(DEEMED TO BE UNIVERSITY)

MECHANICAL ENGINEERING

CURRICULUM & SYLLABUS

APPLICABLE FOR B.TECH. STUDENTS
ADMITTED IN A.Y. 2016-17

B.Tech Mechanical Engineering 2016-17 Course Structure					
S.No	**Course Code**	**Course Name**	**L-T-P**	**Cr**	**Pre-Req.**
I	**HUMANITIES & SOCIAL SCIENCES**				
1	15EN1101	Rudiments of Communication Skills	2-0-0	2	NIL
2	15EN2103	Professional Communication Skills	0-0-4	2	NIL
3	15EN1202	Interpersonal Communication Skills	2-0-0	2	NIL
4	15EN3206	Corporate Communication Skills	0-0-4	2	NIL
5	16MB4057	Economics for Engineers	2-0-0	2	NIL
6	16GN1001	Ecology and Environment	2-0-0	2	NIL
7	15GN1002	Human Values and Professional Ethics	2-0-0	2	NIL
		Credits		**14**	
II	**BASIC SCIENCES**				
1	15MT1001	Single Variable Calculus and Matrix Algebra	2-2-2	4	NIL
2	15MT1203	Multivariate Calculus	2-2-2	4	NIL
3	15CY1001	Engineering Chemistry	2-2-2	4	NIL
4	16MT2002	Complex Variables And Transforms	3-0-0	3	NIL
5	16MT2104	Probability and Numerical Methods	3-1-0	4	NIL
		Credits		**19**	
III	**ENGINEERING SCIENCES**				
1	15PH1001	Engineering Materials	2-2-2	4	NIL
2	15CS1101	C Programming & Data Structures -I	2-4-2	5	NIL
3	15CS1201	C Programming & Data Structures -II	2-4-2	5	NIL
4	15GN1004	Introduction to Engineering	2-0-2	3	NIL
5	15ME1001	Mechanics	2-2-2	4	NIL
6	15ME1002	Engineering Graphics	0-0-6	3	NIL
7	15GN1003	Measurements	0-0-4	2	NIL
8	16ME1003	Thermodynamics	3-0-2	4	NIL
9	15EE2202	Basics of Electrical and Electronics Engineering	2-2-2	4	NIL
		Credits		**34**	
IV	**PROFESSIONAL CORE COURSES**				
1	16ME2106	Strength of Materials	3-0-2	4	15ME1001
2	16ME2104	Fluid Mechanics & Hydraulic Machines	3-0-2	4	NIL
3	16ME2207	Machine Drawing	0-0-4	2	15ME1002
4	16ME2105	Metallurgy	3-0-2	4	15PH1001
5	16ME2108	Manufacturing Technology	3-0-2	4	NIL
6	16ME2210	Kinematics of Machines	3-0-2	4	15ME1001
7	16ME2211	Metal Cutting and Metal Forming	3-0-0	3	NIL
8	16ME2212	Vapour Power Systems	3-0-2	4	16ME1003

9	16ME3114	Gas Power Systems	3-0-2	4	16ME1003
10	16ME3115	Dynamics of Machines	3-0-2	4	16ME2210
11	16ME3116	Machine Tools & Metrology	3-0-2	4	NIL
12	16ME3117	Internal Combustion Engines	3-0-2	4	16ME1003
13	16ME3118	Operations Research	3-2-0	4	NIL
14	16ME3219	Robotics	3-0-0	3	16ME2210
15	16ME3220	Heat Transfer	3-0-2	4	16ME2104
16	16ME3221	Design of Machine Elements	3-2-0	4	16ME2106
17	16ME3222	Computer Integrated Manufacturing	3-0-2	4	16ME3116
18	16ME3223	Production and Operations Management	3-2-0	4	NIL
19	16ME4124	Mechatronics	3-0-2	4	NIL
20	16ME4125	Design of Transmission Elements	3-2-0	4	16ME3221
		Credits		**76**	
V	**TECHNICAL SKILL COURSES**				
1	16TS701	Problem Solving techniques in Design (Skilling for Engineers-1)	0-0-4	2	NIL
2	16TS702	Problem Solving techniques in Thermal (Skilling for Engineers-2)	0-0-4	2	NIL
3	16TS703	Manufacturing Technologies (Skilling for Engineers-3)	0-0-4	2	NIL
4	16TS704	Control Systems for Machines (Skilling for Engineers-4)	0-0-4	2	NIL
		Credits		**8**	
Counseling & Cocurricular Activities					
1	16GN1101	Counseling -1	0-0-1	0	NIL
2	16GN1202	Counseling -2	0-0-1	0	NIL
3	16GN1107	Cocurricular Activity -1	0-0-2	0	NIL
4	16GN1208	Cocurricular Activity -2	0-0-2	0	NIL
VI	**PROFESSIONAL ELECTIVES**				
1	PE	Prof. Elective-1	2-0-2	3	NIL
2	PE	Prof. Elective-2	2-0-2	3	NIL
3	PE	Prof. Elective-3	2-0-2	3	NIL
		Credits		**9**	
VII	**OPEN ELECTIVES**				
1	15GN2205	Open Elective -1(Coding Skills)	0-0-10	5	NIL
2	OE	Open Elective -2	3-0-0	3	NIL
3	OE	Foreign Language	3-0-0	3	NIL
		Credits		**11**	
VIII		**PROJECT**			
1	16IE2246	Industrial Training	0-0-4	2	NIL
2	16ME3145	Mini Project	0-0-4	2	NIL
3	16IE3247	Term Paper	0-0-4	2	NIL

4	16IE4048/ 16IE4050	Project (Part I) / Practice School	0-0-12	6	NIL
5	16IE4049/ 16IE4050/ 16IE4051	Project (Part II) / Practice School/ Internship	0-0-12	6	NIL
		Credits		**18**	
		Total Credits		**189**	

List of Professional Electives							
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Cr**	**Pre-requisite**
Design Specialization							
1	16ME4051	Finite Element Method	2	0	2	3	16ME2106
2	16ME4052	Theory of Elasticity and Plasticity	3	0	0	3	16ME2106
3	16ME4053	Advanced Vibrations and Noise Control	2	0	2	3	16ME3115
4	16ME4054	Computer Aided Design	2	0	2	3	16ME2207
5	16ME4055	Creep, Fatigue and Fracture Mechanics	3	0	0	3	15ME1001
6	16ME4056	Advanced Strength of Materials	2	0	2	3	16ME2106
7	16ME4057	Mechanics of Composite Materials	2	0	2	3	15ME1001
Strategic Manufacturing Specialization							
8	16ME4061	Modern Manufacturing Processes	2	0	2	3	16ME2108
9	16ME4062	Advanced Materials	3	0	0	3	16ME2105
10	16ME4063	Additive Manufacturing	2	0	2	3	16ME2108
11	16ME4064	Tool Engineering and Design	2	0	2	3	16ME2211
12	16ME4065	Flexible Manufacturing Systems	2	0	2	3	16ME3222
13	16ME4066	Geometric Dimensioning and Tolerancing	2	0	2	3	Nil
14	16ME4067	Reverse Engineering and Rapid Prototyping	3	0	0	3	Nil
Automobile Engineering Specialization							
15	16ME4071	Automobile Engineering	2	0	2	3	16ME3117
16	16ME4072	Automobile Engine Design	2	0	2	3	16ME3221
17	16ME4073	Automotive Transmission	2	0	2	3	16ME3115
18	16ME4074	Autotronics & Safety	2	0	2	3	16ME4124

19	16ME4075	Alternative Energy Sources for Automobiles	2	0	2	3	Nil
20	16ME4076	Automotive Electrical and Electronics System	2	0	2	3	16ME4124
21	16ME4077	Automobile Engine System and Performance	2	0	2	3	16ME3117
Autotronics Specialization							
22	16ME4081	Automotive Sensor and Applications	2	0	2	3	Nil
23	16ME4082	Autotronics	2	0	2	3	Nil
24	16ME4083	Electronic Engine Management System	2	0	2	3	Nil
25	16ME4084	Instrumentation in Automotive Industries	2	0	2	3	Nil
26	16ME4085	Autotronics and Vehicle Intelligence	2	0	2	3	Nil
27	16ME4086	Automotive Systems	2	0	2	3	Nil
28	16ME4087	Programmable Logic Controller	2	0	2	3	Nil
Robotics and Mechatronics Specialization							
29	16ME4091	Artificial Intelligence for Robotics	2	0	2	3	Nil
30	16ME4092	Automation System Design	2	0	2	3	Nil
31	16ME4093	Industrial Automation and Control	2	0	2	3	Nil
32	16ME4094	Industrial Hydraulic and Pneumatic Systems	2	0	2	3	Nil
33	16ME4095	Industrial Robotics and Material Handling Systems	2	0	2	3	Nil
34	16ME4096	Micro Controllers and PLC	2	0	2	3	Nil
35	16ME4097	Mechatronics System Design	2	0	2	3	Nil
Soft Computing and Data Analytics							
36	16ME4101	Programming Skills	2	0	2	3	Nil
37	16ME4102	Data Analytics	2	0	2	3	Nil
38	16ME4103	Python	2	0	2	3	Nil
39	16ME4104	Machine Learning	2	0	2	3	16ME4102
40	16ME4105	Artificial Intelligence	2	0	2	3	16ME4102
41	16ME4106	Fuzzy Logic and Neural Networks	2	0	2	3	Nil
42	16ME4107	Robotics	2	0	2	3	Nil

List of Open Electives								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	15BT30A1	IPR & Patent Laws	3	0	0	0	3	Nil
2	15CE30A2	Environmental Pollution Control Methods	3	0	0	0	3	Nil
3	15CE30A3	Solid and Hazardous waste management	3	0	0	0	3	Nil
4	15CE30A4	Remote Sensing & GIS	3	0	0	0	3	Nil
5	15CE30A5	Disaster Management	3	0	0	0	3	Nil
6	15CS30A6	Fundamentals of DBMS	3	0	0	0	3	Nil
7	15CS30A7	Fundamentals of Software Engineering	3	0	0	0	3	Nil
8	15CS30A8	Fundamentals of Information Technology	3	0	0	0	3	Nil
9	15EC30A9	Image Processing	3	0	0	0	3	Nil
10	15EM30B1	Linux Programming	3	0	0	0	3	Nil
11	15EM30B2	E-Commerce	3	0	0	0	3	Nil
12	15EE30B3	Renewable Energy Sources	3	0	0	0	3	Nil
13	15ME30B4	Robotics	3	0	0	0	3	Nil
14	15ME30B5	Mechatronics	3	0	0	0	3	Nil
15	15ME30B6	Operations Research	3	0	0	0	3	Nil
16	15PH30B7	Nano Materials & Technology	3	0	0	0	3	Nil
17	15PE30B8	Subsea Engineering	3	0	0	0	3	Nil
18	15PE30B9	Oil and Gas Management	3	0	0	0	3	Nil
19	15GN30C1	Self Development	3	0	0	0	3	Nil
20	15GN30C2	Indian Culture and History	3	0	0	0	3	Nil
21	15GN30C3	Emotional Intelligence	3	0	0	0	3	Nil
22	15GN30C4	Professional Ethics and Values	3	0	0	0	3	Nil
23	15GN30C5	Behavioral Sciences	3	0	0	0	3	Nil

List of Management Electives								
1	15MB3051	Paradigms in Management thought	3	0	0	0	3	Nil
2	15MB3052	Indian Economy	3	0	0	0	3	Nil
3	15MB3053	Managing Personal Finances	3	0	0	0	3	Nil
4	15MB3054	Basics of Marketing for Engineers	3	0	0	0	3	Nil
5	15MB3055	Organization Management	3	0	0	0	3	Nil
6	15MB3056	Resources Safety and Quality Management	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	15GN3051	Arabic Language	3	0	0	0	3	Nil
2	15GN3052	Bengali Language	3	0	0	0	3	Nil
3	15GN3053	Chinese Language	3	0	0	0	3	Nil
4	15GN3054	French Language	3	0	0	0	3	Nil
5	15GN3055	German Language	3	0	0	0	3	Nil
6	15GN3056	Hindi Language	3	0	0	0	3	Nil
7	15GN3057	Italian Language	3	0	0	0	3	Nil
8	15GN3058	Japanese Language	3	0	0	0	3	Nil
9	15GN3059	Kannada Language	3	0	0	0	3	Nil
10	15GN3060	Russian Language	3	0	0	0	3	Nil
11	15GN3061	Simhali Language	3	0	0	0	3	Nil
12	15GN3062	Spanish Language	3	0	0	0	3	Nil
13	15GN3063	Tamil Language	3	0	0	0	3	Nil
14	15GN3064	Urdu Language	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	16ME5001	Advanced Heat and Mass Transfer	3	0	2	0	4	16ME3220
2	16ME5002	Computational Fluid Dynamics	3	0	2	0	4	16ME2104
3	16ME5003	Incompressible and Compressible flows	3	0	2	0	4	16ME2104
4	16ME5004	Mechanisms Design and Simulation	3	0	2	0	4	16ME2210
5	16ME5005	Advanced Mechanics of Solids	3	0	2	0	4	16ME2106

Minor in Industrial Engineering								
List of Minor Degree Courses								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**S**	**Cr**	**Pre-requisite**
1	16ME3126	Industrial Engineering Techniques	3	0	2	0	4	Nil
2	16ME3118	Operations Research	3	0	2	0	4	Nil
3	16ME3127	Engineering Management	3	0	2	0	4	Nil
4	16ME3128	Work Study and Ergonomics	3	0	2	0	4	Nil
5	16ME3129	Operations Management	3	0	2	0	4	Nil

HUMANITIES

AND

SOCIAL SCIENCES

RUDIMENTS OF COMMUNICATION SKILLS

Mapping of the course outcomes with Program outcomes:

CO	Course outcome	PO	BTL
CO 1	Remember speech sounds and apply stress and intonation rules to enhance pronunciation skills.	10	2
CO 2	Understand writing strategies and apply those by using the basic and advanced concepts of grammar.	10	2
CO 3	Understand the types of texts and tone of the author.	10	2
CO 4	Understand the importance of interpersonal skills	10	2

Syllabus:

Speaking & listening skills - Vowels in English, Diphthongs, Consonants, Word stress, Intonation, Words in Groups - English Conversation Practice, Difference between British English and American English, Received Pronunciation and Dialects, American Spelling and American Grammar , American Pronunciation, Listen and respond, Speak and Listen, Listen and Speak.

Speaking and listening exercises from Effective Speech Richard W Clark- Speaking to persuade, listening to understand.

General writing skills - Paragraph Writing: Seven 'C's of writing , Identifying & writing Topic sentences, Linkers, Coordinates, Sequencing, Letter Writing: Formal & Informal formats- Full block, Semi block, Modified block- Types & tone of letters, content & brevity, Note Making & Note Taking.

Reading skills - Reading comprehension Practice exercises (TOEFL Level) - Reading for information, Reading for specifics - Theme, Attitude, Identifying tone.

