

**DEPARTMENT OF MECHANICAL ENGINEERING**

**COURSE STRUCTURE AND SYLLABUS**

**For UG –R22**

**B. TECH – MECHANICAL ENGINEERING**

*(Applicable for batches admitted from 2022-2023)*



**ST.ANN'S COLLEGE OF ENGINEERING & TECHNOLOGY  
(AUTONOMOUS)**

**ST.ANN'S COLLEGE OF ENGINEERING & TECHNOLOGY: CHIRALA  
(AUTONOMOUS)  
ME - UG – R22**

**COURSE STRUCTURE**

**I Year I Semester**

Category	Course Code	Course Title	L	T	P	SS	D	I	E	T	C
BS	22UMT01	Mathematics – I	3	1	--	--	4	30	70	100	3
HS	22UEN01	Communicative English	3	1	--	--	4	30	70	100	3
BS	22UCH04	Engineering Chemistry	3	1	--	--	4	30	70	100	3
ES	22UME02	Engineering Drawing	1	-	4	-	5	30	70	100	3
ES	22UCS01	Programming for Problem Solving using C	3	1	--	--	4	30	70	100	3
HS	22UEN02	English Communication Skills Laboratory	--	--	3	--	3	15	35	50	1.5
BS	22UCH05	Engineering Chemistry Laboratory	--	--	3	--	3	15	35	50	1.5
ES	22UCS02	Programming for Problem Solving Using C Laboratory	--	--	3	--	3	15	35	50	1.5
MC	22UCH03	Environmental Science	2	--	--	--	2	--	--	--	0
<b>TOTAL</b>			<b>14</b>	<b>4</b>	<b>13</b>	<b>-</b>	<b>31</b>	<b>195</b>	<b>455</b>	<b>650</b>	<b>19.5</b>
HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course, PC-Professional Core, PE-Professional Elective, OE-Open Elective, OC-Online Course											

**I Year II Semester**

Category	Course Code	Course Title	L	T	P	SS	D	I	E	T	C
BS	22UMT02	Mathematics - II	3	1	--	--	4	30	70	100	3
BS	22UPH03	Engineering Physics	3	1	--	--	4	30	70	100	3
ES	22UME01	Engineering Mechanics	3	1	--	--	4	30	70	100	3
ES	22UEE05	Basic Electrical Engineering	3	1	--	--	4	30	70	100	3
ES	22UME03	Computer Aided Engineering Drawing Practice	1	--	4	--	5	30	70	100	3
BS	22UPH04	Engineering Physics Laboratory	--	--	3	--	3	15	35	50	1.5
ES	22UEE07	Basic Electrical Engineering Laboratory	--	--	3	--	3	15	35	50	1.5
ES	22UME04	Workshop Practice Laboratory	--	--	3	--	3	15	35	50	1.5
MC	22UEN03	Constitution of India	2	--	--	--	2	--	--	--	0
OC	22UOC01	SWAYAM, NPTEL, Spoken Tutorials	-	-	-	2	2	-	-	-	0
<b>TOTAL</b>			<b>15</b>	<b>4</b>	<b>13</b>	<b>2</b>	<b>34</b>	<b>195</b>	<b>455</b>	<b>650</b>	<b>19.5</b>
HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course, PC-Professional Core, PE-Professional Elective, OE-Open Elective, OC-Online Course											

