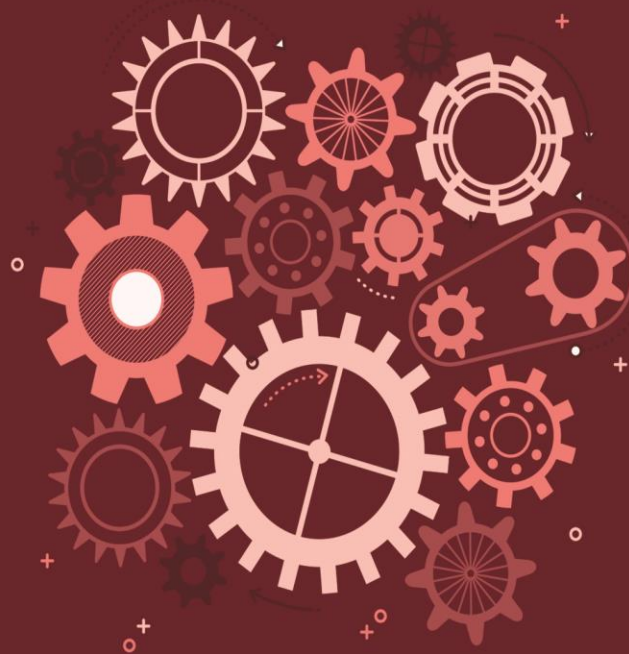




(DEEMED TO BE UNIVERSITY)



# MECHANICAL ENGINEERING

## CURRICULUM & SYLLABUS

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

### B.Tech Mechanical Engineering 2017-18 Course Structure

S.No	Course Code	Course Name	L	T	P	S	Cr	Pre-requisite
<b>HUMANITIES &amp; SOCIAL SCIENCES</b>								
1	17EN1201	Building Blocks for Communication Skills	0	0	4	0	2	NIL
2	17EN3102	Instant Communication Skills	0	0	4	0	2	NIL
3	17EN3203	Corporate Communication Skills	0	0	4	0	2	NIL
4	17MB4057	Economics for Engineers	2	0	0	0	2	NIL
5	17GN1001	Ecology And Environment (will be offered Online)	2	0	0	0	2	NIL
6	17UC0010	Universal Human Values & Professional Ethics	0	0	2	0	1	NIL
		<b>Total</b>	<b>4</b>	<b>0</b>	<b>14</b>	<b>0</b>	<b>11</b>	
<b>AUDIT COURSES</b>								
1	17AC1001	Indian Heritage and Culture	0	0	2	0	0	NIL
2	17AC1002	Indian Constitution	0	0	2	0	0	NIL
3	17AC1003	Environment and Sustainability	2	0	0	0	0	NIL
4	17AC1004	Gender Sensitization	2	0	0	0	0	NIL
		<b>Total</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	
<b>BASIC SCIENCES</b>								
1	17MT1101	Single Variable Calculus and Matrix Algebra	3	0	2	0	4	NIL
2	17MT1102	Foundations of Computational Mathematics	3	0	0	0	3	NIL
3	17MT1203	Multivariate Calculus	3	1	0	0	4	NIL
4	17MT1204	Logic and Reasoning	2	0	0	0	2	NIL
5	17MT2012	Theory of Differential Equations for Engineering and Mechanics	2	0	2	0	3	NIL
6	17PH1001	Engineering Materials	3	0	2	0	4	NIL
7	17CY1001	Engineering Chemistry	3	0	2	0	4	NIL
		<b>Total</b>	<b>19</b>	<b>1</b>	<b>8</b>	<b>0</b>	<b>24</b>	
<b>ENGINEERING SCIENCES</b>								
1	17CS1101	Problem Solving through Computer Programming	2	2	2	0	5	NIL

2	17GN1204	Coding Skills for Engineers	0	0	10	0	5	17CS1101
3	17ME1001	Engineering Mechanics	3	0	2	0	4	NIL
4	17ME1002	Engineering Graphics and Design	1	0	4	0	3	NIL
5	17ME1003	Workshop Practice	0	0	2	0	1	NIL
6	17ME1104	Introduction to Mechanical Engineering	2	0	2	0	3	NIL
7	17GN1003	Basic Engineering Measurements	2	0	2	0	3	NIL
8	17ME2005	Computational Thinking and Data Sciences	2	0	2	0	3	NIL
9	17ME2206	Numerical Computation for Mechanical Engineers	3	0	2	0	4	NIL
10	17EE2205	Circuits and Electronics	3	0	2	0	4	NIL
		<b>Total</b>	<b>18</b>	<b>2</b>	<b>30</b>	<b>0</b>	<b>35</b>	

### PROFESSIONAL CORE COURSES

1	17ME2107	Machine drawing	0	0	4	0	2	17ME1002
2	17ME2108	Thermal-Fluids Engineering-I	3	0	2	0	4	NIL
3	17ME2109	Mechanics and Materials-I	3	0	2	0	4	17ME1001
4	17ME2110	Dynamics and Control-I	3	0	2	0	4	17ME1001
5	17ME2211	Dynamics and Control-II	3	0	2	0	4	17ME2110
6	17ME2212	Thermal-Fluids Engineering-II	3	0	2	0	4	17ME2108
7	17ME2213	Mechanics and Materials-II	3	0	2	0	4	17ME2109
8	17ME3114	Design and Manufacturing-I	3	0	2	0	4	17ME2109
9	17ME3115	Engineering Management	3	0	0	0	3	NIL
10	17ME3116	Heat Transfer	3	0	2	0	4	17ME2108
11	17ME3117	Finite Element Analysis of Solids and Fluids	3	0	2	0	4	17ME2108, 17ME2109
12	17ME3118	Introduction to Robotics	3	0	2	0	4	NIL
13	17ME3219	Design and Manufacturing-II	3	0	2	0	4	17ME3114
14	17ME3220	Elements of Mechanical Design	2	0	2	0	3	17ME2213
		<b>Total</b>	<b>38</b>	<b>0</b>	<b>28</b>	<b>0</b>	<b>52</b>	