Soft skills - Introduction to soft skills, Body Language, Postures, Gestures, Eye contact, Personality styles, Grooming, Dress code, Group discussion - Format, Do s and Don'ts, scoring method

Text book:

1. Material produced by the Dept.

References Book:

1. Mark Hancock and Sylvie Donna, "English pronunciation in use: Intermediate", 2nd edition,Cambridge publication.
2. Krishna Mohan & N P Singh, "Speaking English Effective (English) 2nd Edition", Laxmi Publications-New Delhi, (2005).

3. Mr. Gopalaswamy Ramesh et al, "The Ace of Soft Skills", Pearson publishers, (2010).
4. Richard W.Clark, "Effective speech", Glencoe Pub. Co., (1988).

INTERPERSONAL COMMUNICATION SKILLS

Mapping of Course outcomes with Program outcomes:

CO No	Course outcome	PO	BTL
CO 1	Understand the method of identifying the meaning of words from the context and form sentences using words.	10	2
CO 2	Understand and analyze seven types of reading techniques and improve reading speed.	10	2
CO 3	Understand and apply writing strategies for office/ formal communication.	10	2
CO 4	Understand and analyze different cultures and the importance of empathy in cross-cultural communication.	10	2

Syllabus:

Speaking skills - Interactive Skills: Group Activities taken from **keep Talking by Mary Spratt; at the chalk face Oxford word skills (Units 21-50)**

Vocabulary Skills -Basic Word List (900 words), Identifying meaning from context, Antonyms and Synonyms (Level 1)

Writing skills - Inter Office Communication and Intra Office Communication - Memo Writing, Circulars, Emails -

Netiquette, Formal and Informal Formats, Clear, concise expression, Dos and Don'ts of Email writing.

Reading skills - Types of Reading - Vertical Reading, Identifying the central idea, Speed Reading, and Seven techniques to improve reading speed.

Soft skills-II (Case Studies, Vodcasts and Role Play - ICT enabled) - Cultural sensitivity, Empathy and understanding, Diversity and Acculturation

Text Books:

1. Aruna Koneru, "Professional Communication", Tata Mc Graw- Hill Publishing Company, New Delhi, (2008)t.
2. Asha Kaul, "Effective Business Communication", PHI Learning Private Limited, New Delhi, (2011).
3. Sharon J. Gerson, Steven M Gerson, "Technical Writing Process and Product" (third edition), Pearson Education, Asia.

References Book:

1. Frangoise Grelle, "Developing Reading Skills: A Practical Guide to Reading Comprehension Exercises", Cambridge University Press, (1981)
2. Eric H. Glendinning, Beverly Holmström, "Study Reading: A Course in Reading Skills for Academic Purposes", Cambridge University Press, (2004)
3. Content Area Reading: Teaching and Learning in an Age of Multiple Literacies, Video-Enhanced Pearson eText, Maureen, Pearson Education (US), (2014)

PROFESSIONAL COMMUNICATION SKILLS

Mapping of Course outcomes with Program outcomes:

CO No	Course outcome	PO	BTL
CO 1	Understand the concept of Group Discussion and listen and speak effectively during the discussion.	10	2
CO 2	Understand and improve learners' competency in competitive English and apply the principles of grammar in real life contexts.	10	2
CO 3	Understand skimming & scanning, and apply the types of reasoning in comprehending the information.	10	2
CO 4	Understand the mechanics and application of presentation skills.	10	2

Syllabus:

Speaking skills - Group Discussions (Level 1) - 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 (exercises) - Sentence Completion (Single blank TOEFL level), Analogies, One word substitutes, Mechanics of Grammar - Correction of Sentences, Errors in grammar and usage**,** Jumbled Sentences / Paragraph scramble, Rephrasing.

Reading skills level 2 (gre gmat cat level) - Skimming and scanning, Word Perception tests, Reading speed development (7 skill exercises), Searching for key words, Reasoning Skills - Analytical Reasoning, Critical Reasoning, Language Specific Reasoning

Soft skills III - Seminars, Presentations, Case Studies: Role Plays and Simulated Presentation.

Text Books:

1. Edgar Thorpe and Showick Thorpe, "Objective English"3rd Ed,Pearson Publishers, (2010).
2. R. S. Aggarwal, "Objective General English", S Chand Publishers, New Delhi.
3. **Mortimer J. Adler, Charles Van Doren,** Simon and Schuster, "How to Read a Book: The Classic Guide to Intelligent Reading" , (2014).

References Book:

1. **Bob Underwood, Jesse Zuck, "P**hilosophy Skills Book: Exercises in Philosophical Thinking, Reading, and... **Chris Case",** A&C Black, (2012)
2. Joanne Carlisle, "**Reasoning and Reading Level 1",** School Specialty Intervention, (1999)
3. Patsy Mc Carthy & Caroline Hatcher, "Presentation skills. The essential guide for students", Sage publications, (2002).

CORPORATE COMMUNICATION SKILLS

Mapping of Course outcomes with Program outcomes:

CO. No	Course outcome	PO	BTL
CO 1	Understand and analyze the depth of a topic and use the advanced levels in creative speaking and debating.	8, 10	2
CO 2	Understand and analyze various strategies involved in writing an essay and apply various styles in writing.	8, 10	2
CO 3	Understand and analyze the given text critically and answer questions on critical reasoning based on the given information.	8, 10	2
CO 4	Acquire knowledge on various employability skills & analyze a situation and develop adaptability.	8, 10	2
CO5	Apply the Concepts of basic geometry and their importance while solving the problems.	8, 10	2

Syllabus:

Speaking skills - Speaking and listening exercises, From Effective Speech Richard W Clark, Storytelling and interpretation - Speaking to Explain, Speaking Activities - JAM, Information Gap / Creating stories, Picture Description, Debate

Writing skills - Five Types of Essays (TOEFL IBT pattern) - Agree or disagree, which you prefer and why, If / imaginary, Description / Explanation, Comparison and Contrast, **Styles in Writing: Modes of Discourse -** Narration, Description, Exposition, Argumentation/ Persuasion

Reading skills - Reading Comprehension - Critical Reading, Searching for implied meanings, Answering questions on theme, tone, point of view, title etc.

Soft skills - Interview Skills**,** Mock Interviews**,** Writing personal profile & Company profile**,** Answering unconventional HR questions**,** Dress Code**,** Dining etiquette**,** Interpersonal skills.
Quantitative reasoning -2: Geometry - Circles, Lines and Angles, Polygons, Quadrilaterals, Three-Dimensional Figures, Triangles – **Data Analysis-** Counting Methods, Data Interpretation Examples, Distributions of Data, Random Variables, and Probability Distributions, Graphical Methods for Describing Data, Numerical Methods for Describing Data, Probability.

Text Books:

1. Sanjay Kumar & Pushp Lata, "Communication Skills", Oxford University Press, (2014)
2. Akanksha Makwana, Heeral Bhatt, "IELTS Essay Booster (One Stop Destination for the Writing Module) (English)", MK Book Distributors- Ahmedabad.

References Book:

1. GRE Analytical Writing: Solutions to the Real Essay Topics (English), Create space Independent Pub
2. Critical Reading: English for Academic Purposes **1st Edition,** Pearson Education ESL; 1 edition, (2015)
3. **Eric H. Glendinning, Beverly Holmström, "**Study Reading: A Course in Reading Skills for Academic Purposes", Cambridge University Press, (2004).

HUMAN VALUES AND PROFESSIONAL ETHICS

Mapping of the course outcomes with Program outcomes:

CO No	Course outcome	PO	BTL
CO1	Understand and identify the basic aspiration of human beings	8	1
CO2	Envisage the roadmap to fulfill the basic aspiration of human beings.	8	2
CO3	Analyze the profession and his role in this existence.	8	2

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.

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).

BASIC SCIENCES

SINGLE VARIABLE CALCULUS AND MATRIX ALGEBRA

Mapping of Course outcomes with Program outcomes:

CO.No	Course outcome	PO	BTL
CO-1	Formulate physical laws and relations mathematically in the form of first order differential equations and identify a method for solving and interpreting the results.	1	2
CO-2	Formulate physical laws and relations mathematically in the form of second/higher order differential equations and identify a method for solving and interpreting the results.	1	2
CO-3	Provide solutions for Fourier series of periodic/non-periodic phenomenon in models involving differential equations.	1	2
CO-4	Apply numeric solution methods for a system of linear algebraic equations and application oriented matrix eigenvalue problems.	1	2
CO-5	Verify the solution of problems through MATLAB.	5	2

Syllabus:

Differential Equations: Definitions and terminology and mathematical models used in a 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. Erwin Kreyszig ,"Advanced engineering mathematics". JOHN WILEY Publishers , 10 th edition.
2. Green Berg ,"Advanced engineering mathematics", PHI publishers, 2 nd edition.

Reference Books:

1. Differential equations for engineers, WEI-CHAU XIE, Cambridge University Press, New York.
2. Dr. B.S. Grewal ,"Higher Engineering Mathematics',Publisher: Khanna,New Delhi.
3. S.C. Chapra ,"Advanced Numerical methods with Matlab" , Tata Mc-Graw Hill.

MULTI VARIATE CALCULUS

Mapping of Course outcomes with Program outcomes:

CO No.	Course outcome	PO	BTL
CO 1	Determine the maximum and minimum values for the function involving two variables	2, 5	3
CO 2	Calculate the length of the arc, area, volume of the surface of a solid revolution	2, 5	3
CO 3	Model the given phenomena as a partial differential equations of first and second orders	2, 5	3
CO 4	Solve the partial differential equations by analytical and finite difference methods	2, 5	3
CO 5	Verify the solution of problems through MATLAB.	2, 5	3

Syllabus:

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

Integral Calculus: Line integrals- length of the arc, 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

Modeling with partial differential equations: Formation of partial differential equations, solutions of first order linear and nonlinear PDEs by Lagrange and Charpit's methods, 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", 10th Edition, , John Wiley &Sons, Inc, Newyork .(2015)
2. Nakhle H Asmar, "Partial differential equations with Fourier series and boundary value problems", Second edition Pearson Pub.

Reference Books:

1. Michael Greenberg, Advanced Engineering Mathematics. 2nd Ed, **Prentice Hall, USA.**

2. Zafar Ahsan, Differential equations and their applications, 2nd Ed., PHI

COMPLEX VARIABLES AND TRANSFORMS

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

CO No	Course outcome	PO	BTL
1	Apply Cauchy-Riemann equations to test the analyticity of a complex function and Compute the complex integrals, using Cauchy theorem and Cauchy Integral formulae.	1	1,2
2	Represent analytic functions as Taylor, Maclaurine and Laurent series expansions and compute real and complex integrals using the Residue theorem. Also transform complex functions using bilinear transformation.	1	1,2
3	Apply Laplace transform techniques to solve differential equations	1	1, 2
4	Compute Fourier transforms using integrals and solve differential equations	1	1, 2

Syllabus:

Complex variables: Complex Functions: Limit, Continuity, differentiability, analytic functions, Cauchy-Riemann equations, Laplace equations, Harmonic functions, conformal mapping, Cauchy integral theorem, Cauchy integral formula,

Power series: Taylor series, Laurent series, zeros, singularities, residues and evaluation of real integrals.

Transform Techniques: Laplace transform: Inverse transform, Linearity, Laplace transforms of derivatives and integrals, partial fractions, unit step function, impulse function, applications of Laplace transform for solving differential equations.

Fourier transform: Fourier integral, Fourier sine and cosine transform, convolution, applications of Fourier transform for solving differential equations.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, John Wiley &Sons, Inc, New York. (2015).
2. John H Mathews and Russel Howell, Complex analysis for Mathematics and engineering, Narosa publishing House, Newdelhi.

Reference Books:

1. Dr. B.S. Grewal, Higher Engineering Mathematics, Khanna Pub, New Delhi.
2. Raywylie C and Louis C Barrat, Advanced Engineering Mathematics, Tata Macgrawhill, New Delhi.

ENGINEERING CHEMISTRY

Mapping of Course outcomes with Program outcomes:

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

Syllabus:

ENERGY SOURCES: Chemical Energy: Basic concepts of electrochemistry – electrode potential, origin of single electrode potential, Galvanic cells, Reference electrodes- Determination of pH using glass electrode. Chemistry, construction and engineering aspects of Primary (zinc-carbon cell) and secondary (lead-Acid cell, Ni-Cd cell, Lithium cells) and fuel cells– Hydrogen–Oxygen fuel cell, advantages of fuel cell. Nuclear Energy: Fission and fusion– power rectors– Atomic pile applications. Solar Energy: Methods of utilization– thermal conversion– Liquid Flat– Plate collector, photovoltaic conversion- solar cell and Applications. Thermal Energy: Fuels, classification– Solid fuels – coal – Liquid fuels – primary – petroleum – cracking, knocking, synthetic petrol, gaseous fuels– natural gas, calorific value of fuel– HCV, LCV. CORROSION AND ITS CORROSION CONTROL: Introduction, causes and different types of corrosion and effects of corrosion. Theories of corrosion– Chemical, Electrochemical corrosion and corrosion reactions; 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. Control Methods – Cathodic protection, sacrificial anode, impressed current cathode. Surface coatings: methods of application on metals- hot dipping, galvanizing, tinning, cladding, electroplating; Organic surface coatings– paints constituents and functions. WATER TREATMENT: 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, corrosion, priming & foaming. Softening of water: Internal and external treatments -Lime soda, Ion exchange process and Numerical problems. Desalination-reverse osmosis and electro dialysis - domestic water treatment POLYMERS AND PLASTICS: Definition – Types of polymerization – Mechanisms of polymerization. Effect of polymer structure on properties. 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: Poly acetylene, polyaniline, conduction, doping, applications. Liquid Crystal polymers: Characteristics and uses. Nano-Chemistry: Introduction, types of Nano materials, General methods of preparation of Nano materials, Applications. PHASE RULE: Definitions – phase, component, degree of freedom, phase rule equation. Phase diagrams – one component system: water system. Two component system lead - silver system, heat treatment based on iron-carbon phase diagram, hardening, annealing.

Text Book:

1. J C Kuriacose & J Rajaram ,"Chemistry in Engineering and Technology", Volume 2, , TMH, New Delhi.
2. Shashi Chawla, " text book of Engineering Chemistry," Dhanpat Rai , New Delhi.

Reference Books:

1. O G Palanna, ,"Engineering Chemistry", TMH, New Delhi.
2. B. Sivasankar," Engineering Chemistry", TMH, New Delhi.
3. Jain & Jain ,"Engineering Chemistry," , Dhanpat Rai Publishing Company. New Delhi.
4. C Parameswara Murthy, C V Agarwal and Andra Naidu ,"Engineering Chemistry", , B S Publications.

PROBABILITY AND NUMERICAL METHODS

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

CO No	Course outcome	PO	BTL
1	Apply the conditional probability and discrete distributions to suitable real- world situations.	1	1, 2
2	Apply continuous distributions to suitable real- world situations and also analyze bivariate data using correlation and regression analysis.	1	1, 2
3	Test for means-single and two sample means	1	1, 2
4	Identify different mathematical problems and reformulate them in a way that is appropriate for numerical treatment .	1	1, 2

Syllabus:

Probability: Introduction to Probability, Conditional probability and Baye's theorem. Random variables, distribution functions, binomial, Poisson, geometric, Normal and exponential distributions.