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**II Year I Semester**

Category	Course Code	Name of the course	L	T	P	SS	I	E	T	C
HS	22UMB01	Managerial Economics & Financial Analysis	3	1	-	-	30	70	100	3
PC	22UME05	Metallurgy and Material Science	3	1	-	-	30	70	100	3
PC	22UME06	Engineering Thermodynamics	3	1	-	-	30	70	100	3
PC	22UME07	Fluid Mechanics and Hydraulic Machinery	3	1	-	-	30	70	100	3
PC	22UME08	Mechanics of Solids	3	1	-	-	30	70	100	3
MC	22UEN05	Environment Health and Safety	1	-	-	-	-	-	-	0
PC	22UME09	Fluid Mechanics and Hydraulic Machinery Lab	-	-	3	-	15	35	50	1.5
PC	22UME10	Mechanics of Solids and Metallurgy Lab	-	-	3	-	15	35	50	1.5
PC	22UME11	Machine Drawing Practice	-	-	3	-	15	35	50	1.5
SC	22UME12	Modeling and Drafting Lab	1	-	2	-	-	50	50	2
<b>Total</b>			<b>17</b>	<b>5</b>	<b>11</b>	<b>-</b>	<b>195</b>	<b>505</b>	<b>700</b>	<b>21.5</b>
* At the end of II Year I Semester, students must complete the Community Service Project										
HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course, PC-Professional Core, PE-Professional Elective, OE-Open Elective, OC-Online Course, SC-Skill Course, CP-Community service Project, SI-Summer Internship, SP-Social Relevant Project, TS-Technical Seminar, PW-Project Work										

**II Year II Semester**

Category	Course Code	Name of the course	L	T	P	SS	I	E	T	C
BS	22UMT04	Probability & Statistics	3	1	-	-	30	70	100	3
PC	22UME13	Manufacturing Processes	3	1	-	-	30	70	100	3
HC	22UME14	Industrial Engineering and Management	3	1	-	-	30	70	100	3
PC	22UME15	Thermal Engineering	3	1	-	-	30	70	100	3
PC	22UME16	Kinematics of Machines	3	1	-	-	30	70	100	3
PC	22UME17	Renewable Energy Sources	3	1	-	-	30	70	100	3
MC	22UMB02	Professional Ethics and Human Values	1	-	-	-	-	-	-	0
PC	22UME18	Manufacturing Process Lab	-	-	3	-	15	35	50	1.5
PC	22UME19	Thermal Engineering Lab	-	-	3	-	15	35	50	1.5
Evaluation of Community Service Project which is completed at the end of II B.Tech I Semester			-	-	-	-	15	35	50	4
<b>Total</b>			<b>19</b>	<b>6</b>	<b>6</b>	<b>-</b>	<b>225</b>	<b>525</b>	<b>750</b>	<b>25</b>
*At the end of II Year II Semester, students shall complete summer internship spanning between 1 to 2 months at Industries/ Higher Learning Institutions/ APSSDC										
HS-Humanities & Sciences, BS-Basic Sciences, ES-Engineering Sciences, MC-Mandatory Course, PC-Professional Core, PE-Professional Elective, OE-Open Elective, OC-Online Course, SC-Skill Course, CP-Community service Project, SI-Summer Internship, SP-Social Relevant Project, TS-Technical Seminar, PW-Project Work										

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Year & Sem	I Year – I Semester					
Course Code	22UMT01	L	T	P	SS	C
Course Name	MATHEMATICS-I	3	1	0	0	3

**Course Objectives:**

- To instruct the concept of Matrices in solving linear algebraic equations.
- To assist the students to learn the concepts of partial differentiation.
- To enlighten the learners in the concept of differential equations.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.
- To make clear the students in the concepts of Multiple Integrals.

**Course Outcomes:**

At the end of the course, the student will be able to

**CO1:** Apply matrix techniques to model and solve system of linear equations.

**CO2:** To apply the mean value theorems to real life problems.

**CO3:** Solve the differential equations related to various engineering fields.

**CO4:** Apply double integration techniques in evaluating areas bounded by region.

**CO5:** Student will learn important tools of calculus in higher dimensions.  
Students

will become familiar with 2-dimensinal and 3-dimensional coordinate systems.

**UNIT-I: System of Linear Equations, Eigen Values, Eigen Vectors**

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss Elimination method – Eigen values and Eigen vectors and properties. Cayley-Hamilton theorem (without proof) – Reduction of a matrix to Diagonal form. Applications – Finding the inverse and power of a matrix by Cayley Hamilton theorem.

**UNIT-II: Differential Calculus**

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Mac Laurin's theorems with remainders, Problems and applications on the above theorem. Partial Differentiation: Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mac Laurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.