### TECHNICAL SKILL COURSES

1	17TS701	Skilling for Engineers-1 (Manufacturing Technologies)	0	0	0	8	2	NIL
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2	17TS702	Skilling for Engineers-2 (Control Systems for Machines)	0	0	0	8	2	NIL
3	17TS703	Skilling for Engineers-3 (Problem Solving techniques in Thermal)	0	0	0	8	2	17ME2108
4	17TS704	Skilling for Engineers-4 (Problem Solving techniques in Design)	0	0	0	8	2	17ME2213
5	17TS705	Technical Proficiency & Training-1(Automobile Design and Building)	0	0	0	4	1	NIL
6	17TS706	Technical Proficiency & Training -2(Robot Design)	0	0	0	8	2	NIL
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>44</b>	<b>11</b>	
<b>Counseling &amp; Cocurricular Activities</b>								
1	17GN2103	Counseling -1	0	0	1	0	0	NIL
2	17GN2204	Counseling -2	0	0	1	0	0	NIL
3	17GN3105	Counseling -3	0	0	1	0	0	NIL
4	17GN3206	Counseling -4	0	0	1	0	0	NIL
5	17GN2109	Cocurricular Activity -1	0	0	0	2	0	NIL
6	17GN2210	Cocurricular Activity -2	0	0	0	2	0	NIL
7	17GN3111	Cocurricular Activity -3	0	0	0	2	0.5	NIL
8	17GN3212	Cocurricular Activity -4	0	0	0	2	0.5	NIL
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>8</b>	<b>1</b>	
<b>PROFESSIONAL ELECTIVES</b>								
1	PE	Professional Elective-1	2	0	2	0	3	NIL
2	PE	Professional Elective-2	2	0	2	0	3	NIL
3	PE	Professional Elective-3	2	0	2	0	3	NIL
4	PE	Professional Elective-4	2	0	2	0	3	NIL
5	PE	Professional Elective-5	2	0	2	0	3	NIL
		<b>Total</b>	<b>10</b>	<b>0</b>	<b>10</b>	<b>0</b>	<b>15</b>	
<b>OPEN ELECTIVES</b>								
1	OE	Open Elective -1	3	0	0	0	3	NIL
2	OE	Open Elective -2	3	0	0	0	3	NIL

3	OE	Open Elective -3(Foreign Lang.)	3	0	0	0	3	NIL
		<b>Total</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>9</b>	
<b>PROJECT</b>								
1	17IE2246	Industrial Training	0	0	0	0	2	NIL
2	17IE3247	Term Paper	0	0	4	0	2	NIL
3	17IE4048/ 17IE4050	Project (Part I) / Practice School	0	0	0	24	6	NIL
4	17IE4049/ 17IE4050/ 17IE4051	Project (Part II) / Practice School/ Internship	0	0	0	24	6	NIL
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>48</b>	<b>16</b>	
		<b>GRAND TOTAL</b>	<b>102</b>	<b>3</b>	<b>102</b>	<b>100</b>	<b>174</b>	

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

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

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

List of Foreign Language Elective								
S.No	Course Code	Course Name	L	T	P	S	Cr	Pre-requisite
1	17FL3051	Arabic Language	2	0	0	0	2	Nil
2	17FL3052	Bengali Language	2	0	0	0	2	Nil

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

#### List of Management Electives

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

#### List of Honor Degree Courses

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

**Minor in Industrial Engineering**

**List of Minor Degree Courses**

<b>S.No</b>	<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>Cr</b>	<b>Pre-requisite</b>
1	17ME3121	Industrial Engineering Techniques	3	0	2	0	4	Nil
2	17ME3122	Operations Research	3	0	2	0	4	Nil
3	17ME3123	Engineering Management	3	0	2	0	4	Nil
4	17ME3124	Work Study and Ergonomics	3	0	2	0	4	Nil
5	17ME3125	Operations Management	3	0	2	0	4	Nil

**HUMANITIES &  
SOCIAL SCIENCES**

## BUILDING BLOCKS FOR COMMUNICATION SKILLS

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

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

### Syllabus:

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

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

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

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

### Reference Books:

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

## INSTANT COMMUNICATION SKILLS

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

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

### Syllabus:

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

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

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

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

### Text Books:

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

### Reference Books:

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

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

## **CORPORATE COMMUNICATION SKILLS**

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

<b>CO No</b>	<b>Course Outcome</b>	<b>PO</b>	<b>BTL</b>
1	Analyse the method of identifying synonyms and antonyms and analyze the meaning of a word from the context.	10	4
2	Analyze various strategies involved in writing an essay and apply various styles in writing.	10	4
3	Analyse the organization of the passage and also analyze the tone, attitude and style of the author.	10	4
4	Acquire knowledge on various employability skills & analyze a situation and develop adaptability.	5	4

### **Syllabus:**

**Speaking Skills:** Verbal Ability: Synonyms & Antonyms: Analogy: One word substitution: Sentence completion: Analyzing arguments: Sentence correction: Speaking Practice: Persuasive speaking: Sell out: Impromptu speaking: My News my paper

**Writing Skills: Résumé Writing:** Five Types of Essays: Agree or disagree: Which do 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