Inferential Statistics: Test for means-single and two sample means.

Numerical methods: Non-linear equations: False Position method, Newton's method, Convergence criteria, , Interpolation : Lagrange's polynomial, divided differences, Differentiation and integration- Numerical differentiation evenly spaced and unevenly spaced data, Numerical integration: Trapezoidal rule, Simpson's 1/3 and $3/8^{th}$ rule.

Text Books:

1. Richard A Johnson, Miller & Freund's, Probability and statistics for Engineers, Prentice Hall, New Delhi, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10 th Edition, John Wiley &Sons, Inc, New York. (2015)

Reference Books:

1. Dr. B.S. Grewal, Higher Engineering Mathematics, Khanna Pub, New Delhi.
2. S. C. Chapra, Advanced Numerical methods with MATLAB, Tata Mc Graw Hill publishers.

ENGINEERING SCIENCES

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.

INTRODUCTION TO ENGINEERING

Mapping of Course outcomes with Program outcomes:

CO No.	Course Outcome	PO	BTL
CO-1	Understand the basic principles of engineering design	6, 8	2
CO-2	Understand the aspects of critical thinking and problem solving in engineering	6, 8	2
CO-3	Apply to knowledge of critical thinking to frame real-world problems and provide basic solution approach to such problems from engineering perspective	6, 8	2
CO-4	Understand and analyze the possible career options in Engineering and develop strategic plan, career targets and mechanism to achieve the same.	6, 8	2

Syllabus:

History Of Engineering, What is Engineering, Fields of Specialization in Engineering, Engineering Design Process, Types of Engineering Design, Societal considerations in Engineering Design, The Engineer as a Professional: Characteristics And Responsibilities - Ideals And Obligations Of Professional Engineers - Engineering Ethics - Codes Of Engineering Ethics - Case Studies In Ethics, Career Paths for Engineers - Initial Career Profiles, Engineering Communication and Presentations: Brief Overview

LAB COMPONENT: MS Office- MS WORD, MS PPT, MS XCEL

Text Book:

1. George E Dieter and Linda C Schimidt ,"Engineering Design" , Mc Graw Hill Publications

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:

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

Reference Books:

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

C PROGRAMMING & DATA STRUCTURES-I

Mapping of Course outcomes with Program outcomes:

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

Syllabus:-

Introduction to C language, Control structures, Functions, recursive functions**.** storage classes and scope of variables. **Arrays-** passing arrays as parameters to functions. **Searching-** linear search, binary search, **Sorting-** Bubble sort, quick sort. Strings, operations on strings and Multidimensional arrays. Pointers, call by value Vs call by reference. Structures and Unions. Dynamic memory allocation. **Stack and Queue-** implementation of Stack, Queue, circular Queue. Infix, post-fix and prefix notations, Stack Applications - Evaluation of infix expression, conversion of infix to post-fix expressions using stacks. **Linked List-** Linked List vs Arrays, Creation, insertion, deletion of Singly linked list, Doubly linked list and Circular linked list . Linked list representation of Stack and Queues. **Trees-** Tree, Binary trees, Binary search tree:- Creation, Insertion, Deletion and Tree traversals.

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

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.
6. Jean Paul Trembly Paul G.Sorenson, "An Introduction To Data Structures with applications", 2nd Edition.

C PROGRAMMING & DATA STRUCTURES-II

Mapping of Course outcomes with Program outcomes:

CO No.	Course Outcome	PO	BTL
CO-1	Solve typical problems using computers and Programming	1, 2	4
CO-2	Apply linear Data Structures in solving problems	2	4
CO-3	Implement Non - Linear Data Structures	2	4
CO-4	Implement Height balanced trees & Hashing	1,2	4
CO-5	Apply the knowledge obtained by the course to solve real world problems	5	4

Syllabus:

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

Text Books:

1. Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language: ANSI C Version", 2/e, Prentice-Hall/Pearson Education-2005.
2. R. F. Gilberg, B. A. Forouzan, "Data Structures", 2nd Edition, Thomson India Edition-2005.
3. Mark Allen weiss, Data Structures and Algorithm Analysis in C, 2008, Third Edition, Pearson Education.

Reference Books:

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

ENGINEERING GRAPHICS

Mapping of Course outcomes with Program outcomes:

CO No.	Course Outcome	PO	BTL
CO-1	Draft Orthographic views, projections of planes and solids manually and by using CAD software Tool (AutoCAD)	5, 12	3
CO-2	Drafting Sectional views, Isometric views ,development of surfaces and perspectives views manually and by using AutoCAD	5, 12	3
CO-3	Project based workshop to prepare different models with the aid of workshop trades i.e., Carpentry, Tin smithy, House wiring and Fitting	5, 12	3

Syllabus:

Introduction To Computer Aided Drafting: Commands, Tool Bars, Layout of Drawing sheet, Dimensions, Point Style and Text.

Projections Of Points: Theory of Projection, Elements of projection, Planes of projection, Quadrants, Projection of points in four (4) Quadrants and Conclusions.

Projections Of Planes: Different Planes, Projections of planes in various positions w.r.t planes of projection (Use First Angle Projection).

Projections Of Solids: Types of Solids, Names and Nomenclature of Solids, Projection of solids in simple position, Projections of solids with axis inclined to one reference plane and parallel to the other reference plane (Use First Angle Projection).

Orthographic Views: Projection, Orthographic projection, Importance of Front view, Position of Top view and side views w.r.t Front view, Difference between First Angle Projection and Third Angle Projection, Symbol indicating the Angle of Projection.

Sectional Views: Purpose of Sectioning, Types of sections, Importance of Hatching.

Development Of Surfaces: Principle of Development of Surfaces, Methods of Development of Surfaces, Practical Applications of Development of Surfaces.

Isometric Views: Principle of Isometric Projection, Isometric Axes, Isometric lines, Non-Isometric lines, Isometric Planes, Non-Isometric Planes, Isometric scale, Difference between Isometric drawing and Isometric Projection.

Perspective Views: Principle of perspective projection, Definitions of Perspective elements, Methods of Drawing Perspective view(s).

MEASUREMENTS

Mapping of Course outcomes with Program outcomes:

CO No.	Course Outcome	PO	BTL
CO-1	Understand and apply the fundamentals of a measurement system, characteristics, and metrology using simulation and experimentation tools.	1, 4	2
CO-2	Understand various electrical & computer parameters, and apply different measuring techniques on various electrical parameters using simulation and experimentation tools.	1, 4	2
CO-3	Understand electronic & electro-physiological parameters, and apply measuring techniques on electronic parameters using simulation and experimentation tools.	1, 4	2
CO-4	Understand and apply different measuring techniques on civil and mechanical parameters using simulation and experimentation tools.	1, 4	2
CO-5	Apply the theoretical concepts to measure different parameters	1, 4	2

Syllabus:

Fundamentals of Measurements: Introduction, significance, types, GMS, Static & Dynamic characteristics, Error – types, sources and remedies, Statistical & Regression analysis of data, Transducers – classification. **Metrology:** Definition, types, linear metrology, angular metrology. Straightness, flatness, squareness, parallelism, roundness and cylindricity measurements. Applications and advanced measurement techniques. **Measurement of Electrical & Computer parameters:** Definition, Representation and analogy of Current, Voltage, Power, Energy, Power factor and R – L – C components. Analog meters: Types, connections, Selection & Extension of range, applications. Electrical Bridge circuits for R, L, and C. Computer terms: Units of digital information, memory measurement, measurement of RAM, Processor speed, internet transfer speed, network connection speed, baud rate. **Measurement of Electronic & Electrophysiological parameters:** DSO – front panel controls, connectivity, measurement of Amplitude and Time period, Phase and Frequency

using lissajuous patterns. Applications and advanced measurement techniques. Metric system, Electrophysiological measurements (EEG, ECG, EMG, ERG), tilt measurement, acceleration in human body (jumps), Arm flexion and rotation angle, stability of hand muscles and breathing muscles contraction, pulse rate, blood pressure, oxygen content in exhaled air, registration of algal rest and action bio potentials. Biomedical applications and advanced measurement techniques. **Measurement of Civil & Mechanical parameters:** Definition and representation of Displacement (Linear/Angular), Speed, Force, Torque, Stress/Strain, Flow, Temperature, Humidity, Viscosity. Measurement of angles and distances (height, area, distance between two elevations), Water and waste water analysis (Spectrophotometry/ Chromatography), Liquid Level using Direct and Indirect methods, Hardness of a given material sample using Brinell/Rockwell hardness testing machine, Modulus of Elasticity of a specimen using tension test, measurement analysis of air pollution. Industrial applications and advanced measurement techniques.**NI MyDAQ/ LabVIEW:**

Introduction, Hardware/Software overview, Getting started with MyDAQ (Signal connections), applying the MyDAQ as DMM, DVM, DAM, Oscilloscope, Function Generator, Real-time signal capturing, interfacing of sensors (Thermistor/LM35/Thermocouple/Opto-coupler).

Text books & References:

1. JP Holman," Experimental methods for engineers", McGraw Hill Ltd.
2. Thomas G Beckwith ,"Mechanical measurements", 6/E, Pearson
3. Martin U Reissland ,"Electrical measurements "New Age Int.
4. A course in Electrical, Electronic Measurement and Instrumentation- AK Sawhney-Dhanpat Rai & Co.
5. Bewoor," Metrology & Measurement", McGraw Hill Ltd.
6. NI MyDAQ User Manual

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING

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

CO No	Course Outcome	PO	BTL
1	Understand basics of DC circuit analysis, fundamentals of AC and introduction three phase circuits	1	2
2	Understand construction & working principle of DC Machines	1	2
3	Understand construction & working principle of Transformer, three phase and single phase induction motor.	1	2
4	Understand number systems and their conversions, characteristics of PN junction diode	1	2
5	Conduct an experiment to analyze the performance of various electrical and electronic devices and draw their char characteristics.	1	4

Syllabus:

Circuit elements and AC fundamentals: Basic Circuit elements, series and parallel circuits, Voltage and Current dividers, Kirchhoff's laws, Mesh analysis, sinusoidal voltage and current, peak, average and RMS Values of alternating signals, Three phase systems (Y and Δ Systems)

D.C. Machines: Constructional features and principle of operation of DC Generator, EMF Equation (No derivation), Types of Excitation systems, Torque development in Motors, Torque Equation (No derivation), Applications of DC Generators and Motors.

Transformers: Principle and operation of transformers, EMF equation (No derivation)

Induction Motor: Principle operation and construction of three phase induction motor, single phase induction motor and applications.

Conduction in semiconductors: Conductivity of a semiconductor, carrier concentration in an intrinsic semiconductor, Fermi – level in an intrinsic semiconductor, law of mass action, Donor and acceptor impurities, charge densities in a semiconductors, Fermi level in a semiconductor having impurities, diffusion.

Semiconductor diode: Quantitative theory of P – N JUNCTION DIODE, V-I Characteristics and its temperature dependence, transition and diffusion capacitances of P – N Junction diode. .

Number systems & binary codes number systems: Decimal, Binary, Octal, Hexadecimal Number systems and their conversions, signed binary numbers, Binary Arithmetic additions, subtraction using the method of complements, Binary Codes: BCD, Excess-3, Grey codes and their conversions.

Text books:

1. S.K. Bhattacharya, "Basic Electrical and Electronics Engineering", 2nd edition, pearson, 2011.
2. Edward Hughes, "Electrical & Electronics Technology", 12th edition, Pearson, 2016

Reference books:

1. Ashfaq Husain, "Electric Machines", 2nd Edition, Dhanpat Rai& Co, 2014.
2. Jacob Millman, Christor. C W. H. Hayt, J.E. Kimmerly, "Engineering circuit analysis", 8th Edition, Tata Mc-Graw Hill, 2014.
3. Halkias, "Electronic Devices and Circuits" TMH 2002.
4. Morris Mano, "Digital Logic and computer Design" PHI, 2003.
5. Jagan and C. LAkshmi Narayana, "Network Theory", B. S. Publications.
6. Robert L Boylested, Louis Nashelsky, "Electronic Devices and circuit Theory", 8th, Edition, Pearson Education, 2002.

THERMODYNAMICS

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

CO No.	Course outcome	PO	BTL
1	Understand the fundamentals of thermodynamic systems and processes.	1	1, 2
2	Apply first law of thermodynamics to various flow and non-flow processes.	1, 2	3, 4
3	Apply second law of thermodynamics and principle of entropy to Engineering Devices.	1	1, 2
4	Apply principles of combustion for gravimetric and volumetric analysis of fuels.	1, 2	3, 4
5	Plan and conduct simple experiments to demonstrate thermodynamic principles.	4	3, 4

Syllabus:

Fundamental Concepts and Definitions: Thermodynamic system and control volume, Macroscopic and Microscopic points of view. Thermodynamic properties, processes, state, path, cycle. Thermodynamic equilibrium and Quasi-static process. Reversible and Irreversible processes, Zeroth law, concept of temperature.

Work and Heat: Definition of work, units, work done at the moving boundary of system, work done in various non-flow processes, definition of heat, units, comparison of heat and work.

First Law for Non-Flow Systems: First law of thermodynamics for a closed system undergoing a cycle and for a change of state; energy - a property of system, internal energy and enthalpy. Specific heat at constant volume and constant pressure.

First Law for Flow Systems: Control mass and control volume, First law of thermodynamics for a control volume, Steady flow energy equation and applications to engineering equipment. PMM-1.

Second Law of Thermodynamics: Thermal reservoirs, Kelvin-Plank and Clausius statements of second law of thermodynamics; Equivalence of Kelvin-Plank and Clausius statements, PMM-2; Carnot cycle, Carnot engine, Corollary of Carnot's theorem, Absolute thermodynamic temperature scale.

Entropy: Definition of entropy, Clausius theorem, entropy change in reversible process Temperature-entropy plot, Inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, Applications of entropy principle, entropy change of an ideal gas; Availability and Irreversibility.

Fuels and Combustion: Types of fuels, exothermic and endothermic combustion equation, stoichiometry. Conversion of gravimetric to volumetric analysis and vice versa; excess air, exhaust gas analysis.

Text Books:

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

Reference Books:

1. Fundamentals of Thermodynamics - G. J. Van Wyle
2. n, Sonntag, 6th Edition, Wiley India Publications.
3. Engineering Thermodynamics - Cohen and Rogers, 5th Edition, Pearson Education India limited.
4. Heat and Thermodynamics - Zemansky, McGraw Hill, 5th Edition.

LIST OF EXPERIMENTS:

Experiments using physical equipment

1. Zeroth law of thermodynamics-temperature measurement
2. First law of Thermodynamics applied to closed system
3. First law of thermodynamics applied to open system
4. Demonstration of heat engines
5. Determination of calorific value of a fuel using Bomb calorimeter
6. Determination of Flash and Fire point of a fuel.

Experiments using Software (Energy 2D)

1. Thermal equilibrium between identical objects
2. Thermal equilibrium between objects with different specific heats
3. Thermal equilibrium between objects with different densities
4. Thermal equilibrium between objects having different temperatures.