**UNIT-III: Differential Equations of First Order and First Degree**



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<b>Year &amp; Sem</b>	<b>I Year – I Semester</b>					
<b>Course Code</b>	<b>22UEN01</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>COMMUNICATIVE ENGLISH</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **Introduction**

With the growing importance of English for global communication and the emphasis on training the learners to gain communicative competence, the syllabus is designed to develop linguistic and communicative competence of the engineering students. The major focus of the syllabus is to enhance the communicative ability, with the focus on the language skills, grammar, vocabulary of the learners and to improve the learner's ability to use English language effectively in social, academic and professional contexts. There is a shift from learning about the language to using the language. Thereby enables the learner to appear confidently for international language qualification tests like IELTS, TOEFL, BEC Etc.

### **Course Objectives:**

- Help students develop effective listening skills so that they can understand academic lectures and native English speakers' speech.
- Encourage the development of speaking abilities by taking part in exercises like role-playing, dialogues, and organized talks / oral presentations.
- Pay special attention to effective reading techniques for understanding a range of academic literature and real-world resources.
- Introduce useful writing techniques and illustrate them by summarizing, composing essays with a clear structure, recording and reporting relevant information.
- Increase vocabulary and grammatical knowledge, and promote proper use of words both in speech and writing.

### **Course Outcomes:**

At the end of the module, the learners will be able to

- Comprehend social or transactional discussions presented by native English speakers and recognize the context, subject, and specific information.
- Introduce one self and others and engage in general conversation about well-known subjects.
- Employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information.
- Recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs

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- Form sentences using proper grammatical structures and correct word forms.

### **Unit- 1**

**Lesson-1: The Scare Crow by Satyajit Ray from Panorama, a course on reading, Oxford publications.** Listening: Listening to short audio texts and identifying the topic. Listening to prose and conversations. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work studies and interests. Self-introduction and introducing others. **Reading:** Skimming text to get the main idea. Scanning to look for specific pieces of information. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices, linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

**Vocabulary:** Synonyms and Antonyms, Affixes.

**Grammar:** Content words and function words, word forms.

### **Unit-2**

**Lesson-1: Nehru's letter to his daughter Indira on her birthday from "Infotech English", Maruthi Publications.**

**Listening:** Answering a series of questions about the main idea and supporting ideas after listening to audio texts, both in speaking and writing.

**Speaking:** Discussion in pairs / small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

**Writing:** Summarizing - identifying main idea and rephrasing what is read; avoiding redundancies and repetitions. **Vocabulary:** Synonyms and Antonyms, Root words

**Grammar:** Parts of Speech.

### **Unit- 3**

**Lesson-1: Telephone Conversation by Wole Soyinka**

**Listening:** Listening for global comprehension and summarizing what is listened to, both in speaking and writing. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing. **Reading:** Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading. **Writing:** Letter writing-types, format and principles of letter writing. E-mail etiquette, Writing CV's.

**Vocabulary:** Synonyms and Antonyms, Word Formation

**Grammar:** Verbs, Subject Verb agreement, Common Errors.

## **Unit 4**

### **Lesson-1: Water the Elixir of life by C.V.Raman**

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

**Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs / tables, writing for media. **Vocabulary:** Synonyms and Antonyms, Phrasal verbs.

**Grammar: Tenses, correction of sentences.**

## **Unit 5**

### **Lesson-1: Stay Hungry-Stay foolish from “Infotech English”, Maruthi Publications**

**Listening:** Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing, TEDX Videos. **Speaking:** Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving. **Reading:** Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques. **Reading for Writing:** Writing academic proposals- writing research articles: format and style. **Vocabulary:** Synonyms and Antonyms, Idioms and Phrases. **Grammar:** Voices, Degrees of comparison & Reported speech.