### **Text Books:**

1. Communication Skills, Sanjay Kumar & PushpaLata, Oxford University Press, 2014 print.

### **Reference Books:**

1. IELTS Essay Booster (One Stop Destination for the Writing Module) (English), Akanksha Makwana, Heeral Bhatt, MK Book Distributors- Ahmedabad.
2. GRE Analytical Writing : Solutions to the Real Essay Topics (English), Create space Independent Pub

3. Critical Reading: English for Academic Purposes 1st Edition, Pearson Education ESL; 1 edition, 2015
4. Study Reading: A Course in Reading Skills for Academic Purposes, Eric H. Glendinning, Beverly Holmström, Cambridge University Press, 2004.
5. Soft skills enhancing employability – connecting campus with corporate, M S Rao, International Publishing Pvt Ltd, 2002.
6. Personality development and soft skills, Sunitha Mithra, OUP 2012.
7. Objective English : 3 rd Edition, Edgar Thorpe and Showick Thorpe, Pearson Publishers, 2010 print.
8. Objective General English, RS Agarwal, S Chand Publishers, New Delhi.

### 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. **Environmental Pollution-** Définition, Causes, effects, control measures of Air pollution, Water pollution, oil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. **Soil waste management. Electronic waste management, Biomedical waste management** - Role of an individual in prevention of pollution. **Disaster management**-.Climate change, global warming, acid rain, ozone layer depletion. **Environmental Legislation** and objectives of Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife protection Act, Forest conservation Act, Biodiversity Act, Public awareness. **Environmental Impact Assessment Process.**

**Text Book:**

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

**UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS**

**Mapping of Course Outcomes (CO) to Program outcomes:**

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

**Syllabus:**

**Introduction to Value Education:** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - The Basic Human

Aspirations, Right Understanding, Relationship and Physical Facilities, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations.

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

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

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

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

**Text Book:**

1. R R Gaur, R Sangal and G P Bagaria, “ A Foundation Course in Human Values and Professional Ethics”, 1<sup>st</sup> Ed, Excel Books.

**INDIAN HERITAGE AND CULTURE**

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

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

**Syllabus:**

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

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

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

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

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

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

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

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

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

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

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

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

Scientific and Technological Developments in Medieval India: Influence of the Islamic world and Europe; Developments in the fields of Mathematics, Chemistry, Astronomy and

Medicine; Innovations in the field of agriculture - new crops introduced, new techniques of irrigation etc.

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

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

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

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

#### **Text Books:**

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

## **INDIAN CONSTITUTION**

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

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

#### **Syllabus:**

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

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

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

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

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

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

**Reference Books:**

1. Indian Polity' by Laxmikanth
2. Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti
5. 'Constitutional Law of India' by Seervai H.M.
6. 'Constitution Of India' by Shukla V.N.
7. 'The Indian Constitution: Cornerstone of a Nation' by Granville Austiin
8. 'Indian Constitutional Law' by M.P. Jain

# **BASIC SCIENCES**

## SINGLE VARIABLE CALCULUS AND MATRIX ALGEBRA

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

CO No	Course Outcome	PO	BTL
1	Model the physical laws and relations mathematically as a first order differential equations, solve by analytical and numerical methods also interpret the solution.	1	4
2	Model physical laws and relations mathematically as second/higher order differential equations, solve by analytical method and interpret the solution.	1	4
3	Obtain the Fourier series expansions of periodic functions and use the series to solve ordinary differential equations.	1	4
4	Model physical problems mathematically as a system of linear equations and solve them by analytical and numerical methods. Also, determine the nature of Quadratic form using Eigen values.	1	4
5	Verify the solution of problems through MATLAB.	5	4

### Syllabus:

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

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

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

### Text books:

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

### Reference Books:

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

## FOUNDATIONS OF COMPUTATIONAL MATHEMATICS

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

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

### Syllabus:

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

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

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

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

### Text Books:

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

### Reference Books:

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

## MULTIVARIATE CALCULUS

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

CO No	Course out come	PO	BTL
1	Determine extreme values for functions of several variables	1	4
2	Determine area, volume moment of inertia through multiple integrals in Cartesian or polar co ordinates.	1	4
3	Apply the concepts of vector calculus to calculate the gradient, directional derivative, arc length , areas of surfaces and volume of solids in practical problems	1	4
4	Obtain analytical and numerical solutions of Heat and wave equations	1	4
5	Verify the solution of problems through MATLAB	5	4

### Syllabus:

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

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

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

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

### Text books:

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

### Reference Books:

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

## LOGIC AND REASONING

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

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

### Syllabus:

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

**Probability:** Definitions of Probability, Addition and Multiplication Theorems.

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

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

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

**Cubes:** Basics of a cube, Finding the minimum number of cuts when the number of identical pieces are given, Finding the maximum number of pieces when cuts are given, Problems on painted cubes of same and different colors, Problems on cuboids, Problems on painted cuboids, Problems on Dice.