Experiments using Software (EES)

1. Calculation of efficiency of heat engines, COP of heat pumps and refrigerators
2. Calculation of entropy for various engineering devices

Professional

Core Courses

METALLURGY

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

CO No	Course Outcome	PO	BTL
1	Understand the significance of cooling curves and phase diagrams.	1	2
2	Ability to understand various heat treatment processes.	4	2
3	Identify fuels and furnaces used in metallurgical industries and to Understand the mineral processing basic principles.	1	2
4	Acquires knowledge on extraction of metals, production of components using powder metallurgy technique.	1	2
5	Identify and differentiate various types of materialsand understand various heat treatment method.	1	2

Syllabus:

Engineering Materials: Introduction to engineering materials

Equilibrium Diagrams: Phases and their significance, components, degrees of freedom, Gibb's phase rule, equilibrium heating/ cooling, classification of phases in binary alloys, Equilibrium diagrams for single component systems, coring and its effects in Type I systems, factors and techniques for elimination of coring, equilibrium diagrams for binary systems having unlimited solubility in liquid and solid states, equilibrium diagrams for binary eutectic systems, Inverse lever rule.

Iron-Carbon Systems: Components and phases of Iron-Carbon system, Iron and Iron Carbide diagram, Invariant reactions of Iron-Carbon systems, Critical temperatures and critical temperature lines.

Heat Treatment of Steels: Need and main steps in heat treatment processes, classification of heat treatment processes on basis of heat treatment temperature and on the basis of purpose, various types of Annealing, Normalising, Hardening and Tempering treatments, factors affecting the hardenability of steels.

Surface Heat Treatment (Case Hardening) Methods: General features of surface hardening processes, Flame and Induction hardening of steel; Chemical heat treatment of steels: Carburising, Nitriding, and Cyaniding of steels.

Fuels, furnaces and refractories: comparative study of solid, liquid and gaseous fuels, furnaces-classification and principle of furnaces used in metallurgical industries, Refractories-Introduction, classification, properties and applications.

Extractive Metallurgy: Minerals of economic importance, comminution techniques, size classification, Flotation, gravity and other methods of mineral processing; agglomeration, Pyro- hydro- and electro-metallurgical processes; principles and processes for the extraction of non-ferrous metals – Aluminium, copper and titanium; iron and steel making – principles, structure and properties of slags.

Powder metallurgy: Production process, characteristics of powder, pressing and sintering, advantages and application.

Text Books:

1. Introduction to Physical Metallurgy, Sidney H Avner (TMH)
2. Principles of Extractive Metallurgy, H. S. Ray & A. Ghosh
3. Refractories and furnaces, Francis Thompson Havard (Mc-Graw Hill)

Reference Books:

1. Materials science & Engineering by William D.Callister, Wiley India.
2. Materials science & Metallurgy by V.D.Kodgire
3. Physical Metallurgy by Lakhtin

LIST OF EXPERIMENTS:

1. Specimen Mounting
2. Microstructural Study of White Cast Iron & Gray Cast Iron
3. Microstructural Study of Malleable Cast Iron & Spheroidal Grey Cast Iron
4. Microstructural Study of Low Carbon Steel & High Carbon Steel
5. Microstructural Study of Aluminum & Copper (Non ferrous metals)
6. Microstructural Study of Brass & Inconel
7. Normalizing of Steels
8. Jominy End Quench Test (Hardenability Test)
9. NDT by Magnetic particle inspection (Flaw Detection)
10. NDT by Ultrasonic Flaw Detection

STRENGTH OF MATERIALS

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

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

Syllabus:

Simple Stresses and Strains: Introduction, Types Of Stress, Stress Strain Diagram, Hooke's Law, Types of Strains.

Axially Loaded Members: Deflection of an Axially Loaded Member, Statically Indeterminate Structures (Stiffness Method), Temperature Effects.

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

Analysis Of Stress And Strain: Introduction, Principle Stress and Maximum Shear Stress, Mohr's Circle for Plane Stress.

Shearing Forces And Bending Moments: Types of Beams, Shear Force and Bending Moment, Relationship Between Load, Shear Force And Bending Moment, Shear Force And Bending Moment Diagrams.

Stresses In Beams: Introduction, Bending Stresses In Beams, Bending Stresses In Beams with symmetric Cross Section Shapes and T shape Of Beams, Shear Stresses In Rectangular Beams, Shear Stresses in The Webs Of Beams With Flanges.

Deflections of beams: Deflections by integration of the bending moment equation and Macaulay's method for simple beams.

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

Columns: Buckling And Stability, Columns with Pinned Ends, Columns with Other Support Conditions, Limitations of Euler's Formula, Rankine's Formula, Columns with Eccentric Axial Loads, Secant Formula.

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.
5. Timoshenko S P and Young D H “Elements of Strength Of Materials” East West Press, New Delhi.
6. Shames, I. H., Pitarresi, J. M “Introduction to Solid Mechanics”, Prentice-Hall, NJ.
7. L S. Srinath “Strength of Materials”.

LIST OF EXPERIMENTS:

1. Tension Test using Universal Testing Machine
2. Compression Test using Compression Testing Machine/Universal Testing Machine
3. Shear Test using Universal Testing Machine
4. Torsion Test using Torsion Testing Machine
5. Spring Test using Spring Testing Machine
6. Impact Test using Impact Testing Machine
7. Hardness Test using Hardness Testing Machine
8. Defection Test on Cantilever Beam using Cantilever Beam
9. Defection Test on Simply Supported Beam using Simply Supported Beam
10. Shear Force and Bending Moment Diagram for Simply Supported Beam using Ansys
11. Shear Force and Bending Moment Diagram for Cantilever Beam using Ansys
12. Deflection Test on Overhang Beam using Ansys

MANUFACTURING TECHNOLOGY

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

CO No	Course Outcome	PO	BTL
1	Understand and appreciate the breadth and depth of the field of manufacturing technology.	2	2
2	Understand various casting procedures and melting practices used for producing different products.	2	2
3	Understand various special casting approaches used for producing precision components.	2	2
4	Understand various welding methods for joining metals and alloys.	2	2
5	Gain hands on experience in converting a given raw material into desired shape and size by applying suitable casting and welding processes.	4	4

Syllabus:

Introduction to manufacturing processes: Classification of manufacturing processes.

Metal casting processes: Introduction and terminology. Pattern: Types, Allowances, Materials. Sand moulding procedure, Core making.

Gating systems for casting: Introduction, raiser design and Gating design. Solidification and cooling.

Melting Practice: Cupola and Crucible furnaces.

Special Casting Processes: Shell moulding, Precision Investment casting, Permanent mould casting, Die casting. Casting defects and remedial measures.

Joining Processes: Principles of Welding, Gas welding, ARC Welding, TIG Wleding, MIG Welding, Submerged Arc Welding, Resistance Welding, Thermit welding. Brazing, soldering and adhesive bonding. Welding diffects remedial measures.

Industrial visit at the end of the course after the completion of 3rd internal test.

Text Books:

1. Serope Kalpakjian and Steven R.Schmid,"Manufacturing Engineering & Technolgy", Pearson Education, Inc., 5th edition.
2. P.N.Rao, "Manufacturing Technology", Tata Mc Graw Hill Publications.

Reference Books:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Casting", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2005.
2. Khanna O P, "Welding Technology", Dhanpat Rai and Sons, New Delhi, 1994.
3. William K Dalton, Gregg Bruce R, "Modern Materials and Manufacturing Processes", Pearson Education, 2007.
4. Peter Beeley, "Foundry Technology", Butterworth, Second Edition, 2005.
5. Baldev Raj and Shankar V, "Welding Technology For Engineers", Narosa Book Distributors Pvt. Ltd., 2006

LIST OF EXPERIMENTS:

1. Preparation of a sand mold, using the given single piece pattern
2. Preparation of a sand mold, using the given split piece pattern
3. Preparation of double ended pipe flange mould
4. Preparation of hand wheel mould
5. Manufacturing of pulley in sand casting by melting and pouring aluminium alloy
6. Manufacturing of connecting rod in die casting by melting and pouring aluminium alloy
7. Preparation of a Butt joint in arc welding process
8. Preparation of a Lap joint in arc welding process
9. Preparation of a Lap joint in Spot welding process

10. Preparation of a Butt Joint Using Submerged arc welding process
11. Preparation of a Butt Joint Using Plasma arc welding process
12. Preparation of lap joints using brazing
13. A study on casting equipment
14. A study on welding equipment

FLUID MECHANICS & HYDRAULIC MACHINES

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

CO No.	Course Outcome	PO	BTL
1	Understand physical laws related to fluid statics and buoyancy.	1, 2	1,2
2	Apply continuity, Euler's and Bernoulli's equations in various fluid flow situations.	1, 2	3,4
3	Understand and apply momentum equation and boundary layer concepts to flow through pipes and to impact of jets.	1, 2	3,4
4	Apply fluid dynamical principles to hydraulic machines.	1, 2	3,4
5	Conduct experiments on various hydraulic machines like turbines and pumps	4	3,4

Syllabus:

Fluid Properties: Definition of fluid, properties of fluid - density, specific weight, specific gravity, viscosity; classification of fluids, surface tension and capillarity; vapour pressure.

Fluid Statics: Introduction, pressure, Pascal's law, hydrostatic law, measurement of pressure, simple and differential manometers; Total pressure and center of pressure on vertical, horizontal, inclined and curved surfaces.

Buoyancy: Buoyancy, forces on submerged bodies, stability of floating bodes.

Fluid kinematics: Introduction, types of fluid flow, discharge, Continuity equation, potential function and stream function.

Fluid dynamics: Introduction, Euler's equation of motion, Bernoulli's equation and applications, Venturi meter, Orifice meter, Dimensional analysis and model similitude.

Flow through pipes: Introduction, major and minor energy losses, friction coefficient in laminar and turbulent flow, Hagen-Poiseuille law, Hydraulic gradient and total energy line, pipes in series and parallel, power transmission through pipes, Reynold's experiment and water hammer.

Boundary layer theory: Introduction, laminar and turbulent boundary layers, boundary layer thickness, displacement thickness, momentum thickness, energy thickness, boundary layer separation, methods of preventing separation.

Impact of Jets: Introduction to impulse-momentum equation and its applications, force exerted by jet on fixed target, moving target, and series of curved vanes.

Hydraulic Machines - Turbines: Introduction, types and classification Pelton wheel, Francis turbine, Kaplan turbine-theory, work done and efficiency, design parameters, problems.

Hydraulic Machines - Centrifugal pumps: Definition of pump, classification, description and general principle of working; Priming. Work done and efficiency of a centrifugal pump, minimum starting speed, cavitation in centrifugal pumps, multi-stage pumps, problems on centrifugal pumps.

Text Books:

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

Reference Books:

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

LIST OF EXPERIMENTS:

1. Determination of viscosity of oils by using Redwood viscometer.
2. Meta Centric Height Apparatus.
3. Verification of Bernoulli's theorem.
4. Determination of coefficient of discharge of Venturi meter.
5. Determination of coefficient of discharge of Orifice meter.
6. Fluid flow analogy using Reynolds apparatus.
7. Determination of Darcy friction factor due to friction in a pipe flow.
8. Determination of minor losses due to sudden expansion and contraction in a pipe flow.
9. Determination of coefficient of impact on Impact of jet apparatus.

10. Performance test on Pelton wheel.
11. Performance test on Francis turbine.
12. Performance test on Kaplan turbine.

KINEMATICS OF MACHINES

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

CO No	Course Outcome	PO	BTL
1	Identify various possible 4 link mechanisms and their inversions and applicability	1, 2	2
2	Analyze mechanisms kinematically using velocity and acceleration diagrams	1, 2	4
3	Analyze lower pair mechanisms and cam profiles and the motion of their followers	1, 2	4
4	Analyze gears and gear trains kinematically	1, 2	4
5	Apply the theoretical concepts to conduct various experiments to Analyze Mechanism , gear trains and draw Cam Profile.	4	4

Syllabus:

Basic kinematic concepts: introduction to mechanism, links, and kinematics pairs, kinematic chains, mechanisms. Inversions of 4 bar, slider crank and double slider mechanisms

Displacement, Velocity and acceleration analysis of plane mechanism: Instantaneous centre method, Relative velocity method for velocity analysis, acceleration diagram, coriolis component of acceleration. Computer aided analysis and synthesis of planer mechanisms

Lower pairs: Straight link mechanism, steering gears, Hookes joint

CAMS: introduction to cams, followers and their classification. Motion of follower, layout of cam profile.

Gears: Classification of gears, law of gearing, forms of teeth, path and arc of gearing, Interference, Min No. of teeth, undercutting

Gear trains: Analysis of simple, Compound, reverted and epicycle gear trains

Text Books:

1. Kinematics and Dynamics of Machinery by Robert Norton 1 st Edition, Tata Mc Graw Hill.
2. Theory of Machines and Mechanisms by shigley J.E., and Uicker J.J., McGraw Hill,1995.

Reference Books:

1. Theory of Machine by Thomas Bevan, CBS Publications.
2. The theory of Machines Through solved problems, Rao, J.S.,New Age International.

3. Mechanisms and machine Theory by A.Ghosh and A.K Mallik,3rd edition ,EWP Pvt Ltd.
4. Theory of Machine by S.S Rattan Mc.Graw Hill.
5. Machines and Mechanisms-Applied Kinematic Analysis by David H.Myszka, 4th Edition.
6. Jagdish lal "Theory of Mechanisms and Machines" Metropolitan Book Company

LIST OF EXPERIMENTS:

The following exercises are to be performed in computer lab (ADAMS Software)/ Drawing hall.

1. Various commonly used mechanisms and its inversions in machines
2. Simulation and study of the structure.
3. Simulation and study of four bar mechanisms
4. Simulation and study of slider crank mechanisms
5. Simulation and study of crank and slotted lever mechanisms
6. Velocity analysis of (i) 4bar mechanisms (ii) Slider crank mechanisms (iii) crank and slotted lever mechanisms (Velocity diagrams to be practiced in drawing hall)
7. Acceleration analysis of (i) 4bar mechanisms (ii) Slider crank mechanisms (iii) crank and slotted lever mechanisms (Acceleration diagrams to be practiced in drawing hall)
8. Cam profiles of knife edge and roller shaped radial follower.
9. Camp profile of mushroom follower mechanism
10. Cam profiles of knife edge and roller shaped offset follower (Cam profiles to be practiced in drawing hall)
11. To analyse kinematically compound gear trains
12. To analyse kinematically Epicyclic gear trains (To calculate the torque on a Planet Carrier and torque on internal gear using epicyclic gear train and holding torque apparatus)

METAL CUTTING AND METAL FORMING

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

CO No	Course Outcome	PO	BTL
1	Understand the theoretical background of metal cutting.	2	2
2	Understand and estimate the economics of machining various processes.	2	2
3	Understand the theory of metal forming in shaping of components.	2	2
4	Understand and estimate the loads in various metal forming processes.	2	2

Syllabus:

Metal Cutting: Introduction, Basic elements of machining, Orthogonal and oblique cutting,

classification of cutting tools, tool geometry of a single point cutting tool, functions of different angles, tool signature in coordinate systems: machine reference system (American system) and orthogonal rake system. Chip formation: types of chips, chip thickness ratio, chip velocity relations. Cutting forces in orthogonal cutting (turning): Merchant's circle diagram. Cutting forces in drilling. Measurement of cutting forces, tool force dynamometers. Thermal aspects in machining, cutting fluids, tool life and tool wear, cutting tool materials. Economics of machining.