### **Suggested books:**

1. **Infotech English**”, Maruthi Publications.
2. **“Panorama, a course on reading”**, Oxford publications
3. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
4. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
5. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
6. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012
7. [https://onlinecourses.nptel.ac.in/noc20\\_hs19/preview](https://onlinecourses.nptel.ac.in/noc20_hs19/preview)
8. <https://nptel.ac.in/courses/109106094>
9. <https://news.stanford.edu> (Steve Jobs' Speech)

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**



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**CO – PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	1	3	1	1
CO2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	-

Year & Sem	I Year – I Semester							
Course Code	22UCH04			L	T	P	SS	C
Course Name	ENGINEERING CHEMISTRY			3	1	0	0	3

**COURSE OBJECTIVES**

1. Importance of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
2. Outline the basics for the construction of electrodes and batteries. Understand the mechanism of corrosion and how it can be prevented.
3. Express the increases in demand as wide variety of advanced materials are introduced; which have excellent engineering properties. Classify and discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also summarized.
4. Relate the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
5. Explain the importance and usage of water as basic material in almost all the industries; interpret drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

**UNIT I: POLYMER TECHNOLOGY**

**Polymerization:** -Introduction, types and methods of polymerization (emulsion and suspension), mechanical properties.

**Plastics:** Types, Compounding, Fabrication (compression, injection, blowing and extrusion moldings), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).

**Elastomers:** -Introduction, vulcanization of rubber, advantages of vulcanized rubber, preparation, properties and applications (BunaS, Thiokol and polyurethanes).

**Composite materials:** Fiber reinforced plastics, conducting polymers, biodegradable and biomedical polymers.

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**UNIT II: ELECTRO CHEMICAL CELLS AND CORROSION**

Electrochemical cell, Single electrode potential, standard hydrogen electrode, calomel electrode, construction of glass electrode, electrochemical series and uses of series, galvanic series, differentiation between electrochemical series and galvanic series, batteries (Dry cell, Li ion battery and zinc air cells).

**Corrosion:** -Definition, factors influencing rate of corrosion, theories of corrosion (direct chemical attack and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints(constituents and special paints).

**UNIT III: MATERIAL CHEMISTRY**

**NANOMATERIALS:** Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications). Refractories: Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

**Lubricants:** -Definition, mechanism of lubricants, properties (definition and importance).

**Cement:** - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

**UNIT IV: FUELS**

Introduction, calorific value, higher calorific value, lower calorific values, problems using Dulong's formula, proximate and ultimate analysis of coal sample and their significance, petroleum (refining-cracking), synthetic petrol (Fischer Tropsch and Bergius), petrol knocking, diesel knocking, octane and cetane ratings, anti-knocking agents, Introduction to alternative fuels (Bio-fuel, natural gas, liquefied petroleum gas, compressed natural gas), Flue gas analysis by Orsa apparatus, rocket fuels.

**UNIT V: WATER TECHNOLOGY**

Hardness of water, determination of hardness by complex metric method, boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement), internal treatments, softening of hard water (zeolite process and ion exchange process), treatment of industrial wastewater, characteristics of potable water, steps involved in purification of water, chlorination, break point chlorination-desalination (reverse osmosis and electro dialysis)

**Text Books:**

1. P.C.Jain and M.Jain "Engineering Chemistry", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "Engineering Chemistry", Cambridge University Press,

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NewDelhi,(2019).

3. S. S. Dara, "A Text book of Engineering Chemistry", S.Chand&Co,(2010).
4. Shashi Chawla, "Engineering Chemistry",Dhanpat Rai Publicating Co.(Latest edition).

**Reference Books:**

1. K. Sesha, Maheshwaramma and Mridula Chugh, " **Engineering Chemistry**", Pearson India Edn.
2. O.G.Palana, "**Engineering Chemistry**", TataMcGrawHillEducationPrivateLimited,(2009).
3. C N R Rao and J M Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)
4. B.S. Murthy, P.Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press(latest edition)

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO-PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1												
CO-2	1											
CO-3												
CO-4						1						
CO-5						1						1
AVG	1	NC	NC	NC	NC	1	NC	NC	NC	NC	NC	1

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<b>Year &amp; Sem</b>	<b>I Year – I Semester</b>					
<b>Course Code</b>	<b>22UME02</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENGINEERING DRAWING</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:** To impart

- The students to use drawing instruments and to draw polygons, Engineering. Curves.
- The students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.
- The students draw the projections of the plane inclined to both the planes.
- The students draw the projections of the various types of solids indifferent positions inclined to one of the planes.
- The students to construct object in 3D view through isometric view, to represent and convert the isometric view to orthographic view and vice versa.