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

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

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

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

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

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

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

Comparison & Elimination

**Text Books:**

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

**Reference Books:**

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

**THEORY OF DIFFERENTIAL EQUATIONS IN ENGINEERING AND MECHANICS**

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

CO No	Course Outcome (CO)	PO	BTL
1	Obtain the response of a mechanical system having single degree-of-freedom for free and forced vibrations through linear differential equations.	1	3
2	Model and solve free and forced vibrations of a two- degree-of-freedom system through system of linear differential equations.	1	3
3	Obtain canonical forms of linear second order PDEs and Demonstrate the nature of the incompressible fluid flow using Euler and Bernoulli equations.	1	3
4	Identify the heat and wave equations in different forms, obtain their responses and develop empirical relations.	1	3
5	Determine the response of mechanical vibrating systems and heat equations which are modelled by ordinary or partial differential equations using MATLAB.	11	3

**Syllabus:**

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

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

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

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

### Text Books

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

### Reference Books

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

## ENGINEERING MATERIALS

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

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

### **Syllabus:**

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

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

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

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

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

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

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

### **Text books:**

1. [William D. Callister](#), Jr. "Materials Science and Engineering: An Introduction" 6<sup>th</sup> edition, 2007, Wiley India Pvt.Ltd.
2. Charles Kittel, "Introduction to Solid State Physics" 8<sup>th</sup> edition, 2012, Wiley India Pvt.Ltd.

### **Reference Books:**

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

## ENGINEERING CHEMISTRY

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

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

### Syllabus:

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

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

**Text books:**

1. Engineering Chemistry, Jain & Jain, Dhanpat Rai Publishing Company, New Delhi.
2. Engineering Chemistry, O G Palanna, The Tata McGraw Hill, New Delhi.

**Reference Books:**

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

**LIST OF EXPERIMENTS:**

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

# **ENGINEERING SCIENCES**

## PROBLEM SOLVING AND COMPUTER PROGRAMMING

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

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

### Syllabus:

Problem Solving Approach, **Algorithms and Algorithm Analysis**, Program Development Steps, Structure of C Program, Pre-Processor Directives, **Formatted I/O, C Tokens, Data Types**: Primitive, Extended and Derived Including Pointers, Operators, Precedence, Associativity, **Redirecting I/O**: Files and File Operations, **Control Flow Statements, Functions, Recursion**, Scope of Variables and Storage classes, **Arrays**, 2-Dimensional Arrays, Dynamic Memory Allocation, **Searching**: Linear Search and Binary Search, **Sorting**: Bubble Sort, **Strings, Structures and Unions**, Introduction to **Stacks**-Implementation using array, Introduction to Queues - Linear **Queue**-Implementation using array, Introduction to **Lists**: Single Linked List- Insertion, Deletion, Display, Introduction to **Trees**- Binary tree, Definition, Terminology.

### Text Books:

1. Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language: ANSI C Version", 2/e, Prentice-Hall/Pearson Education-2005.
2. E. Balagurusamy, "Programming in ANSI C" 4<sup>th</sup> ed., Tata McGraw-Hill Education, 2008
3. R. F. Gilberg, B. A. Forouzan, "Data Structures", 2<sup>nd</sup> Edition, Thomson India Edition-2005.

### Reference Books:

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

## INTRODUCTION TO MECHANICAL ENGINEERING

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

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

### Course Objective:

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

### Syllabus:

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

### Brief treatment of **Measurements, Units, and Conversions**

Introduction to engineering Design process: Its importance, types of designs, various ways to think about design like visualization, photography etc, simplified iteration model, design versus scientific method, a problem solving methodology.

Considerations of a good design Achievement of performance requirements, Total life cycle, Regulatory and social issues in Indian context

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

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

An exposure to various aspects of design including visual, creative and user-centric design (Visual merchandising, trends, materials, technology and techniques). Evolution in Transportation and Communication Technology, Bullock Cart to Lear Jets, Personal messengers to Cell Phones, Fighter planes.

Case study on any topic from Manufacturing Engineering Magazine Published by Society of Manufacturing Engineers (USA), Machinist Magazine, Technorama published by Institution

of Engineers (India) and Manufacturing Today and any other magazine related to mechanical engineering.

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

**Evaluation:**

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

**References:**

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

**ENGINEERING MECHANICS**

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

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

**Syllabus:**

**STATICS:**

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

**Equilibrium of Rigid bodies**–Equilibrium and Equations of Equilibrium, Lamé’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.

### **FRICITION AND PROPERTIES OF AREAS**

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

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

### **DYNAMICS**

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

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

#### **Text Books:**

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

#### **Reference Books:**

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

### **LIST OF EXPERIMENTS**

1. Calculation of Moment of Force using weight balancing technique.
2. Determination of angle of deflection due to eccentric loading on T bar
3. Determination of Centroid for Plane laminas of straight edges
4. Determination of Centroid for Plane laminas of curved edges
5. Determination of axial forces in Trapezoidal Truss
6. Determination of axial forces in Triangular Truss
7. Understanding vectors and vector quantities

8. Calculation of Moment of Force using weight balancing technique and system of pulleys.
9. Verification of Lamie's Theorem
10. Determination of coefficient of static friction between two surfaces.
11. Determination of motion parameters using work-energy principle
12. Determination of moment of inertia of a flywheel.

### **WORKSHOP PRACTICE**

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

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

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

**FITTING** : Hands on practice on preparing fits.

**TIN SMITHY** : Hands on practice on sheet metal working.

**HOUSE WIRING:** Hands on practice on House wiring connections Electrical

**IT WORKSHOP** : Identify the peripherals of a computer components in CPU and its functions

#### **TRADES FOR DEMONSTRATION**

- 1) Demonstration on drilling machine, power hacksaw machine, grinding machine.
- 2) Demonstration on welding machine.