Metal Forming: Plastic deformation and yield criteria, fundamentals of hot and cold working processes. Bulk metal forming processes (forging, rolling, extrusion, and drawing): principle, types, and load estimation. Sheet metal forming processes: blanking and punching operations, shear on punches/dies, load estimation, effect of shear on load requirement, plate bending operations and deep drawing operations.

Text Books:

1. P N Rao, Manufacturing Technology, Volume 1&2, Tata McGraw- Hill Publishing co.Ltd.7thed.2004.
2. Milton C Shaw, "Metal Cutting Principles", Glarendon Process, OXFORD.1999.
3. Ghosh, A., Mallik, A. K., "Manufacturing science", New Delhi: Affiliated East-West Press Private, 1985.

Reference Books:

1. Kalpakjian,"Manufacturing Engineering and Technology", Fourth Edition, Pearson Publisher.2001.
2. Chapman W, workshop Technology Part-2, taylor & Francis 1972.
3. Edward m Trent, Paul K Wright, Metal Cutting, Butterworth, 2006.
4. James Brown, "Advanced Machining Technology Handbook", McGraw Hill Book Company,Newyork,1998

VAPOUR POWER SYSTEMS

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

CO No.	Course outcome	PO	BTL
1	Understand the properties of pure substance and evaluate the Rankine cycle efficiency for regenerative and binary vapor power cycles.	1, 3	1,2
2	Understand the working principles of steam generators and steam nozzles.	4, 2	3,4
3	Evaluate the performance of steam turbines and condensers.	4, 2	3,4
4	Understand the principles of refrigeration and psychrometry.	1, 2	1,2
5	Experimental verification of various vapour power devices.	4	3,4

Syllabus:

Pure Substance: Pure substance; vapor-liquid-solid phase equilibrium in a pure substance, Properties of a pure substance, Tables of thermodynamic properties, Mollier Chart.

Vapor Power Cycles: Rankine cycle, methods to improve performance of Rankine cycle, Ideal regenerative cycle, practical regenerative system, Binary vapor power cycle.

Steam Generators: Function, classification, mountings and accessories, modern high pressure boilers, critical and super-critical boilers; draught – natural and forced; calculation of boiler efficiency equivalent rate of evaporation.

Steam Nozzles: Types of nozzles, isentropic flow through nozzles, effect of friction, nozzle efficiency, critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier diagram, supersaturated flow.

Steam Turbines: Types of steam turbines, impulse turbines, pressure and velocity compounding, velocity diagrams, work output, power, blade efficiency and stage efficiency; Reaction turbines, velocity diagrams, degree of reaction, work output, power, blade efficiency and stage efficiency, governing of turbines, overall efficiency and reheat factor.

Steam Condensers: Jet and surface condensers, condenser vacuum and vacuum efficiency, condenser efficiency, thermodynamic analysis, air pumps, capacity of air extraction pumps.

Refrigeration: Need for refrigeration, definitions, methods of refrigeration, air refrigeration system, vapor compression refrigeration system, vapor absorption refrigeration cycle.

Psychrometry: Psychrometric properties, psychrometric chart and air-conditioning process.

Text Books:

2. Applied Thermodynamics - T. D. Eastop, 6th Edition, Longman Scientific and Technical & John Wiley, New York.
3. Steam Turbines Theory & Practice - Kearton, ELBS

Reference Books:

1. Engineering Thermodynamics, Yunus A. Cengel & Boles
2. Engineering Thermodynamics, 5th Edition , P. K. Nag, TMH, New Delhi
3. Applied Thermodynamics , R. Yadav, CBH, Allahabad
4. Power Plant Engineering (Steam & Nuclear), P. K. Nag, TMH.

Note: Use of steam tables and R & A/c tables is permitted in University examinations.

LIST OF EXPERIMENTS:

1. Study of Boilers

2. Performance analysis of Steam Boiler (Using EES Software)
3. Performance Calculation of Steam turbine (Using Software)
4. Performance calculation of Vapour power cycles (Rankine cycle) (EES Software)
5. Performance Calculation on a steam nozzle (Using EES Software)
6. Calculation of dryness fraction of steam (Using EES Software)
7. Calculation of the effectiveness of a steam condenser (Using EES Software)
8. Determination of COP of Vapour Compression Refrigeration Test rig.
9. Study of psychrometric properties of air in re-circulating air-conditioning test rig.
10. Study of heat produced from various components in the room for cooling load calculation (EES Software)
11. Study of summer and winter air-conditioning system.
12. Study of vortex tube refrigeration system.

MACHINE DRAWING

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

CO No	Course Outcome	PO	BTL
1	Understand different types of fasteners and draft various types of joints, locking arrangements.	1, 5	4
2	Understand and draft various types of couplings and their arrangements and model the same using Solid works	1, 5	4
3	Prepare the assembly drawing of engine parts, machine Components both in conventional form and then by using software.	1, 5	4
4	Generate detail drawings of individual parts of an assembled machine Component both in conventional form and then by using software.	1, 5	4

Syllabus:

MACHINE DRAWING CONVENTIONS:

Need for drawing conventions – Introduction to ISI conventions.

a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs
b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
d) Title boxes, their size, location and details – common abbreviations and their liberal usage.
e) Types of drawings – working drawings for machine parts.

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.

Shaft Coupling: Introduction, Rigid couplings – Split-muff coupling, Protected flange coupling. Flexible couplings-Bush pin type flanged coupling. Non-aligined 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:

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

LIST OF EXPERIMENTS:

The following experiments are to be performed using Solid Works /AutoDesk / Creo /CATIA / UG)

1. Solids works - GUI Demonstration, 2D-Sketching Tools and practice exercises
2. Introduction to 3D-Part modeling tools and practice exercises
3. Modeling of Nuts, Bolts and keys
4. Modeling of Machine Components
5. Modeling of Machine Components: Shaft Couplings
6. Advanced Part modeling commands and Practice exercises (Journal and foot step bearings)
7. Part modeling - Hexagonal & Square headed bolt and nut, Stud
8. Assembly - Introduction, Bolted joint and stud joint
9. Parts and assembly of rigid Flanged coupling
10. Parts and assembly of Universal coupling

11. Parts modeling and assembly of Stuffing box
12. Parts modeling and assembly of Screw jack
13. Demo-1: Sheet Metal Module using Solid works package
14. Demo-2: Simulation Module using Solid works Package

GAS POWER SYSTEMS

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

CO No.	Course outcome	PO	BTL
1	Understand thermodynamic relations to ideal and real gas problems.	1, 2	3,4
2	Understand the working principles of reciprocating air compressors and evaluate their performance.	1, 2	3,4
3	Understand the working principle of rotary compressors and evaluate their performance.	1, 2	3,4
4	Understand the operating principles of gas turbine and jet propulsion and evaluate their performance.	1, 2	3,4
5	Conduct experiments on reciprocating and rotary machines.	4	3,4

Syllabus:

Thermodynamic Relations: Maxwell's equations, TdS equations, difference in heat capacities, ratio of heat capacities, energy equation; Real gas behavior, Clausius - Clapeyron equation, throttling, Joule-Thompson porous plug Experiment.

Reciprocating Air Compressors: Use of compressed air in industry, Classification of air compressors, Single stage reciprocating compressors, Isothermal efficiency, Volumetric efficiency, work required with clearance, Intercooling, multi-stage compression.

Rotary Compressors: Principle, difference between reciprocating and rotary compressors; Roots blower, Vane blower, Polytropic, isentropic and isothermal efficiencies; Centrifugal and Axial flow compressors: Surging, choking and stalling. Effect of pre-whirl; slip factor, work requirement, inlet and outlet velocity triangles; Different components of axial flow compressors and their arrangement; Isentropic, polytropic and Isothermal Efficiencies.

Gas Turbines: Closed and open Brayton cycle gas turbines, Analysis of closed cycle gas turbine, Compressor and turbine Efficiencies, Gas turbine cycle with inter cooling, reheat and regeneration.

Jet Propulsion: Basic principles of Jet propulsion - specific thrust, propulsive efficiency and overall efficiency of a jet engine; Screw propulsion, turbojet and turbo propulsion and aero-thermodynamic duct.

Text Books:

1. Thermodynamics, P. K. Nag, 5th Edition, McGraw Hill Publishing Co.
2. A Treatise on Heat Engineering, Vasandhani and D. S. Kumar, Metropolitan Publications

Reference Books:

1. Thermodynamics and Heat Engines, R. Yadav, Central Book Depot.
2. Turbines, Compressors and Fans, 4th Edition, S. M. Yahya, McGraw Hill Education.

LIST OF EXPERIMENTS:

1. Performance Test on Stirling engine (Using EES Software)
2. Performance Test on Single-Stage, Single cylinder Reciprocating Air Compressor
3. Performance Test on Two-Stage, two-cylinder Reciprocating Air Compressor
4. Performance Test on Single-Stage, two cylinder Reciprocating Air Compressor (using EES software)
5. Determination of the overall efficiency of a Centrifugal blower
6. Performance analysis of (Screw Type) Rotary Compressor (Using EES Software)
7. Performance analysis of Axial flow compressor (Using EES Software)
8. Performance analysis of a Gas turbine power plant (Using EES Software)
9. Performance analysis of a reheating Gas turbine power plant (Using EES Software)
10. Performance analysis of a Regeneration Gas turbine power plant (Using EES Software)
11. Performance analysis of a Gas turbine power plant with inter cooling (Using EES Software)
12. Performance analysis of Turbo-jet engine (Using EES Software).

DYNAMICS OF MACHINES

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

CO No	Course Outcome	PO	BTL
1	Analyze the static and dynamic forces of planar mechanisms and flywheels	1, 2	4
2	Analyze the static and dynamic balancing of rotating as well as reciprocating masses due to unbalanced forces	1, 2	4
3	Understand the free and forced vibrations of single degree freedom systems	1, 2	4
4	Analyzethe gyroscope and governor mechanisms for controlling the moving vehicles	1, 2	4
5	Apply the theoretical concepts to mechanisms by using the simulation software and analyzing the data	4, 5	4

Syllabus:

FORCE ANALYSIS OF MECHANISMS:

Static, inertia and combined force analysis- Introduction, Analysis of Planar mechanisms - Slider crank mechanism and four bar mechanism, analytical and graphical methods.

Turning moment diagram and flywheels - Turning moment – inertia torque connecting rod angular velocity and acceleration, crank effort and torque diagrams – Fluctuation of energy – Fly wheels and their design.

BALANCING

Introduction- Static balancing, dynamic balancing, transferring of a Force from one plane to another, **Balancing of Rotating masses** – single mass and several masses in the same and different planes-Analytical and graphical methods, **Balancing of Reciprocating masses**- Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods.Unbalanced forces and couples. Examination of "V' and multi cylinder inline and radial engines for primary and secondary balancing - Locomotive balancing – Hammer blow, Swaying couple, variation of tractive efforts.

VIBRATIONS

Free vibrations of single degree of freedom systems: periodic motion – non harmonic motion – Fourier analysis – undamped free vibrations– liner and torsional solution – natural frequency of single degree freedom systems – Bifilar, Trifilar suspensions – Free vibrations with viscous damping of single degree systems and solution – logarithmic decrement.

Forced vibrations of single degree of freedom systems: Forced vibrations of single degree szstems with damping – reciprocating and rotating unbalance – vibration isolation and transmissibility – base excitation – self excited vibrations with examples.

MECHANISMS FOR CONTROL

Governers: Watt, porter and proellgoverners. Spring loaded governers – Hartnell and hartung with auxiliary springs. Sensitiveness, isochronism and hunting

Gyroscopes: Introduction, Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships

Text Books:

1. Theory of Machines / Shigley / MC Graw Hill Publishers
2. Theory of Machines / Thomas Bevan / Pearson
3. Theory of Machines / S S Rattan / McGraw Hill

References:

1. Theory of Mechanisms and Machines / JagadishLal / Metropolitan Book Company
2. Mechanical Vibrations/ G K Groover / Lakshmi Publications / 5th Edition
3. Mechanism and Machine Theory/JS Rao and RV Dukkipati/New Age

LIST OF EXPERIMENTS:

The following exercises are to be performed in computer lab (ADAMS Software)/ Drawing hall.

1. To study gyroscopic effects through models.
2. To determine gyroscopic couple on Motorized Gyroscope.
3. To perform the experiment for static balancing on static balancing machine.
4. To perform the experiment for dynamic balancing on dynamic balancing machine.
5. Determination of critical speed of a rotating shaft.
6. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proell / Hartnel Governor
7. To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
8. To determine the natural frequency of undamped torsional vibration of two rotor shaft system.
9. To determine the frequency of undamped free vibration of an equivalent spring mass system.
10. To determine the frequency of damped force vibration of a spring mass system.
11. To Determine the Amplitude of a spring mass system for given response.
12. To Determine Logarithmic decrement of given spring mass damper system.

MACHINE TOOLS AND METROLOGY

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

CO No.	Course Outcome	PO	BTL
1	Understand the working of standard machine tools such as lathe, milling, drilling, grinding, and allied machines.	2	2
2	Understand and principles and design considerations of jigs and fixtures used in various machining operations.	2	2
3	Understand the procedures to measure the geometrical details of various mechanical elements and assemblies using linear and angular measuring instruments.	2	2
4	Understand the procedures to measure the surface roughness and roundness of given mechanical components.	2	2
5	Gain hands on experience on usage of various machining processes to convert a given raw material into desired shape and size and to measure the geometrical and surface quality of the mechanical components.	4	4

Syllabus:

Machine tools:

Lathe: Principles, parts of lathe, specifications, operations, capstone and turret lathe. **Drilling Machine**: Principle, types, Radial drilling machine, Specifications, Operations. **Milling Machine**: Principle, Types, Horizontal Milling Machine, Operations. **Grinding Machine**: Principle, Types, Description and Working of Cylindrical Grinding Machine, Surface grinding Machine, center less grinding. Shaper, Planer and slotter. **Jigs & Fixtures**: Definition, principles of work holding, design of jigs and fixtures.

Metrology:

Linear and angular measurement: Definition of metrology, Linear measuring instruments: Vernier, Micrometre, internal measurement, Slip gauges and classification, Interferometery, optical flats. **Limits and Fits**: Tolerances, and Limit gauges. **Gauge Calibration**: Gauge repeatability and gauge reproducibility studies. **Comparators:** Mechanical, pneumatic and electrical comparators, applications.

Angular measurements: Sine bar, optical bevel protractor, angle Decker – Taper measurements.

