM

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

CO No.	Course Outcome	PO	BTL
1	Understanding battery, Cranking motor construction and testing methods.	1	2
2	Understand the principle of alternator and to test the alternator.	3	2
3	Understand the Electronic Controls in Gasoline Engine.	2	2
4	Understand the basics of Vehicle Motion Control and telematics system	2	2
5	Perform OBD II test on vehicle and Program MYRIO hardware using Lab view.	1	2

Syllabus:

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

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

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

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

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

Text Books:

1. Tom Denton, “Automobile Electrical and Electronic Systems”, 3rd edition, Elsevier Butterworth-Heinemann 2004.
2. William B. Ribbens, “Understanding Automotive Electronics” 7th edition Butterworth-Heinemann publications, 2012.
3. Ed Doering “NI MYRIO Project Essential Guide” 2013, National Technology and Science Press

4. Allan. W. M. Bonnick, “Automotive Computer Controlled System 2001, Butterworth-Heinemann
5. Robert Bosch Gmbh, “Bosch Automotive Electric and Electronics”, 5th edition, Springer-Verlag.

LIST OF EXPERIMENTS:

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

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

CO No.	Course Outcome	PO	BTL
1	Apply the knowledge of basic engine technology along with principle. Summaries of Engine Cycles.	1, 2	3
2	Apply the concept performance aspect of mixture preparation and ignition system for SI and CI Engines and Combustion in Engines.	1, 2	3
3	Pollutant Formation, Emission control methods and Emission norms	1	3
4	Engine Testing, Performance analysis and Emerging Engine Technologies	1, 2	4
5	Experiments on I C Engines for performance calculation	4	2

Syllabus:

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

Text Books:

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

Reference Books:

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

List of Experiments:

1. Study and Demonstration of 4 stroke Diesel Engine with water cooled and Mechanical Loading
2. Study and Demonstration of 4 stroke Petrol Engine with water cooled and Electrical Loading
3. Determination of Brake thermal, Mechanical and Indicated efficiency of Diesel Engine using EES software

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

AUTOMOTIVE SENSOR AND APPLICATIONS

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

CO No	Course Outcome	PO	BTL
1	Learn the sensor classification and sensor product selection guide.	1	2
2	Analyze the measurement of engine parameter using sensor.	4	3
3	Apply required sensors and actuators for automotive applications	3	3
4	Analyze the sensors for intelligent transport systems	3	3

Syllabus:

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

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

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

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

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

Text Books:

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

List of Experiments

1. Study and classification of automotive sensors
2. Measurement of pressure and flow sensors
3. Measurement of humidity and temperature sensors
4. Measurement of speed, acceleration and torque sensors
5. Measurement of oxygen, light and level senors
6. Study and calibration of LVDT transducer for displacement measurement.

7. Calibration of various Sensors and interfacing techniques for Engine control, adaptive cruise control
8. Brake Pedal Position Measurement (i) using Hall Effect sensor (ii) Designing of P, PI, PID controllers using performance criteria
9. Characteristics of intelligent transport systems
10. Study and calibration of Sensors for traction control, steering and stability
11. Study of The digital vehicle
12. Study of Intelligent vehicle systems
13. Programming of micro controllers and micro processors
14. Interfacing of microprocessors, microcontroller, stepper motors and servo motors

AUTOTRONICS

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

CO No	Course Outcome	PO	BTL
1	Understand the automotive electronics for engine management system	1	1
2	Analyze required sensors and actuators for an automotive application	4	3
3	Apply the suitability of a control system for automotive application	3	3
4	Ability to analyze of electronic system for automotive applications	2	3

Syllabus

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

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

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

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

Digital Engine Control System: Open Loop and Closed Loop Control System – Engine Cooling and Warm Up Control – Idle Speed Control – Acceleration and Full Load

Enrichment – Deceleration Fuel Cut-off – Fuel Control Maps – Open Loop Control of Fuel Injection – Closed Loop Lambda Control – Exhaust Emission Control – On Board Diagnostics: Diagnostics – Future Automotive Electronic Systems – Electronic Dash Board Instruments – Onboard Diagnosis System.