#### **Text Books:**

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

#### **Reference Books:**

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

### **LIST OF EXPERIMENTS:**

#### **A. WORKSHOP PRACTICE**

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

#### **B. IT PRACTICE**

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

## ENGINEERING GRAPHICS

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

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

### Syllabus:

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

**Geometrical Constructions**-Divion of Lines, Angles, Polygons

**Engineering Curves used in Engineering Practice & their Constructions:**

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

**Special Curves:** Cycloid, Epicycloid, Hypocycloid and Involute.

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

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

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

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

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

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

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

### Text Books:

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

**Reference Books:**

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

**BASIC ENGINEERING MEASUREMENTS**

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

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

**Syllabus:**

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

**Text Books:**

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

**Reference Books:**

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

**LIST OF EXPERIMENTS:**

1. Measurement of Linear displacement using LVDT.
2. Measurement of Strain using Strain Gauge Bridge.
3. Measurement of Voltage using MyDAQ.

4. Measurement of Current using MyDAQ.
5. Measurement of Signal parameters (Amplitude, Time period and Frequency ) using DSO.
6. Measurement of Unknown resistance using Wheatstone bridge.
7. Measurement of 1 phase Power, Energy of a R-L load.
8. Measurements of Inductance using Anderson Bridge.
9. Measurement of capacitance using Schering's Bridge
10. Measurement of Angular Displacement using Potentiometer.
11. Calibration of Pressure gauge using Dead Weight Pressure Tester.
12. Characterization of Temperature Sensor (RTD,TC,Thermistor).

## CIRCUITS AND ELECTRONICS

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

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

### Syllabus:

Fundamentals of the lumped circuit abstraction. Resistive elements and networks, independent and dependent sources, switches and MOS devices, digital abstraction, amplifiers, and energy storage elements. Dynamics of first- and second-order networks; design in the time and frequency domains; analog and digital circuits and applications.

### Text Books:

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

### Reference Books:

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

# **PROFESSIONAL CORE**

## MACHINE DRAWING

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

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

### SYLLABUS

#### MACHINE DRAWING CONVENTIONS:

Need for drawing – Principles of Drawing

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

#### DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS:

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

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

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

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

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

**THERMAL-FLUIDS ENGINEERING-I**

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

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

**Syllabus:**

Fundamental principles of thermodynamics and fluid mechanics, Law of conservation of energy and momentum with applications. Focus on the applications of the first and second laws of thermodynamics with special emphasis on Entropy generation. Study of Properties of fluids, Hydrostatics, Fluid kinematics and application of Bernoulli equation. Internal and external laminar and turbulent viscous flow analysis and Boundary layer theory.

**Text Books:**

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

**Reference Books:**

1. Engineering Thermodynamics, Nag, P.K., TMH Publications.
2. Fundamentals of Engineering Thermodynamics, Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisie D, Bailey, Margaret B., 7<sup>th</sup> edition, Wiley publishers.
3. Fundamentals of Thermodynamics, G.J. Van Wylen., Sonntag (6E), Wiley India publications.
4. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Mc Graw Hill.
5. Fox and McDonald's Introduction to Fluid Mechanics, Pritchard, Philip J.; Leylegian, John C.; Bhaskaran, Rajesh; Mitchell, John W., SI Version, Wiley publishers.
6. Fluid Mechanics, Frank Kreith, CRC press

**MECHANICS AND MATERIALS-I**

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

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

**Syllabus:**

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

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

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

**Multi axial stresses and strains:** Introduction to Multiaxial Stress, Multiaxial Stress and Strain Multiaxial Strain and Multiaxial Stress-strain Relationships Stress and Strain

Transformations Stress Transformations and Principal Stress Failure of Materials and Examples

**Shearing Forces and Bending Moments:** Shear Force and Bending Moment, Relationship Between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.

Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams

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

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

**Columns:** Buckling and Stability

**Text Books:**

1. Gere & Goodno “Mechanics of Materials” Cengage Publishers
2. RC Hibbeler, “Mechanics of Materials” 10<sup>th</sup> edition, Pearson.

**Reference Books:**

1. Pytel A H and Singer F L, Harper Collins “Strength of Materials”, New Delhi.
2. Shames, I. H., Pitarresi, J. M “Introduction to Solid Mechanics”, Prentice-Hall, NJ.
3. E.P.Papov “Mechanics of Materials” Prentice Hall Publications
4. L S. Srinath “Strength of Materials”. Tata McGraw Hill
5. S.S.Rattan “Strength of Materials” Tata McGraw Hill

## DYNAMICS AND CONTROL-I

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

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

**Syllabus:**

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

**Text books:**

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

**Reference Books:**

1. R C Hibbeler, Engineering Mechanics, Pearson
2. W.T.Thomson Mechanical Vibrations, Pearson education ,2<sup>nd</sup> Edition
3. S.S.Rao , Mechanical Vibrations, Pearson education, 4<sup>th</sup> edition

**List of Experiments**

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

## DYNAMICS AND CONTROL-II

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

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

### Syllabus:

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

### Text Books:

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

### List of Experiments:

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

### THERMAL-FLUIDS ENGINEERING - II

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

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

### Syllabus:

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

### Text Books:

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

### Reference Books:

1. Engineering Thermodynamics, Nag, P.K., TMH Publications.
2. Fundamentals of Engineering Thermodynamics, Moran, Michael J.; Shapiro, Howard N.; Boettner, Daisy D.; Bailey, Margaret B., 7<sup>th</sup> edition, Wiley publishers.