**Course Outcomes:** The student will be able to

CO1: Understand the fundamental principles of Engineering Drawing.

CO2: Analyze the applications of scales in Engineering.

CO3: Develop projections of points, lines, planes and solids.

CO4: Understand the applications of orthographic projections

CO5: Understand the applications of isometric projections

**UNIT I:**

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**Polygons:** Constructing regular polygons by general methods, inscribing and describing polygons on circles.

**Curves:** Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normal for the curves. Scales: Plain scales, diagonal scales and Vernier scales

**UNIT II:**

**Orthographic Projections:** Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to another plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

**UNIT III:**

**Projections of planes:** regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

**UNIT IV**

**Projections of Solids** – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the plane.

**UNIT V:**

**Conversion of isometric views** to orthographic views; Conversion of orthographic views to isometric views.

**TEXT BOOKS:**

1. Engineering Drawing by N.D. Bhatt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

**REFERENCE BOOKS:**

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGraw Hill Publishers

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	-	-	-	-	-	-	2
CO2	3	2	2	3	2	-	-	-	-	-	-	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2
CO4	3	2	2	3	2	-	-	-	-	-	-	2

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CO5	3	2	2	3	2	-	-	-	-	-	-	2
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Year & Sem	I Year – I Semester						
Course Code	22UCS01		L	T	P	SS	C
Course Name	PROGRAMMING FOR PROBLEM SOLVING USING C		3	1	0	0	3

**Course Objectives:**

The objectives of Programming for Problem Solving Using C are

- To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
- To gain knowledge of the operators, selection, control statements and repetition in C
- To learn about the design concepts of arrays, strings
- To assimilate about pointers, dynamic memory allocation
- To assimilate about File, I/O and significance of functions

**Course Outcomes:**

Upon the completion of the course the student will learn

**CO1:** To write algorithms and to draw flowcharts for solving problems and to convert flowcharts/algorithms to C Programs, compile and debug programs

**CO2:** To use different operators, data types and write programs that use two-way/ multi-way selection

**CO3:** To select the best loop construct for a given problem

**CO4:** To design and implement programs to analyze the different pointer applications

**CO5:** To decompose a problem into functions and to develop modular reusable code and to apply File I/O operations

**UNIT-I**

**Introduction to Computers:** Computer Systems – Block Diagram of Computer, Hardware, Software, Algorithms, Flow Charts, Pseudocode **Introduction to the C Language:** Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples. **Structure of a C Program:** Expressions, types of expressions,



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CO2	3	1	2									
CO3	3		1									
CO4		2	3	2	3							
CO5		1		2	3							



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<b>Year &amp; Sem</b>	<b>I Year – I Semester</b>					
<b>Course Code</b>	<b>22UEN02</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENGLISH COMMUNICATION SKILLS LAB</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**Course Objectives**

- Learners learn the basics of phonetics- recognize phonetic symbols and facilitates the learners' use of dictionary for pronunciation.
- To enhance the articulation of the sounds and pronunciation of words.
- To improve the communication skills and clarity of speech.
- To enhance effective communication skills.
- Enables learners to speak and communicate confidently.

**Course Outcomes:**

By the end of the semester the learners develop

1. Proper and accurate articulation of the sounds by following standard pronunciation of words and communicate intelligibly.
2. Speaking fluently with neutral accent.
3. Clarity of speech.
4. To communicate in various contexts using choice of appropriate expressions.
5. To acquire several communicative functions. Thereby enable to interact in different social and work situations.

The course material is divided into five units.

**Unit 1:**

Introduction and importance of phonetics. Letters and Sounds, Sounds of English (Consonant Sounds, Vowel Sounds)

**Unit 2**

Pronunciation and pronunciation rules, Plural and past tense marker rules.

**Unit 3:**

Syllable, word stress, stress in mono, di, and poly syllabic words, stress in compound words, contrastive, word stress, Rhythm and Intonation.