Text Books:

1. Arthur Primrose Young, Leonard Griffiths, "*Automobile Electrical and Electronic Equipment: Theory and Practice for Students, Designers, Automobile Electricians and Motorists*", London Butterworths, 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

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

CO No	Course Outcome	PO	BTL
1	Understand the automotive instruments and automotive sensors	1	1
2	Learn the measurement of engine parameter by using sensor.	4	2
3	Acquire ability to analyze the electronic fuel injection system	4	3
4	Apply the principles of digital control techniques and the application of on board diagnosis	3	4
5	Experiments on computerized Diesel Engine and Lab view based Engine control unit	4	4

Syllabus:

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

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

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

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

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

Text Books:

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

List of Experiments:

1. Introduction about lab and dividing the students in to batches
2. Study of Sensors and Actuators used in vehicles
3. Experiment on computerized Diesel Engine to measure the temperature of cooling water and exhaust gas and by sensors
4. Experiment on computerized Diesel Engine to measure the pressure and ignition details
5. Experiment on computerized Diesel Engine to measure the combustion details
6. Experiment on computerized Diesel Engine to analysis the exhaust emission

7. Experiment on computerized Diesel Engine to analysis the performance
8. Experiment on computerized Diesel Engine to draw the heat balance chart
9. Study of Emission norms
10. Measure and monitor in real time emissions of O_2, NO, CO, SO_2, and CO_2 using Virtual instrument for Emissions Measurement (VIEM) software in the platform of Labview 2010
11. Study of Labview based Engine Control Unit
12. NI CompactRIO platformand LabVIEW software used as ECU
13. 8085 Microprocessor programming / Diagnosis of ECU

INSTRUMENTATION IN AUTOMOTIVE INDUSTRIES

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

CO No.	Course Outcome	PO	BTL
1	Understand the knowledge of various Measuring Instruments to design a simple Instrumentation system	1	2
2	Analyze the various instruments and use them in various fields	4	3
3	Learn and apply the measuring instruments in various industries application	3	3
4	Analyze suitable instrument for a given application	3	3

Syllabus:

Measurements in LMV & HMV: Pressure, Level, Temperature, Density, Viscosity, Torque, Vibration, Luminosity

Instrumentation application in vehicles: Analysis of Fuel and Emitted particles Co2, Nox, Hydro carbons

Embedded application in MV: Microprocessor based front panel Indicators Ignition Systems – Engine Controls – RTOS applications.

Communication protocols: Serial bus, CAN bus, GPS tracking Systems

Automation in manufacturing industry: Assembly line applications, PLC and DCS implementation – Robotic Controls.

Reference books:

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

List of Experiments:

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

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

AUTOTRONICS AND VEHICLE INTELLIGENCE

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

Co. No	Course Outcome	PO	BTL
1	Analyze various electronics systems like sensors	1, 2	4
2	Understand Fuel injection and Ignition system	1, 2	2
3	Understand Electric vehicles and hybrid vehicles	1, 2	2
4	Design of intelligence vehicle systems	3	4

Syllabus:

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

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

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

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

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

Text Books:

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

AUTOMOTIVE SYSTEMS

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

Co. No	Course Outcome	PO	BTL
1	Understand the importance of automotive systems	1, 3	2
2	Understand the Two-wheel drive, four-wheel drive vehicles	1, 3	2
3	Analyze the transmission system	1, 3	4
4	Analyze control system for Automotive systems	1, 3	4

Syllabus:

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

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

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

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

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

Text Books:

1. Heinz Heister, “Vehicle and Engine Technology”, SAE Second Edition, 1999.

2. John B Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill International Editions, 1988.

Reference Books:

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

PROGRAMMABLE LOGIC CONTROLLERS

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

Co. No	Course Outcome	PO	BTL
1	Understand the importance of Factory Automation	1, 3	2
2	Understand the functions and operations of PLC	1, 3	2
3	Understand the Installation and maintenance procedures for PLC	1, 3	2
4	Analyze PLC for the control of industrial processes	1, 3	4

Syllabus:

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

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

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

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

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

Text Books:

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

Reference Books:

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

List of Experiments:

1. Win pro ladder operations
2. Basic control circuits
3. Light control
4. Traffic light control
5. Digital clock control
6. Step motor control
7. Tank filling device control
8. Keypad control
9. DC motor control
10. Multiple PLC trainers
11. Temperature control
12. Counter application programming

ARTIFICIAL INTELLIGENCE FOR ROBOTICS

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

CO No	Course Outcome	PO	BTL
1	Understand the concepts of AI	1	1, 2
2	Apply basic principles of AI in solutions that require problem solving and planning.	4	3
3	Apply basic principles of AI in solutions that require problem solving, planning, reasoning and learning	4	3
4	Analyze AI in Robotics	3	4

Syllabus:

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

List of Experiments:

1. Write a program in prolog to implement simple facts and Queries.
2. Write a program in prolog to implement simple arithmetic.
3. Write a program in prolog using Depth First Search.
4. Write a program in prolog using Best First Search.
5. Write a program in prolog for handling the list and its operations.

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

AUTOMATION SYSTEM DESIGN

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

CO No	Course Outcome	PO	BTL
1	Understand the design principles of automation and its application in an automated manufacturing system	1	1
2	Analyze pneumatic sub-systems of an automated manufacturing system in terms of design, operation and control aspects	4	3
3	Analyze hydraulic sub-systems of an automated manufacturing system in terms of design, operation and control aspects	4	3
4	Understand programmable automation with regard to the computer integrated manufacturing system	2	4

Syllabus:

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

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

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

INDUSTRIAL AUTOMATION AND CONTROL

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

CO No	Course Outcome	PO	BTL
1	Understand the concepts industrial automation and measurement systems	1	2
2	Apply the controllers in automation	3	3
3	Analyze and select a suitable PLC system for the given application	4	4
4	Apply the concepts of control systems for industrial automation	3	4

Syllabus:

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems,

Measurement Systems Specifications, Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of Level, Humidity, pH, Signal Conditioning Circuits, Estimation of errors and Calibration.

Introduction to Process Control, P-I-D Control, Controller Tuning, Implementation of P-I-D Controllers, Special Control Structures: Feedforward and Ratio Control, Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Split Range Control

Introduction to Sequence/Logic Control and Programmable Logic Controllers, Relay Ladder Logic, Scan Cycle, RLL Syntax, Structured RLL Programming, The PLC Hardware environment

Control of Machine tools: Introduction to CNC Machines, Analysis of a control loop.

Introduction to Actuators: Hydraulic Actuator Systems: Principles, Components
Pneumatic Control Systems: Components, Pneumatic Control Systems

Text Books:

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

LIST OF EXPERIMENTS

1. Different applications of Push buttons.
2. Working of different types of Timers.
3. Working of different types of Counters.
4. Sequential operation of ON/OFF of a set of lights.
5. Latching and Unlatching of a Motor.
6. Automatic indication of water tank level.
7. Traffic lights indication.
8. Logic Gates
9. Latching and Unlatching
10. Interlocking
11. Sequential operation of ON/OFF of a set of lights
12. Counters
13. Forward and Reverse direction control of Motors.

INDUSTRIAL HYDRAULIC AND PNEUMATIC SYSTEMS

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

CO No	Course Outcome	PO	BTL
1	Learn the concepts hydraulic or pneumatic actuation system	1	2
2	Analyze diagnose maintenance problems of hydraulic and pneumatic system	4	3
3	Analyze required components to develop an automation system using pneumatics and hydraulic system	3	3
4	Develop circuits for controlling hydraulic and pneumatic using PLC	2	4

Syllabus:

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

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

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

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

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

Text Books:

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

Reference Books:

1. Majumdar, S.R, "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2003.
2. Rohner P, "Fluid Power Logic Circuit Design – Analysis, Design Method and Worked Examples", Macmillan Press Ltd., UK, 1979.
3. Sudin Izman and Venkatesh V C, "Precision Engineering", Tata Mcgraw-Hill Inc.New Delhi , 2007.
4. Werner Deppert and Kurt Stoll, "Pneumatic Controls : An Introduction to Principles", Vogel-Druck Wurzburg, Germany, 1975.
5. Pippenger J.J Tyler G Hicks, "Industrial Hydraulics", Mcgraw-Hill, USA, 2007