3. Fundamentals of Thermodynamics, G.J. Van Wylen., Sonntag (6E), Wiley India publications.
4. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Mc Graw Hill.
5. Fox and McDonald's Introduction to Fluid Mechanics, Pritchard, Philip J.; Leylegian, John C.; Bhaskaran, Rajesh; Mitchell, John W., SI Version, Wiley publishers.
6. Fluid Mechanics, Frank Kreith, CRC press

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

## MECHANICS AND MATERIALS - II

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

CO No.	Course Outcome	PO	PSO	BTL
1	Apply materials in mechanical design based on mechanical behavior of engineering materials.	1, 3	2	2
2	Emphasize the fundamentals of mechanical behavior of materials	2	2	2
3	Determine the mechanical properties of materials to design.	2	1	3
4	Select the material for mechanical application.	2	1	3
5	Determine the properties of materials experimentally	2	1	3

### Syllabus:

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

### Text Books:

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

### Reference Books:

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

## DESIGN AND MANUFACTURING – I

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

CO No	Course Outcome	PO	PSO	BTL
1	Generate, analyze, and refine the design of electro-mechanical devices making use of physics and mathematics.	1	2	2
2	Understand the function, performance and failure modes and manufacturing of common machine elements.	3	1	2
3	Apply experimentation and data analytic principles relevant to mechanical design.	3	2	4
4	Communicate a design and its analysis (written, oral, and graphical forms).	3	1	3
5	Fabricate the parts using machine tools	2	2	3

### Syllabus:

Emphasis on the creative design process bolstered by application of physical laws. Instruction on how to complete projects on schedule and within budget. Robustness and manufacturability are emphasized. Subject relies on active learning via a major design-and-build project. Lecture topics include idea generation, estimation, concept selection, visual thinking, computer-aided design (CAD), mechanism design, machine elements, basic electronics, technical communication, and ethics

**Lab:** Introduces the fundamentals of machine tools use and fabrication techniques. Students work with a variety of machine tools including the bandsaw, milling machine, and lathe.

### 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

## ENGINEERING MANAGEMENT

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

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

### Syllabus:

Introduction and overview of engineering management. Financial principles, management of innovation, technical strategy and best management practices.

### Text books:

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

### Reference Books:

1. I.M. Pandey, Financial Management, Vikas Publishing House Pvt. Ltd., 10th Edition, 2010, ISBN- 13 9788125937142.
2. James C Van Horne, Financial Management and Policy, Prentice-Hall of India/Pearson, 12th Edition, 2001 ISBN10: 0130326577
3. Vinnie Jauhari, Sudhanshu Bhushan, Innovation Management, Oxford University Press, 1st Edition, 2014

## HEAT TRANSFER

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

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

### Syllabus:

Introduces fundamental processes of heat transfer. Fourier's law. Heat conduction processes including thermal resistance, lumped capacitance, fins. Elementary convection, including laminar and turbulent boundary layers, internal flow, and natural convection. Heat transfer in boiling and condensation. Thermal radiation, including Stefan-Boltzmann law, small object in large enclosure, and parallel plates. Basic concepts of heat exchangers.

### Text Books:

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

### Reference Books:

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

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

## FINITE ELEMENT ANALYSIS OF SOLIDS AND FLUIDS

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

CO No.	Course Outcome	PO	PSO	BTL
1	Learn modern analysis techniques used in a general finite element program.	2	1	1
2	Establish computational models and solve the problems of solids and fluids.	2	2	2
3	Implement the knowledge of mechanics to solve problems numerically on the computer.	1	2	3
4	Apply the finite element analysis techniques for solving industrial problems in the field of mechanical engineering.	1	1	4
5	Analyze beams, bars Fluid flow using ANSYS software	2	1	3

### Syllabus:

Finite element methods for analysis of steady-state and transient problems in solid, structural, fluid mechanics, and heat transfer. Presents finite element methods and solution procedures for linear and nonlinear analyses using largely physical arguments. Demonstrates finite element analyses. Includes modeling of problems and interpretation of numerical results

### Text Books:

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

### Reference Books:

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

## INTRODUCTION TO ROBOTICS

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

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

### Syllabus:

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

### Text Books:

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

### Reference Books:

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

## DESIGN AND MANUFACTURING – II

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

CO No	Course Outcome	PO	PSO	BTL
1	Internalize the attributes along which the success or failure of a manufacturing process, machine, or system will be measured: quality, cost, rate, and flexibility.	2	1	2
2	Apply physics to understand the factors that control the rate of production and influence the quality, cost and flexibility of processes.	1	2	3
3	Understand the impact of manufacturing constraints on product design and process planning.	4	1	2
4	Apply an understanding of variation to the factors that control the production rate and influence the quality, cost and flexibility of processes and systems.	3	2	3
5	Apply modern techniques to solve problems related to mechanical engineering	5	2	2

### Syllabus:

Integration of design, engineering, and management disciplines and practices for analysis and design of manufacturing enterprises. Emphasis is on the physics and stochastic nature of manufacturing processes and systems, and their effects on quality, rate, cost, and flexibility. Topics include process physics and control, design for manufacturing, and manufacturing systems. Group project requires design and fabrication of parts using mass-production and assembly methods to produce a product in quantity.

**Lab:** Design, construction, and testing of field robotic systems, through team projects with each student responsible for a specific subsystem. Projects focus on electronics, instrumentation, and machine elements. Design for operation in uncertain conditions is a focus point, with ocean waves and marine structures as a central theme. Basic statistics, linear systems, Fourier transforms, random processes, spectra and extreme events with applications in design. Lectures on ethics in engineering practice included.

### 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

## ELEMENTS OF MECHANICAL DESIGN

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

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

### **Syllabus:**

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

### **Text Books:**

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

### **Reference Books:**

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

# **TECHNICAL SKILL COURSES**

**MANUFACTURING TECHNOLOGIES**  
**(Skilling for Engineers-1)**

**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:**

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 software is required to perform the manufacturing processes simulation.