Form measurement: Measurement of screw threads, thread gauges, floating carriage micrometer. Surface finish, straightness, flatness and roundness measurement

Text Books:

1. P N Rao, Manufacturing Technology, Volume -2.
2. Geoffrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, CRC Press, 15-Nov-1988
3. Mahajen, A Textbook Of Metrology,

4. Gupta S.C, Engineering Metrology, Dhanpatrai Publications, 1994
5. R.K. Jain,"Engineering Metrology", Khanna Publishers.
6. Mahajan,"Engineering Metrology ",Danpath Rai Publications.
7. D.S.Kumar, "Measurement Systems: Applications & design",Anuradha Agencies.
8. BeckWith, Marangoni,Linehard, " Mechanical Measurements", 6th edition, PHI/PE.

Reference Books:

1. I.C.Gupta ,"Engineering Metrology", Danpath Rai Publications.
2. Connie Dotson "Fundamentals of Dimensional Metrology, 4e ", Thomson Publications.
3. Doeblin Earnest.O. Adaptation by Manik and Dhanesh, "Measurement systems: Application and design", Tata Mc Graw Hill Publications.

LIST OF EXPERIMENTS:

1. Plane turning and step turning on lathe
2. Threading and knurling operations on lathe
3. Step milling operation on milling machine
4. Drilling and tapping operation
5. Surface grinding operation
6. V-grove cutting on shaping machine
7. Measurement of lengths, heights, diameters by Vernier callipers, micrometres etc.
8. Measurement of bores by internal micrometres and dial bore indicators
9. Use of gear tooth Vernier callipers and checking the chordal thickness of spur gear
10. Angle and taper measurements by Bevel protractor, sine bars etc.
11. Thread measurement by two wire/three wire methods and tool maker's microscope
12. Calibration of Micrometre using slip gauges
13. Study and observe through demonstration the metal cutting processes

INTERNAL COMBUSTION ENGINES

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

C.O. No.	Course outcome	PO	BTL
1	Analyze various air standard cycles and their performance	1, 2	3, 4
2	Understand the working principles of 2-stroke and 4-stroke engines, SI and CI Engines.	1	1, 2
3	Understand fuel supply system and combustion phenomenon in SI and CI Engines.	1	1, 2
4	Analyze and evaluate performance of SI and CI Engines.	4, 2	3, 4
5	Conduct experiments on SI and CI Engines, analyze and interpret the experimental data and observations.	4	3, 4

Syllabus:

Air standard cycles: Otto, Diesel, Dual, Brayton, Stirling, Ericsson and Atkinson cycles; Performance evaluation and mean effective pressure; Reversed Brayton cycle; Bell-Coleman cycle.

IC Engines: Basic engine nomenclature, Review and classification of IC Engines, working principles of SI and CI Engines (2-stroke and 4-stroke); Valve and port timing diagrams; Differences between SI and CI engines and 2-stroke & 4-stroke engines.

Fuel-Air Cycles and Their Analysis: Fuel-Air cycles significance, composition of cylinder gases, variable specific heats, dissociation, comparison of air standard and fuel-air cycles, effect of operating variables.

Actual Cycles and Their Analysis: Comparison of air standard and actual cycles, Time loss factor, Heat loss factor, Exhaust blow down, loss due to rubbing friction.

Fuel Supply Systems in SIEngines - Carburetion, injection system, chemically correct air-fuel ratio, Air-fuel mixture requirements, simple float type carburetor.

Fuel Supply Systems in CIEngines - Fuel supply and injection systems, Bosch fuel pump.

Combustion in SI Engine: Normal Combustion and abnormal combustion, delay period, importance of flame speed and effect of engine variables, pre-ignition and detonation. Knock Rating of Fuels -Octane number.

Combustion in CI Engine: Phenomenon of Combustion, delay period and its importance, effect of engine variables, Diesel knock, Knock Rating of Fuels - Cetane number, anti-knock additives.

Testing of IC Engines: Indicator diagram, evaluation of Indicated Power, Brake power, Frictional Power, Fuel consumption, SFC, mechanical and thermal efficiencies, mean effective pressure, air-fuel ratio, heat balance, Engine performance curves; Variables affecting engine performance for SI and CI Engines.

Text Books:

1. Internal Combustion Engines-E. F. Obert and B. H. Jennings, International Textbook Co.
2. Internal Combustion Engines Fundamentals- John B. Heywood, McGraw Hill Pub. Co., New York
3. Engineering fundamentals of the I. C. Engine – Willard W. Pulkrabek, PHI, India.

Reference Books:

1. Fundamentals of I.C. Engines - P. W. Gill, J. H. Smith & Ziurys - IBH & Oxford Pub.
2. Internal Combustion Engines - V. Ganesan, Tata McGraw Hill.
3. Internal Combustion Engines and Air pollution - Obert E. F., Hopper & Row Pub., New York.

LIST OF EXPERIMENTS:

1. Determination of carbon content in a fuel.
2. Dismantling/Assembly of IC Engines to identify the parts and their position in an engine.
3. Valve timing diagram of a single-cylinder, 4-stroke diesel engine.
4. Port timing diagram of a 2-stroke petrol engine.
5. Performance evaluation test on computerized diesel engine test rig.
6. Performance test on four stroke multi-cylinder petrol engine.
7. Heat balance test on a four stroke multi-cylinder diesel engine.
8. Performance evaluation test on 4-stroke single-cylinder diesel engine with electrical loading.
9. Performance evaluation test on 4-stroke single-cylinder petrol engine test rig.
10. Performance evaluation test on 2-stroke single-cylinder petrol engine test rig with electrical loading.
11. Performance evaluation test on the VCR engine under different compression ratios.
12. Evaluation of Engine friction by conducting Morse test on a 4-stroke four cylinder petrol engine.

OPERATIONS RESEARCH

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

CO No	Course Outcome	PO	BTL
1	Identify Optimum solutions for various single objective problems using Linear Programming models.	2, 11	2
2	Identify Optimum Solutions through Transportation and Assignment models	2, 11	2
3	Identify Optimum Solutions through Game theory, DPP, Queuing theory & Simulation models	2, 11	2
4	Solve project management problems using CPM, PERT and Crashing	2, 11	4
5	Solve Various Linear Programming, Transportation, Assignment, Game Theory and Simulation models through POM Software	5, 11	4

Syllabus:

Introduction to Operations Research, Models, Scope, limitations, applications of OR.

Linear Programming Problem: Introduction, Graphical method, Simplex method, Big M method, Two phase method, multiple solutions, infeasible solutions, unbounded solution, degeneracy, Dual Simplex method.

Transportation: Introduction, methods of feasible solution, optimality test, Degeneracy in transportation problem, unbalanced transportation problem. **Assignment Problem:** Introduction, Hungarian method, travelling salesman problem.

Game theory – To solve the rectangular two person Zero sum programme, solution of rectangular game in terms of mixed strategies, solution (2 x 2) game without saddle point, Solution of (m x n) game, Graphical method for (2 x n) and (m x 2) games.

Dynamic Programming – Introduction, Bellman's principle of optimality, application to shortest route problem.

Queueing 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 CPM/PERT: 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, problems.

Text Books:

1. F.S.Hiller, G.J.Liberman, Introduction to Operations Research, 2005, Tata Mc-Graw Hill.

2. H.A.Taha, Operations Research, 2008, Pearson Education.

Reference Books:

1. S.D. Sharma, Operations Research, 11th Edition, 2002, Kedar Nath Ram Nath & Co.
2. R.Paneerselvam, Operations Research, 2nd Edition, 2006, PHI.

LIST OF EXPERIMENTS / ACTIVITIES:

1. Solve LPP to find optimal solution by graphical method using POM Software and validate theoretically
2. Solve LPP to find optimal solution by simplex method using POM Software and validate theoretically
3. Solve LPP to find optimal solution by Big-M method using POM Software and validate theoretically
4. Solve LPP to find optimal solution by Two-phase method using POM Software and validate theoretically
5. Solve Transportation problem to find optimal solution by U-V method using POM Software and validate theoretically
6. Solve minimum assignment problems to find optimal assignment by Hungarian method using POM Software and validate theoretically
7. Solve maximum assignment problems to find optimal assignment by Hungarian method using POM Software and validate theoretically
8. Solve game with different pay-off matrix sizes to find the value of game using POM Software and validate theoretically
9. Solve Simulation problem to find average demand using POM Software and validate theoretically
10. Solve Simulation problem for queuing application using POM Software and validate theoretically
11. Solve Network analysis problem by CPM using POM Software and validate theoretically
12. Solve Network analysis problem by PERT using POM Software and validate theoretically
13. Study various methods of solving linear programming problems to real world applications
14. Identify various real world applications of PERT and CPM
15. Lab Project

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, classification end effectors.	1	2
2	Analyze a suitable sensors for robotic system design with respect to their applications.	3	4
3	Ability to solve the kinematics for robot manipulator	3	4

Syllabus:

Introduction To Robotics: Major components of a Robot, Classification of Robots-coordinate system and control method, Robot Applications.

End Effectors: Introduction, end effectors, types of end effectors: grippers and tools, considerations in the selection and design of end effectors.

Robotic Sensory Devices:

Non-Optical position sensors: Potentiometers, Synchros, inductosyn,

Optical position sensors: opto interrupters, optical encoders

Proximity sensors: Contact type, Non-contact type: reflected light scanning laser sensors.

Touch and slip sensors: Touch sensors – proximity Rod & Photo detector sensors

Slip sensors: Forced oscillation slip sensor, interrupted type slip sensors, force sensors

Robot Kinematics: Homogeneous transformations: translation and rotation, Manipulator Kinematics: D-H notation joint coordinates and world coordinates. Forward Kinematic and Inverse Kinematics problems, Jocobian

Robot Applications: Industrial Applications: material transfer and machine loading/ unloading, processing, Assembly and Inspection. Non-Industrial Applications

Robot Programming: Methods of robot programming, Leadthrough programming methods, Motion interpolation

Text Books:

1. M.P Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, 2008
2. Mittal R K & Nagrath, Robotics and Control

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

HEAT TRANSFER

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

C.O. No.	Course outcome	PO	BTL
1	Understand laws of heat transfer and apply Fourier law of conduction for one dimensional heat conduction to engineering problems.	1, 2	3,4
2	Analyze steady state conduction problems involving internal heat generation and extended surfaces and one dimensional unsteady state heat conduction problems.	1, 2	3,4
3	Apply principles of convection, boiling and condensation and evaluate convective heat transfer coefficient for different flow situations.	1, 2	3,4
4	Design of heat exchangers; Understand principles of radiation and evaluate radiative heat transfer between two bodies.	1, 2	3,4
5	Conduct experiments and demonstrate heat transfer phenomena involving conduction, convection and radiation.	4	3,4

Syllabus:

Introduction: Modes and laws of Heat transfer, thermal conductivity, Fourier's Law, Steady state Heat conduction, General conduction equation in Cartesian, Cylindrical and Spherical coordinates.

One-Dimensional Heat Conduction: Heat flow through plane wall, cylinder and sphere with constant thermal conductivity, Heat flow through composite slab and cylinders, Thermal resistance, Electrical analogy, Thermal contact resistance, variable thermal conductivity, critical thickness of insulation for cylinders and spheres; Conduction with Internal Heat Generation: Simple systems with uniform heat generation in slabs, cylinders. Extended Surfaces: Types, applications; Heat transfer from fins with uniform cross section; Fin efficiency and Effectiveness.

Transient Conduction: Lumped system analysis, time constant, semi-infinite body, Heisler Charts.

Principles of Convection: Principles of convection, Continuity, Momentum and Energy equations.

Forced Convection: Hydrodynamic and thermal boundary layers, boundary layer thickness, use of empirical relations for convective heat transfer over flat plates and cylinders, Internal Flows: Fully developed laminar flow, hydrodynamic and thermal entry lengths, Prandtl analogy, Turbulent flow inside tubes, Empirical relations for pipe flow and duct flow.

Natural Convection: Analysis of laminar flow over a vertical plate, Correlations for vertical plates, horizontal plates, vertical and horizontal cylinders.

Boiling and Condensation: Regimes of boiling, Mechanism, Nusselt's theory, Correlations for solving film-wise condensation.

Heat Exchangers: Classification and types of heat exchangers, Flow arrangement, overall heat transfer coefficient, Fouling factor, LMTD method of Heat exchanger analysis, correction factor, Effectiveness - NTU method.

Radiation: Introduction, Radiative Properties, concept of black, white and grey body, Laws of radiation, Stefan Boltzmann's law; Lamberts cosine law, Kirchhoff's law, Planck's law and Wien's law.

Radiation Heat Exchange Between Two Bodies: Shape factor, shape factor algebra, Heat Exchange by radiation between two finite parallel surfaces, Electrical analogy, solid angle and Radiation intensity, Heat exchange by radiation between two finite black and gray surfaces, Radiation shields, Error in temperature measurement.

Text Books:

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

Reference Books:

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

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

LIST OF EXPERIMENTS:

1. Determination of the thermal conductivity of the given metal rod.
2. Determination of the thermal conductivity of a solid by the *guarded hot plate method*.
3. Determination of the radial temperature distribution in the given lagged pipe.
4. Determination of the overall thermal resistance of a given composite wall structure.
5. Determination of the temperature distribution, convection heat transfer coefficient, Fin efficiency and fin effectiveness using forced convection method.

6. Determination of the temperature distribution and convection heat transfer coefficients for an internal fluid flow through a pipe in forced convection mode.
7. Determination of the temperature distribution, local and mean convection heat transfer coefficients from a heated vertical cylinder in natural convection mode.
8. Determination of heat transfer coefficients in drop-wise and film-wise condensation at different operating pressures.
9. Determination of LMTD and effectiveness of the heat exchanger in parallel flow configuration.
10. Determination of the overall heat transfer coefficient in a *plate heat exchanger.*
11. Determination of the Stefan-Boltzmann constant.
12. Determination of emissivity of a given test plate.

DESIGN OF MACHINE ELEMENTS

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

CO No	Course Outcome	PO	BTL
1	Understand the basics concepts, analyze the different stresses and apply design principles for static and fatigue strength of machine elements	1	4
2	Design the appropriate fastening technique	3	6
3	Design the power transmission elements such as keys, shafts and couplings	3	6
4	Design the appropriate springs such as helical or leaft springs	3	6
5	Analyze machine elements using ANSYS software	4, 5	4

Syllabus:

Introduction: Design Philosophy, General considerations and procedure in machine design, Mechanical properties of materials, preferred numbers, Codes & Standards, Reliability.

Design for Static Strength: Simple Stresses - Combined stresses - Torsional and Bending stresses - Factor of safety and theories of failure.

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

DESIGN OF FASTENERS

Welded joints: Design of Welded joints, Strength of welded joints, Circular fillet welds-bending and torsion, Welded joint with eccentric loading,

Bolted joints: Design of bolts with pre-stresses - Design for leak Proof Joints – Design of joints under eccentric loading - Bolt of uniform strength.

Riveted Joints: Design of Lap Joint, Butt Joint, Eccentric loaded joints and Boiler Joints.