List of Experiments:

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

INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS

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

CO No	Course Outcome	PO	BTL
1	Understand the concepts of robot, sensors and their applications in robots	1	2
2	Learn material handling equipment used both in automated and non-automated systems	1	2
3	Analyze and select a suitable material handling system for the given application	4	4
4	Apply the various applications of robots in material handling	3	3

Syllabus:

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

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

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

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

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

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

Text Books:

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

Reference Books:

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

MICROCONTROLLER AND PLC

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

Co. No	Course Outcome	PO	BTL
1	Understand the concept of 8051 microcontroller	PO1	2
2	Design the 8051 microcontroller	PO1	4
3	Understand the concept of PLC	PO1	2
4	Write ladder logic in Programmable logic controllers.	PO3	4

Syllabus:

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

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

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

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

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

Text Books:

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

Reference Books:

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

List of Experiments:

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

MECHATRONICS SYSTEM DESIGN

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

CO No	Course Outcome	PO	BTL
1	Understand the approach used for mechatronic system design and relevant considerations	1	2
2	Apply the suitable sensors and actuators used in a Mechatronic system	3	3
3	Analyze signal conditioning interface in a Mechatronic system and implementation of control systems	4	3
4	Modeling and Simulation for the Mechatronic System design perspective	3	4

Syllabus:

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

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

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

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

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

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

Case Studies

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 MATLAB
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 MATLAB
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

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

CO No	Course Outcome	PO	BTL
1	Able to know the Basics of Computation, Algorithms, and Functional Programming.	1, 5	2
2	Able understand the Iterative style, recursive style, and efficiency issues in programming.	1, 5	2
3	Able to understand the Basics of imperative style programming, Assertions, and Loop invariants.	1, 5	2
4	Able to understand Top down design, Step-wise refinement, structures, encapsulation, and object-oriented programming.	1, 5	2
5	Able to Apply the theoretical concepts of programming to develop and execute the programs.	1, 5	3

Syllabus:

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

Text Books:

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

DATA ANALYTICS

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

CO No	Course Outcome	PO	BTL
1	Able to know the Basics of Descriptive Statistics.	1, 5	2
2	Able understand the Inferential Statistics.	1, 5	2
3	Able to understand the Basics of Regression & ANOVA.	1, 5	2
4	Able to understand Prescriptive analytics.	1, 5	2
5	Able to Apply the theoretical concepts of data analytics to solve problems.	1, 5	3

Syllabus:

Descriptive Statistics: Introduction to the course Descriptive Statistics Probability Distributions

Inferential Statistics: Inferential Statistics through hypothesis tests Permutation & Randomization Test

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

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

Text Books:

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

PYTHON

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

CO No	Course Outcome	PO	BTL
1	Able to know the Basics of Programming, and Python.	1, 5	2
2	Able understand Lists, Function definition, Sorting, Passing functions.	1, 5	2
3	Able to understand Exception handling, Input / output, File handling, String processing, Backtracking, Scope, Data structures.	1, 5	2
4	Able to understand Classes, Objects and user defines data types.	1, 5	2
5	Able to Apply the theoretical concepts of python to develop and execute the programs.	1, 5	3

Syllabus:

Introduction to programming
Basics of Python
Lists, Inductive function definition, Sorting
Sorting, Tuples, Dictionaries, Passing functions, List comprehension
Exception handling, Input / output, File handling, String processing
Backtracking, Scope, Data structures, Stacks, Queues and heaps
Classes, Objects and user defines data types

Text Books:

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

MACHINE LEARNING

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

CO No	Course Outcome	PO	BTL
1	Able to know the Basics of Machine Learning.	1, 5	2
2	Able understand Model Validation Approaches, Discriminant Analysis.	1, 5	2
3	Able to understand Random Forest, Neural Networks Deep learning.	1, 5	2
4	Able to understand Clustering, Associative Rule Mining, and Challenges for big data analytics.	1, 5	2
5	Able to Apply the theoretical concepts of Machine Learning to solve problems.	1, 5	3

Syllabus:

Machine Learning: Introduction and Concepts

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

Supervised Learning with Regression and Classification techniques -1:
Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines.