**Text Books:**

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

**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 (Skilling for Engineers-2)**

**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. Histan, “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

**PROBLEM SOLVING TECHNIQUES IN THERMAL  
(Skilling for Engineers-3)**

**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  $\pi$  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.

**PROBLEM SOLVING TECHNIQUES IN DESIGN  
(Skilling for Engineers-4)**

**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; Modeling and Simulation.

## **PROJECT MANAGEMENT:**

Tools and Techniques of Project Management.

## **Capstone Project:**

1. Four contact hours are allocated for training the students in modeling software and analysis software and remaining four contact hours are allocated for Capstone Project. Student has to design a modal using Solid works or CATIA and do analysis using ANSYS or Hyperworks or any analysis software.
2. After completion of the project student has to submit the report.

## **Text Books:**

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

## **AUTOMOBILE DESIGN AND BUILDING**

### **(Technical Proficiency and Training –1)**

#### **Syllabus:**

- Study of systems in Vehicle. Power systems: Gasoline, Bio-diesel, Electrical, Hybrids, solar, wind, compressed air, fuel cell, hydrogen etc.,
- Transmission system: Clutch, Gear Trains, Differentials, Suspension, Steering, Brakes etc.,
- Understanding automobiles (aesthetics (exterior/interior), human factors/ vehicle packaging, display & controls etc.)
- Control Engineering Concepts for Modern Automobiles: Clutch, Gear, Dashboard display and Automatic control.
- Hands on Practices on Assembly and Maintenance of Automobiles (Two Wheeler & Four Wheeler).
- Vehicle Structure: Chassis, monocoque, pre-stressed, sheet metal details and tooling.

#### **Capstone Project:**

- One contact hour is allocated for training the student on software packages.
- 3 contact hours are allocated for capstone project in which student has to design an automobile component using modeling software and analysis software.
- After completion of the capstone project student has to submit the report.

#### **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

**ROBOT DESIGN**  
**(Technical Proficiency and Training –2)**

**Syllabus:**

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

**Capstone Project:**

**Step-1:** Define the problem and identify the objectives

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

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

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

**Text Books:**

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

# **PROFESSIONAL ELECTIVES**

## DESIGN OF TRANSMISSION ELEMENTS

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

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

### Syllabus:

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

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

**Bearings**: Classification, modes of Lubrication, Sliding contact bearing design, bearing materials, selection of lubricant.

Rolling contact bearings- types, selection of ball, roller bearings- under static load, dynamic load.

**Brakes and Clutches**: Introduction to Brakes, Types, Analysis and Design of Block brakes, internal shoe Brakes, End shoe Brakes, Pivoted shoe Brakes, Band Brakes, Temperature raise, Friction materials.

Introduction to Clutches, Analysis and Design of simple and multiple disc Clutches, Cone Clutches and Centrifugal Clutch, friction materials, comparison of Brakes and Clutches.

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

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

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

**Worm Gears:** Design and analysis of worm gear drive

**Text Books:**

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

**Reference books:**

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

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

**THEORY OF ELASTICITY AND PLASTICITY**

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

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

**Syllabus:**

**Introduction:**

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

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

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

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

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

**Text Books:**

1. Theory of Elasticity by Timoshenko, McGrawhill Publications.
2. Theory of Plasticity by J.Chakrabarty, 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 TECHNIQS 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 TECHNIQS 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 FATIGUE 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 Lamé'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, 2<sup>nd</sup> edition.

### Reference Books:

1. Pytel A H and Singer F L, "*Strength of Materials*", Harper Collins, New Delhi.
2. Beer P F and Johnston (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, 3<sup>rd</sup> 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,1st 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 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

<b>CO No.</b>	<b>Course Outcome</b>	<b>PO</b>	<b>BTL</b>
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

<b>CO No.</b>	<b>Course Outcome</b>	<b>PO</b>	<b>BTL</b>
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

<b>CO No.</b>	<b>Course outcome</b>	<b>PO</b>	<b>BTL</b>
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:**

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

### **Reference Books:**

3. Litchy, I. C. Engine, McGraw Hill
4. George E. Dieter, "Engineering Design- A Material and Processing Approach", Second Edition, McGraw-Hill International Edition
5. A. Kolchin and V. Demidov, "Design of Automotive Engines", Mir Publishers, Moscow, (1984)
6. 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 casing star and planetary gears
11. Draw a 2D drawing of the three quarter floating rear axle arrangement showing the axle casing, half shaft, bearing and the wheel positions
12. Draw a 2D drawing of the fully floating rear axle arrangement showing the axle casing, 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, Crumple 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, 5<sup>th</sup> 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 their 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:**

1. Tom Denton, “Automobile Electrical and Electronic Systems”, 3rd edition, Elsevier Butterworth-Heinemann 2004.
2. William B. Ribbens, “Understanding Automotive Electronics” 7th edition Butterworth-Heinemann publications, 2012.
3. Ed Doering “NI MYRIO Project Essential Guide” 2013, National Technology and Science Press
4. Allan. W. M. Bonnick, “Automotive Computer Controlled System 2001, Butterworth-Heinemann
5. Robert Bosch Gmbh, “Bosch Automotive Electric and Electronics”, 5th edition, Springer-Verlag.