Power Screws: Types - Mechanics of power screws, Efficiency of Square and Self-locking screw

DESIGN OF POWER TRANSMISSION ELEMENTS

Keys: Introduction-Classification, Application, Forces and stresses in keys, Design of Sunk Keys – Effect of Keyway on strength and stiffness

Shafts: Design of solid and hollow shafts for strength and rigidity, Design of shaft for variable load, Design of shafts for gear and belt drives.

Couplings: Introduction-Classification, applications and uses, Rigid couplings – Muff, Split muff and Flange couplings. Flexible Couplings –PIN-Bush coupling

DESIGN OF SPRINGS

Introduction: Classification-Helical springs, Torsion springs, Spiral springs, Leaf springsand their applications

Helical Springs: Stresses and deflections of helical springs, Design for static and fluctuating loads, natural frequency of helical springs – Energy storage capacity– Design of concentric or Coaxial springs,

Leaf springs: Construction, Nipping, Materials, design of Leaf springs for Automobile applications

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

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

COMPUTER INTEGRATED MANUFACTURING

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 computer aided design and manufacturing.	2	2
2	Explain the basic concepts of NC and CNC programming in machining.	2	2
3	Learn the basic concepts of group technology and flexible manufacturing systems.	2	2
4	Learn the basic concepts of computer aided process planning.	2	2
5	Gain hands on experience in converting a given raw material into desired shape and size by applying suitable casting and welding processes.	4	4

Syllabus:

Basic concepts of CAD / CAM and their integration tools

Conventional Numerical control: Introduction- basic components of an NC system-the NC procedure- NC coordinate system, NC motion control system- application of numerical control- Economics of Numerical control

NC part programming: Introduction - part programming methods - Computer assisted part programming, APT Language, macro statement in APT. NC programming with manual data input. **Computer controls in NC:** NC controllers' technology - Computer Numerical Control (CNC), Direct Numerical control (DNC), Adaptive control machining systems: Adaptive control optimization, Adaptive control constraint.

Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

Flexible Manufacturing Systems: Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.

Computer aided planning systems: Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning(MRP), mechanism of MRP, benefits, and Capacity Planning. Computer process control - Computer Process monitoring and control

Text Books:

1. CAD/CAM - Mikell P.Groover, and Emory W.Zimmers.Jr.

Reference Books:

1. Automation,Production systems and Computer Integrated Manufacturing Systems – Mikel P.Groover.

2. CNC machines – Adithan and Pabla,New Age Publications
3. Computer Automated Manufacturing - David Bed Worth
4. Understanding CAD/CAM by DAVID J.Bowman

LIST OF EXPERIMENTS:

1. Preparation of Manual part program for Linear Interpolation for the given part and simulation using Master CAM software
2. Preparation of Manual part program for Taper turning for the given part and simulation using Master CAM software
3. Preparation of Manual part program for given profile on CNC milling and simulation using Master CAM software
4. Preparation of Manual part program for Drilling operation on CNC milling and simulation using Master CAM software
5. CNC Manual Part Programming for facing and step turning operations
6. CNC Manual Part Programming for multiple rough and finishing turning cycles
7. CNC Manual Part Programming for profile milling on CNC milling
8. CNC Manual Part Programming for drilling on CNC milling
9. An automated guided vehicle (AGV)
10. An automated storage and retrieval system (AS/RS)
11. Pneumatically activated loading/unloading arm
12. Robot programming through computer/teaching box method
13. To get acquainted with “Group technology” philosophy and part family concept through practical examples
14. Collecting and studying the latest information on “Generation of Manufacturing sequence (Process Plan) using design information in computer for a given part in order to have quality product
15. Lab Project

PRODUCTION AND OPERATION MANAGEMENT

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

CO No	Course Outcome	PO	BTL
1	Apply various work-study techniques to determine the standard time and efficiency.	2, 11	3
2	Analyze various quality control techniques for bringing out the best quality output.	2, 11	4
3	Apply various production scheduling techniques to optimize productivity & Forecast the future demand for the product	2, 11	3
4	Apply various strategies to optimize the Inventory cost	2, 11	3
5	Validate the theoretical concepts by doing the experiments in the laboratory	4, 11	4

Syllabus:

Work study: Productivity and factors influencing productivity, basic procedure of work study. Techniques of work study, Method **study**: recording techniques – Flow process chart, two handed process chart, multiple activity chart, travel chart, flow diagram and string diagram

Work measurement: Stopwatch time study procedure, Tools used in time study, rating, allowances, setting standard time. **Work sampling:** Confidence levels, number of observations, use of random number table.

Inspection & Quality Control: Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems, OC curve. Introduction to failure concept & Characteristics: Reliability, Failure Analysis.

Scheduling: sequencing- definition, sequencing of n jobs through one machine, n jobs through 2 machines, (Johnsons' algorithm), sequencing of n jobs through m machines (Cambell Dudek and Smith algorithm)

Forecasting: Definition, approach, types, Methods – Qualitative methods – Judgmental methods, Quantitative methods – times series, regression, Forecast errors.

Inventory Control – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems, Types of Production Systems

Production planning & control: Introduction, definition, functions of PPC Introduction to aggregate planning, Materials Requirement Planning, Brief introduction to: JIT, Lean manufacturing, six sigma, Supply chain management

Text books:

1. ILO, Introduction to Work-Study, Oxford & IBH Publishing Pvt. Ltd., 3rd Edition, 1979.
2. Everette E. Adam, Ronald J. Ebert, Production and Operations Management, PHI Learning Pvt. Ltd., 5th Edition, 1992.

Reference Books:

1. S.N. Chari, Production and Operations Management
2. R. Pannerselvam, Production and Operations Management, PHI Learning Pvt. Ltd., 3rd Edition, 2012.
3. Martand Telsang, Industrial Engineering and Production Management, S.Chand and Company Ltd., 2nd Edition, 2008.
4. Steven Nahmias, Production and Operations Analysis, McGraw-Hill International, 5th Edition, 2005.

MECHATRONICS

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

CO No	Course outcome	PO	BTL
1	Understand the role of sensors and transducers for control systems	1	4
2	Apply the concepts of control systems in the field of automation.	4	3
3	Acquire ability to analyze and simulate response of a control systems	4	4
4	Apply the principles of PLCs in the design of control systems to achieve desired performance characteristics	3	3
5	Modelling of different systems with the help of control systems concepts and controllers to solve the engineering problems.	2	4

Syllabus:

Sensors and Transducers: Introduction, Performance terminology, Displacement-Position-Proximity sensors, Velocity and motion, Force, Fluid Pressure, Liquid flow, Liquid level, Temperature, Light sensors, Selection of sensors.

Introduction to control systems, Open loop and closed loop control systems, Block diagram representation, Introduction to signal conditioning requirements in Mechatronic systems, Quantizing theory, Analog to Digital conversion, Digital to Analog conversion, data acquisition process, Data acquisition systems.

Introduction to modelling of mechanical, electrical, fluid, and thermal systems containing elements such as sensors and actuators used in feedback control systems, Laplace transform, Transfer function.

Closed loop controllers, various control modes: Two-step (ON/OFF) control, closed loop system analysis considering proportional, integral, and derivative controllers and their combinations viz. PD, PI, PID control strategies.

Programmable Logic Controllers, basic architecture of PLCs, I/P and O/P processing, programming, ladder diagrams, Timers, Internal relays and counters, data handling, selection of a PLC.

Text Books:

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

Reference Books:

1. David G. Alciatore, Michael B. Histand, "Introduction to mechatronics and measurement systems", 2nd Edition, McGraw-Hill Professional, (2002).
2. D.A Bradley, D. Dawson, N.C Burd and A. J. Loader, "Mechatronics" CRC Press, (2010).
3. K. Ogata, "Modern Control Engineering", Prentice Hall India (2002).
4. Gene F. Franklin, J. D. Powell, A E Naeini, "Feedback Control of Dynamic Systems", Pearson (2008).
5. John Van De Vegte, "Feedback Control Systems", Prentice Hall (1993).

LIST OF EXPERIMENTS:

1. First order and second order Transfer function
2. Modeling and Testing of Translational Mechanical System
3. Modeling and Testing of Rotational Mechanical System
4. Modeling and Testing of R-C Electrical system
5. Modeling and Testing of R-L-C Electrical system
6. Modeling and Testing of Hydraulic system
7. Modeling and Testing of Thermal System
8. Closed loop Mechanical system with PID control
9. PLC Programming
10. PLC Programming
11. PLC Programming
12. PLC Programming

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 and IC engine components	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.

I.C. Engine Components: Introduction, Design of piston, connecting rod and Crank shaft.

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".

TECHNICAL SKILL COURSES

PROBLEM SOLVING TECHNIQUES IN DESIGN

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

CO No.	Course Outcome	PO	BTL
1	Identify stages in Design process and their implementation methods	3	3
2	Identify methods of scheduling of design process	3	3
3	Implementation of the design process to solve a design problem	4	6

ENGINEERING DESIGN
Introduction: Engineering Design Process, Importance of Engineering Design process, Types of Design, ways to think about engineering design process, Considerations of Good Design, Description of Design process.

DESIGN PROCESS AND TOOLS
Problem Definition and Need identification, Gathering Information, Concept Generation, Decision Making and Concept Selection; Embodiment Design; Detail Design; Modelling and Simulation.

SCHEDULING
Scheduling for the selected design project using Gantt chart and CPM/PERT

Text Books:

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

Note: 2 Hours are allotted to Capstone Project. Student has to design a modal using Solid works or CATIA and do analysis using ANSYS or Hyperworks or any analysis software. After completion of the project student has to submit the report.

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	Understand the Flow Visualization, Analog Methods, Dimensional analysis and Basic concepts of drag and lift of an aerofoil.	1	2
2	Analysis of Compressible Flow and Boundary layer theory	1, 2	4
3	Apply the fluid mechanics theoretical concepts to conduct various experiments by using ANSYS FLUENT	4	4

Syllabus:

Introduction to CFD (Computational Fluid Dynamics).

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

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

Dimensional analysis: Reynolds theorem and Buckingham π theorem.

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

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

Software Tool:

Ansys Fluent software is required to perform Fluid flow simulation.

Text Books:

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

Reference Books:

1. Mechanical Measurements by Thomas G. Beckwith, Addison-Wesley Publications.
2. ANSYS Fluent Tutorial Guide by ANSYS, Inc. Release 17.0 Southpoi.
3. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.

MANUFACTURING TECHNOLOGIES

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

CO No	Course outcome	PO	BTL
1	Analyze the Casting process to Estimate the cooling rate and residual stresses	1, 2	4
2	Analyze the welding process to estimate the temperature distribution profiles	1, 2	4
3	Analyze the Forming process to estimation the material flow	1, 2	4
4	Analyze the Machining process to estimation the cutting tool temperature and stresses	1, 2	4

Syllabus:

Introduction to ANSYS.

Casting: Estimation of cooling rate and residual stresses in various casting techniques. Welding: Estimation of temperature distribution profiles, residual stresses with the possible experimental validation.

Forming: Estimation of material flow, temperature and stresses in rolling, extrusion and drawing.

Machining: Estimation of cutting tool temperature and stresses.

Software Tool:

Ansys required to perform the manufacturing processes simulation.

List of Experiments:

	Expt. No.	Name of the Experiment
Group I (Casting and Welding)	1	Introduction to ANSYS and use of graphical user interaction for manufacturing applications.
	2	Analysis of casting process for estimation of cooling rate using Ansys.
	3	Analysis of casting process for estimation of residual stresses using Ansys.
	4	Analysis of fusion welding for estimation of temperature profiles and cooling rate using ANSYS.
	5	Analysis of solid state welding for estimation of temperature profiles and cooling rate using ANSYS.
Group II (Forming and Machining)	6	Analysis of rolling process.
	7	Analysis of drawing process.
	8	Analysis of extrusion process.
	9	Analysis of turning process.

	10	Analysis of drilling process.
Project	A project on an industrial application related to any one or combination of the manufacturing processes.	

CONTROL SYSTEMS FOR MACHINES

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

CO No	Course outcome	PO	BTL
1	Understand the concept of control systems and actuation systems	1	2
2	Apply the concepts of control systems in the field of automation	4	3
3	Acquire ability to analyze and simulate response of a control Systems	4	4

Syllabus:

Introduction: Systems, measurement systems, control systems, microprocessor-based controllers

Actuation systems: Pneumatic actuation system, hydraulic actuation, electrical actuation system.

System models: Mechanical system, electrical system, fluid system, thermal system, electromechanical systems.

System transfer functions: First order systems, second order system, system in series, systems with feedback loops

Frequency response: First order systems, second order systems, Bode plots.

Closed loop controllers: Continuous and discrete processes, control modes

Case studies of systems: Pick and place Robot, Conveyor based material handling system , PC based CNC machine.

Text Books:

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

Reference Books:

1. David G. Alciatore, Michael B. Histand, “Introduction to mechatronics and measurement systems”, 2nd Edition, McGraw-Hill Professional, (2002).

2. D.A Bradley, D. Dawson, N.C Burd and A. J. Loader, “Mechatronics” CRC Press, (2010).
3. K. Ogata, “Modern Control Engineering”, Prentice Hall India (2002).
4. Gene F. Franklin, J. D. Powell, A E Naeini, “Feedback Control of Dynamic Systems”, Pearson (2008).
5. John Van De Vegte, “Feedback Control Systems”, Prentice Hall (1993).

List of Experiments:

1. Basic MATLAB Commands
2. Basics of SIMULINK
3. Simulation of a Thermal System
4. Simulation of an Electrical System
5. Simulation of a Mechanical System
6. Simulation of a Rotational System
7. PID Control of a Thermal System
8. PID Control of an Electrical System
9. PID Control of a Mechanical System
10. PID Control of a Rotational system

PROFESSIONAL ELECTIVES

FINITE ELEMENT METHOD

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

CO No	Course Outcome	PO	BTL
1	Analyze 3D stresses & strains for general loading and solving complex engineering problems using approximate methods	1, 2	4
2	Analyze 1D structural problems using FEM	1, 2, 5	4
3	Analyze 2D problems including axi-symmetric solids subjected to axi-symmetric loading using FEM	1, 2, 5	4
4	Analyze thermal problems structural dynamic problems using FEM	1, 2, 5	4

Syllabus:

Analysis Of 3-D Stresses & Strains: Introduction, Stresses & Equilibrium, Strain-displacement relations, Stress-strain relations, Stress cubic, principal stress calculations & Von-Mises stress

Approximate Methods and Basic Concepts of F.E.M.: Potential energy and equilibrium, the Rayleigh-Ritz method, Galerkin method, Introduction to FEM, historical background, Fundamental concepts, Saint venant's principle.

One-Dimensional Problems:

Bar element – Introduction, Finite Element Modeling, Potential Energy Approach, Element Stiffness matrix and assembly for Global Stiffness Matrix, Load Vector, Properties of Global Stiffness Matrix, The Finite Element equations, Treatment of boundary conditions-Penalty and Elimination approach, Effect of Temperature, 3-Noded bar element, Stress calculations

Truss element: Introduction, Plane and space Trusses: Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members.