Supervised Learning with Regression and Classification techniques -2:
Ensemble Methods: Random Forest, Neural Networks Deep learning.

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

Text Books:

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

ARTIFICIAL INTELLIGENCE

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

CO No	Course Outcome	PO	BTL
1	Introduction to AI, Understand about intelligence, knowledge and Artificial Intelligence, techniques of AI as a State space search, Production Systems.	1, 3	2
2	Problem solving by Search, Heuristic Search, Randomized search techniques and Finding Optimal paths	2, 5	3
3	Analyze the appropriate methodologies for problem decompositions, planning and constraint data constraint satisfactions.	1, 5	3
4	Understand Knowledge Representation using Predicate Logic, Representing Knowledge using Rules, Semantics Nets, Frames and Conceptual dependencies.	1, 2	2

Syllabus:

Introduction: Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI,Agents.

State Space Search: Depth First Search,Breadth First Search, DFID.

Heuristic Search: Best First Search, Hill Climbing,Beam Search, Tabu Search.

Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony Optimization.

Finding Optimal Paths: Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search.

Problem Decomposition: Goal Trees,AO*, Rule Based Systems, Rete Net. Game Playing: Minimax Algorithm, AlphaBeta Algorithm, SSS*.

Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning,Plan Space Planning, Graphplan, Constraint Propagation.

Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.

Text Books:

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

Reference Books:

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

FUZZY LOGIC AND NEURAL NETWORKS

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

CO No	Course Outcome	PO	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	1, 2	2
2	Applications of Fuzzy sets for real time problems of various domains using Fuzzy Logic control system	2, 5	2
3	Understand Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back propagation, Associative Learning,	1, 2	2
4	Understanding Neuro Fuzzy Approaches, Computing with Neural Nets and Applications of Neural Network in various Domains	1, 2	2

Syllabus:

Basic Concepts of Fuzzy Sets, Fuzzy Logic, Zadeh's Extension Principle, Operations on Fuzzy Sets, Fuzzy Measures, Probability and Possibility Measures, Fuzzy Inference Methodologies, Fuzzy Relations, Applications of Fuzzy Sets in Management, Decision Making, Medicine and Computer Science.

Neural Network: Neural Model and Network Architectures, Perceptron Learning, Supervised Hebbian Learning, Back propagation, Associative Learning, Competitive Networks, Hopfield-Network, Computing with Neural Nets and Applications of Neural Network.

Text Books:

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

Reference Books:

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

ROBOTICS

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

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

MECHATRONICS

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

CO No	Course Outcome	PO	BTL
1	Identify appropriate sensor, Identify appropriate actuation system for a given application.	2	3
2	Identify appropriate microcontroller for a given application and to build a mathematical Model of system for evaluating open loop system performance and behaviour.	2	3
3	Identify an appropriate closed loop control strategy to attain the desired system behaviour.	2	3
4	Suggest a Mechatronic product design for a given application and evaluate its performance.	3	3

Syllabus:

INTRODUCTION TO MECHATRONICS: Introduction, Elements of Mechatronic system, Applications.

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

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

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

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.

ROBOTICS

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

CO No	Course Outcome	PO	BTL
1	Analyze the anatomy of existing robotic systems and their performance specifications, end effectors etc	3, 5	4
2	Analyze a robotic system with respect to the suitable sensors, actuators for its performance.	3	4
3	Understand manipulator kinematic analysis and joint trajectory plan for a given end effector.	3	2
4	Classification of Robot Languages, Comprehensive identification of suitable Robotic system for various applications.	5	4

Syllabus:

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

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

OPERATIONS RESEARCH

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

CO No	Course Outcome	PO	BTL
1	Model and Solve for the optimum solutions using LPP	5	3
2	Model and Find the Optimized solutions for the problems in the field of Transportation and Management / Assignments.	5	3
3	Model and Optimize Game theory, Dynamic Part Programming, Queuing Theory, Inventory Control & Simulation Problems	5	3
4	Understand and solve the Concepts related to PERT/CPM	5	3

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