**LIST OF EXPERIMENTS:**

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

## AUTOMOBILE ENGINE SYSTEM AND PERFORMANCE

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

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

### Syllabus:

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

### Text Books:

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

### Reference Books:

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

5. Ulrich 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

<b>CO No</b>	<b>Course Outcome</b>	<b>PO</b>	<b>BTL</b>
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 sensors
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 Arnold, 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<sub>2</sub>, NO, CO, SO<sub>2</sub>, and CO<sub>2</sub> 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 Co<sub>2</sub>, 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 system in terms of design, operation and control aspects	4	3
4	Understand programmable automation with regard to the computer integrated manufacturing system	2	4

### Syllabus:

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

**Transfer Lines and Automated Assembly:** General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers.

Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

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

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

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

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

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

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

#### **Text Books:**

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

#### **Reference Books:**

1. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.
2. Yeaple F.D, “Hydraulic and Pneumatic Power and Control Design”, McGraw-Hill, USA, 2007
3. Wemer Depper and Kurt Stoll, “Pneumatic Application”, Kemprath Reihe, Vogel Buch Verlag Wurzburg, 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.

- Frank D. Petruzella. Programmable Logic Controllers, McGraw–Hill Book, Company, 1989.

### Reference Books:

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

### List of Experiments:

- INTRODUCTION TO TASM(TURBO ASSEMBLER)
- MULTI-BYTE ADDITION
- FACTORIAL OF A GIVEN 8-BIT NUMBER
- SORTING OF NUMBERS IN ASCENDING ORDER
- STRING DATA TRANSFER
- COMPARISON OF TWO STRINGS
- CONVERSION OF ASCII TO PACKED BCD NUMBER
- CONVERSION OF PACKED BCD TO ASCII NUMBER
- TO COUNT POSITIVE AND NEGATIVE NUMBERS IN A GIVEN ARRAY
- TO COUNT EVEN AND ODD NUMBERS IN A GIVEN SERIES
- COUNT NUMBER OF 0'S AND 1'S IN A MULTI BYTE NUMBER
- SUM OF N 8-BIT BINARY NUMBERS
- TO FIND THE LARGEST NUMBER IN THE GIVEN ARRAY

## MECHATRONICS SYSTEM DESIGN

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

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

### Syllabus:

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

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

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

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

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

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

### **Case Studies**

#### **Text Books:**

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

#### **Reference Books:**

1. D.A Bradley, D. Dawson, N.C Burd and A.J. Loader, “Mechatronics” CRC Press, 2010.
2. David G. Alciatore, Michael B. Histan, “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 of Artificial 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 context-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- 5<sup>th</sup> Edition by Lillesand, Kiefer and Chipman, Published by John Wiley and Sons, Inc, New York, 2007.
2. Text book of Remote sensing and GIS – 3<sup>rd</sup> 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<sup>th</sup> and 5<sup>th</sup> 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<sup>th</sup> 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 Engineering – 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., Addison-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 FUNDAMENTALS:** 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, 4<sup>th</sup>edn. SumitabhadastMH
3. Beginning Linux programming 4<sup>th</sup>edn. 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.Word3<sup>rd</sup>edn.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, Emma Minoli, '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 Berlin Heidelberg 2009.
2. John Twidell & Tony Weir: E&F.N. Spon, "Renewable Energy Sources", Taylor & Francis New York, 2nd edition.
3. John F. Walker & N. Jenkins, "Wind Energy Technology", John Wiley 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 Mikell P. Groover, Mcgraw Hill Publications

### **REFERENCE BOOKS**

1. Robotics – K.S. Fu, Gonzalez & Lee, Mcgraw Hill Publications
2. Robotics For Engineers by Yoram Kkoren, 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" , 3<sup>rd</sup> Edition, Pearson education,2007.
2. David G. Alciatore, Michael B. HI stand," Introduction to mechatronics and measurement systems", 2<sup>nd</sup> 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", 3<sup>rd</sup> 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  $2 \times n$  game, Graphical method for  $2 \times n$  and  $n \times 2$  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](http://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, 13<sup>th</sup> Edn, Pearson Education. 2009.
2. Fred Luthans, Organizational Behaviour, Prentice Hall, 2007
3. Udai Pareek, 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. Jhon Hedgeco, New Book of photography , Dorling Kindersley book Lonon 1994
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 – 10<sup>th</sup> edition

### Reference Books:

1. Management by Stoner, Freeman, Gilbert – PHI – 7<sup>th</sup> edition.
2. Management A Global & Entrepreneurial Perspective – Weihrich, Cannice, Koontz – Mc Graw Hill – 13<sup>th</sup> 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. 12<sup>th</sup> 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, 30<sup>th</sup> ed., Himalaya Publishing House, New Delhi.
3. M.L.Jingan: Macro Economics, 6<sup>th</sup> 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

<b>CO. No</b>	<b>Course Outcome</b>	<b>PO</b>	<b>BTL</b>
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<sup>1</sup> edition, 2008.
2. Koontz & Wehrich., Essentials of Management, 12<sup>th</sup> 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, NaiSaraki, 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, Addison-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, Lagrangian 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,  $\theta$ -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 Linkages-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, stress notation, principal stresses, other properties, differential equations of motion of a deformable body, deformation of a deformable body, strain theory, 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, Anisotropic elasticity, Hooke's Law, Isotropic elasticity, initiation of Yield, Yield criteria.

**Failure Criteria:** Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for number of cycles  $N > 10^6$ ), buckling.

**Application of energy methods:** Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castiglione's theorem on deflections, Castiglione's theorem on 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 – closed ring 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 torsion members, 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 Timoshenko 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 Hartog 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

<b>CO No:</b>	<b>Course Outcome</b>	<b>PO</b>	<b>BTL</b>
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
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### 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 one 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	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 Kotler, 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.



## **KONERU LAKSHMAIAH EDUCATION FOUNDATION**

(Deemed to be University estd. u/s. 3 of the UGC Act, 1956)

(NAAC Accredited "A" Grade University)

Vaddeswaram Guntur District , Andhra Pradesh, India.