Two-Dimensional Problems:

Constant-Strain Triangle (CST): Introduction, Finite Element Modelling Isoparametric Representation, Potential-Energy Approach, Element Stiffness, Force Terms and Stress Calculations, Problem Modelling and Boundary Conditions –

Axisymmetric solids subjected to axisymmetric Loading Introduction, Axisymmetric Formulation, Finite Element Modelling of Triangular Element, Potential-Energy Approach, Load vector, Stress Calculations.

Dynamic Considerations: Introduction, Formulation, Element Mass Matrices, Evaluation of Eigen values and Eigen vectors; properties of Eigen vectors, Eigen value and Eigenvector Evaluation for bar only.

Scalar Field Problems: Introduction, steady-state heat transfer, one dimensional heat conduction, governing equation, boundary conditions, one dimensional element.

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

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.

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

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

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

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

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

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

Text books:

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

Reference Books:

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

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

List of Experiments:

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

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

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

Machines for Rapid Prototyping: Overview 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.	2	2

2	Design and development of various die configurations.	2	2
3	Design and development of jigs for given component.	2	2
4	Design and development of fixtures for given component.	2	2

Syllabus:

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

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

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

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

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

Text Book:

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:

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.

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

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 Book:

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.

AUTOMOBILE ENGINEERING

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

CO No.	Course Outcome	PO	BTL
1	Understand working of engine and cooling system	3	2
2	Understand transmission and vehicle control systems	3	2

Syllabus:

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

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

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

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

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

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 thermodynamics first principles and design major components of an I. C. engine	1	3
2	Design cooling, lubrication and engine component systems	3	3
3	Simulate and Analyze the designed engine components for stresses	4	4
4	Design various automobile engine components experimentally	4	5

Syllabus:

THERMODYNAMIC ENGINE DESIGN: Thermal cycles, Decision on size, length of stroke, rpm of the engine, Design of engine from first principle.
ENGINE FUNCTIONAL DESIGN: Selection, Stroke & Bore, No. of cylinders, Cylinder arrangement, Design considerations for combustion chamber, Engine balancing, Selection of firing order.
DESIGN OF COOLING & LUBRICATION SYSTEM: Heat calculations and Heat balance sheet, Design of radiator, water pump, selection of lubricating oil and pump.
ENGINE COMPONENT DESIGN: Materials, Design of Piston, Piston pin, Connecting rod, Crankshaft, Cylinder liner, cylinder head, Design of Flywheel, Design of Valve, Rocker arm, Push rod, Cam shaft, cam and follower.
ANALYSIS OF THE DESIGNED ENGINE COMPONENTS

2D drawings of piston assembly, crank shaft, cam shaft, cylinder block and cylinder head, rocker and rocker arm, and valves (Using CAD/CATIA).
Failure analysis of critical components using ANSYS:
Model Simulation of piston connecting rod assembly, torque and force analysis for the designed crank shaft, stress analysis for the valve and the push rod.

Text Books:

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

Reference Books:

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

List of Experiments:

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

12. Detailed drawing of the rocker, rocker arm, valves and springs using Auto CAD or CATIA.

AUTOMOTIVE TRANSMISSION

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

CO No.	Course outcome	PO	BTL
1	Understand functionality of clutches and gear box	3	2
2	Principle of working of drive line system and automatic transmission	3	2
3	Understand various Automotive Transmission mechanisms experimentally	4	2

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 working principles of batteries and ignition system	3	2
2	Understand auto wiring electrical systems and safety concept and equipments	3	2

Syllabus:

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

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

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

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

Text Books:

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

Reference Books:

1. Kirpal Singh, "Automobile Engineering".
2. R. B. Gupta, "Automobile Engineering".

List of Experiments:

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

11. Analysis of automatic speed control circuit using Ni Lab View.
12. Analysis of safety air bags operating circuit using Ni lab View.

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	Study and comprehend the application of Hydrogen fuel, Solar Energy and Biofuels for automobiles.	1, 2	3
2	Analyze and estimate the performance of Hybrid and Plug-in vehicles, Natural Gas and Propane vehicles, Emerging and future source of alternative fuels.	1, 2	3
3	Experimental and Simulations of Alternative energy sources using Software tools	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) by James 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:

4. Tom Denton, "Automobile Electrical and Electronic Systems", 3rd edition, Elsevier Butterworth-Heinemann 2004.
5. William B. Ribbens, "Understanding Automotive Electronics" 7th edition Butterworth-Heinemann publications, 2012.
6. Ed Doering "NI MYRIO Project Essential Guide" 2013, National Technology and Science Press
7. Allan. W. M. Bonnick, "Automotive Computer Controlled System 2001, Butterworth-Heinemann
8. 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 platform and 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, fuel injection system.	1,2	4
2	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	Analyse control system for Automotive systems	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 functions and operations of PLC	1	2
2	Analyze PLC for the control of industrial processes	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
   . Editing ladder program
   . Testing ladder program
   . Monitoring status

2. Basic control circuits
   . Self-holding circuit
   . Flashing control
   . Inching control
   . Single button control

3. Light control
   . Simple light control
   . Complex light control

4. Traffic light control
   . Traffic light controller (step)
   . Traffic light controller (conventional)

5. Digital clock control
   . 7-segment display control
   . Time clock

6. Step motor control
   . Speed and direction control
   . Encoder operation
   . Step motor and encoder
   . Step display of step motor

7. Tank filling device control
   . Tank filling control
   . Tank filling control with thumbwheel

8. Keypad control
   . Keypad operation
   . Digital lock control

9. DC motor control
   . PWM speed controller
   . Proximity and micro switches
   . Automatic speed control

10. Multiple PLC trainers
    . Connecting PLCs via RS-485
    . Connecting PLCs via Ethernet

11. Temperature control
    . High temperature control
    . cryogenic temperature control

12. Counter application programming
    . No of bottles moving on a conveyor

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	4	3

	system in terms of design, operation and control aspects		
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	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	1	2
2	Write ladder logic in Programmable logic controllers.	3	4

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 ADDTITON
3. FACTORIAL OF A GIVEN 8-BIT NUMBER
4. SORTING OF NUMBERS IN ASCENDING ORDER
5. STRING DATA TRANSFER
6. COMPARISION 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	1	2

	and relevant considerations		
2	Applythe 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 Mat Lab
2. Introduction to Simulink.
3. To Study and simulate The Response of a Thermal System.
4. To Study and simulate The Response of an Electrical System.

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

PROGRAMMING SKILLS

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

IPR & PATENT LAWS

SYLLABUS

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

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

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

Case Studies on Patents

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

Textbooks:

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

Reference books:

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

ENVIRONMENTAL POLLUTION CONTROL METHODS

SYLLABUS:

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

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

Text Books:

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

Reference Books:

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

SOLID AND HAZARDOUS WASTE MANAGEMENT

SYLLABUS

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

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

REMOTE SENSING AND GIS

SYLLABUS

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

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

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

Text Books:

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

Reference Books:

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

DISASTER MANAGEMENT

SYLLABUS

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

Text books:

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

Reference books:

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

FUNDAMENTALS OF DBMS

SYLLABUS

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

FUNDAMENTALS OF SOFTWARE ENGINEERING

SYLLABUS

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

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

Text Books:

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

Reference Books:

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

FUNDAMENTALS OF INFORMATION TECHNOLOGY

SYLLABUS:

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

TEXT BOOKS

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

IMAGE PROCESSING

SYLLABUS:

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

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

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

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

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

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

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

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

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

Text books:

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

Reference books:

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

LINUX PROGRAMMING

SYLLABUS

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

Text Books:

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

Reference Books:

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

E-COMMERCE

SYLLABUS

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

Text Books:

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

Reference Books:

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

RENEWABLE ENERGY RESOURCES

SYLLABUS

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

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

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

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

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

Text books:

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

Reference books:

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

ROBOTICS

SYLLABUS

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

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

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

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

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

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

Introduction to Trajectory Planning, the manipulator jacobian.

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

MECHATRONICS

SYLLABUS

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

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

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

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

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

SYSTEM MODELS: Modelling of one and two degrees of freedom Mechanical, Electrical, fluid and thermal systems. Block diagram representations for these systems.

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

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

DIGITAL LOGIC: Logic gates, Boolean algebra, Karnaugh maps**.**

PLC: Introduction, basic structure, I/P ,O/P processing, programming, ladder diagrams, Timers, Internal relays and counters ,data handling, Analogue Input and Output, selection of a PLC**.**

DESIGN: Mechatronics system Design, possible design solutions.

CASE STUDY: pick and place Robot, CNC Machine.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. A.K.Sawhney, "A course in Electrical and Electronic Measurement and Instrumentation"- Dhanpat Rai & Sons - 1991.
2. NitaigourPremchandMahalik, “Mechatronics”, Tata McGraw-Hill, 2003.
3. HMT Limited, “Mechatronics”, McGraw-Hill Education (India) Pvt Ltd, 2000.
4. T.G. Beckwith &N.L.Buck, “Mechanical Measurements”, 3rd Edition, Addison-Wesley Pub. Co., 1969.

OPERATIONS RESEARCH

SYLLABUS

Introduction to Operation Research: Introduction, Modeling in Operations Research, Phases of OR study, Scope and application of OR. Linear Programming and its Applications: Linear Programming Problem – Graphical solution of LP Problem. Simplex method, Big M method, two phase methods, multiple solution, infeasible solution, unbounded solution, degeneracy, Dual Simplex method. Transportation: Introduction – Methods of basic feasible solution, Optimality test, Degeneracy in transportation problem, unbalanced transportation Problem, Assignment Problems: Hungarian method for assignment problem, Traveling salesman problem. Theory of Games: Introduction, to solve the rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games.

Inventory Control: Introduction – EOQ with uniform rate of demand, Economic lot size with finite rate of replenishment, Quantity discounts, Deterministic model with Shortages, ABC analysis of inventory. Dynamic Programming: Introduction, Bellman's principle of optimality, application to shortest route problem, linear programming, tabular method. Queuing Theory: Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population, Simulation: Introduction, Monte-Carlo Simulation, Application to Inventory Control. Project Management by PERT/CPM: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rule, Critical path method (CPM)- floats, critical path, project duration, PERT: Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion. Crashing: Introduction, crashing of network, problem

Text Books:

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

Reference Books:

1. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

NANO MATERIALS AND TECHNOLOGY

SYLLABUS

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

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

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

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

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

SUBSEA ENGINEERING

SYLLABUS

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

REFERENCE BOOKS:

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

OIL AND GAS MANAGEMENT

SYLLABUS

Global Oil and Gas: Value Chain and Geopolitics of Oil

The Upstream: Exploration, Development, and Production

The Midstream: Markets and Transportation

The Downstream: Refining and Marketing

The Future Oil and Gas Industry

REFERENCE BOOKS

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

SELF DEVELOPMENT

SYLLABUS

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

TEXT BOOK

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

REFERENCE BOOKS

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

EMOTIONALINTELLIGENCE

SYLLABUS

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

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

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

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

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

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

Textbooks:

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

Reference Books:

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

BEHAVIORALSCIENCES

SYLLABUS

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

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

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

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

Text Books:

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

Reference books:

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

PHOTOGRAPHY

SYLLABUS:

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

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

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

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

Reference Books:

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

MANAGEMENT ELECTIVES

PARADIGMS IN MANAGEMENT THOUGHT

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

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

SYLLABUS:

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

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

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

Recommended Text Book(s):

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

Reference Books:

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

INDIAN ECONOMY

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

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

SYLLABUS:

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

Recommended Text Book(s):

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

Reference Books:

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

MANAGING PERSONAL FINANCES

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

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

SYLLABUS

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

Recommended Text Book(s):

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

Reference books:

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

BASICS OF MARKETING FOR ENGINEERS

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

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

SYLLABUS:

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

Text Books:

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

Reference Books:

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

ORGANIZATION MANAGEMENT

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

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

SYLLABUS:

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

Text books:

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

Reference books:

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

RESOURCE, SAFETY AND QUALITY MANAGEMENT

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

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

SYLLABUS

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

HONOR DEGREE COURSES

ADVANCED HEAT & MASS TRANSFER

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

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

Syllabus:

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

Text Books:

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

Reference Books:

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

INCOMPRESSIBLE AND COMPRESSIBLE FLOWS

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

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

Syllabus:

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

Text Books:

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

Reference Books:

1. Introduction to Fluid Mechanics, E. J. Shaughnessy, I. M. Katz and J. P. Schaffer, Oxford University Press (2004)

2. Compressible fluid flow, M. A. Saad, Prentice Hall (1985)
3. Incompressible flow, R. L. Panton, John Wiley & Sons (2005)
4. Advanced Fluid Mechanics, Som, and Biswas, Tata McGraw Hill (2008)
5. The dynamics and thermodynamics of compressible fluid flow, Vol. 1 & 2, A. H. Shapiro, Ronald Press (1954)

COMPUTATIONAL FLUID DYNAMICS

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

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

Syllabus:

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

Text Books:

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

Reference Books:

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

MECHANISMS DESIGN AND SIMULATION

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

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

Syllabus:

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

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

Path Curvature Theory, Coupler Curve: Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary

curvature. Four bar coupler curve-cusp-crunode coupler driven six-bar mechanisms-straight line mechanisms

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

Synthesis of Coupler Curve Based Mechanisms & Cam Mechanisms

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

Reference Books:

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

ADVANCED MECHANICS OF SOLIDS

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

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

Syllabus:

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

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

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

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

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

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

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

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

Reference Books:

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

MINOR DEGREE COURSES

INDUSTRIAL ENGINEERING TECHNIQUES

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

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

Syllabus:

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

Text Books:

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

Reference Books:

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

OPERATIONS RESEARCH

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

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

Syllabus:

Introduction to Operation Research: Introduction, Modelling in Operations Research, Phases of OR study, Scope and application of OR. **Linear Programming and its Applications**: Linear Programming Problem – Graphical solution of LP Problem. Simplex method, Big M method, two phase methods, multiple solution, infeasible solution, unbounded solution, degeneracy, Dual Simplex method. **Transportation:** Introduction – Methods of basic feasible solution, Optimality test, Degeneracy in transportation problem, unbalanced transportation Problem, **Assignment Problems**: Hungarian method for assignment problem, Traveling salesman problem. **Theory of Games:** Introduction, to solve the rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games. **Inventory Control:** Introduction – EOQ with uniform rate of demand, Economic lot size with finite rate of replenishment, Quantity discounts, Deterministic model with Shortages, ABC analysis of inventory. **Dynamic Programming**: Introduction, Bellman's principle of optimality, application to shortest route problem, linear programming, tabular method. **Queuing Theory:** Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population, **Simulation:** Introduction, Monte-Carlo Simulation, Application to Inventory Control. **Project Management by PERT/CPM**: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rule, Critical path method (CPM)- floats, critical path, project duration, PERT: Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion. Crashing: Introduction, crashing of network, problem

Text Books:

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

Reference Books:

1. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

ENGINEERING MANAGEMENT

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

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

Syllabus:

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

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

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

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

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

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

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

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

Text Books:

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

References:

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

WORK STUDY & ERGONOMICS

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

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

Syllabus:

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

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

Text Books

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

Reference Books

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

OPERATIONS MANAGEMENT

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

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

Syllabus:

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

Text Books:

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

Reference Books:

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

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