**Unit 4:**

Just A Minute (JAM)

**Unit 5:**

Group Discussions and Interview Skills

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**Suggested books:**

1. Infotech English, Maruthi Publications (with Compact Disc).
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
4. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.
5. Strengthen your communication skills by Dr M Hari Prasad, Dr Salivendra Raju
6. English for Professionals by Prof Eliah, B.S Publications, Hyderabad.
7. Cornerstone, Developing soft skills, Pearson Education Technical Communication- Meenakshi Raman, Sangeeta Sharma, Oxford University Press.
8. <https://nptel.ac.in/courses/109106067>

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	-	-	-	-	-	-	-	-	-	<b>3</b>	-	-
<b>CO2</b>	-	-	-	-	-	-	-	-	-	<b>3</b>	-	-
<b>CO3</b>	-	-	-	-	-	-	-	-	-	<b>3</b>	-	-
<b>CO4</b>	-	-	-	-	-	-	-	-	<b>2</b>	<b>3</b>	-	<b>1</b>
<b>CO5</b>	-	-	-	-	-	-	-	-	-	<b>3</b>	-	-

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<b>Year &amp; Sem</b>	<b>I Year – I Semester</b>					
<b>Course Code</b>	<b>22UCH05</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENGINEERING CHEMISTRY LABORATORY</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na<sub>2</sub>CO<sub>3</sub> solution.
2. Determination of alkalinity of a sample containing Na<sub>2</sub>CO<sub>3</sub> and NaOH.
3. Determination of Mn<sup>+2</sup> using standard oxalic acid solution.
4. Determination of ferrous iron using standard K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution.
5. Determination of Cu<sup>+2</sup> using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe<sup>+3</sup> by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of pH by using pH-meter.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg<sup>+2</sup> present in an antacid.
13. Determination of CaCO<sub>3</sub> present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Conduct at-least 10 assessment experiments should be completed in a semester.

**Outcomes:**

The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus, at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

**Reference Books**

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.



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<b>Year &amp; Sem</b>	<b>I Year – I Semester</b>					
<b>Course Code</b>	<b>22UCS02</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>PROGRAMMING FOR PROBLEM SOLVING USING C LABORATORY</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**Course Objectives:**

- Apply the principles of C language in problem solving.
- To design flowcharts, algorithms and knowing how to debug programs.
- To design & develop of C programs using arrays, strings pointers & functions.
- To review the file operations.

**Course Outcomes:**

By the end of the Lab, the student

**CO1:** Gains Knowledge on various concepts of a C language.

**CO2:** Able to draw flowcharts and write algorithms.

**CO3:** Able design and development of C problem solving skills.

**CO4:** Able to design and develop modular programming skills.

**CO5:** Able to trace and debug a program

**Exercise 1:**

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.

**Exercise 2:**

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

**Exercise 3:**

1. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
2. Write a C program to calculate the factorial of a given number.

**Exercise 4:**

1. Write a program in C to display the n terms of harmonic series and their sum.  $1 + 1/2 + 1/3 + 1/4 + 1/5 \dots 1/n$  terms.
2. Write a C program to check whether a given number is an Armstrong number or not.

**Exercise 5:**

1. Write a program to display all prime numbers less than n
2. Write a program to display the following output format

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2    2  
3    3    3  
4    4    4    4  
5    5    5    5    5

**Exercise 6:**

1. Write a program in C to separate odd and even integers in separate arrays.
2. Write a program in C to sort elements of array in ascending order.

**Exercise 7:**

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix

**Exercise 8:**

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

**Exercise 9:**

1. Write a c program to read and display the details of an employee using structure
2. Write a c program to demonstrate array of structures

**Exercise 10:**

1. Write a program in C to demonstrate the use of & (address of) and \*(value at address)operator.
2. Write a C program to find sum of n elements entered by user using pointers
3. Write a C Program to Store Information Using Structures with Dynamically MemoryAllocation

**Exercise 11:**

1. Write a program in C to swap elements using call by reference
2. Find factorial of given number using recursion
3. Write a program in C to get the largest element of an array using the function

**Exercise 12:**

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2							1
CO2	3			2	3							1
CO3		3		2	3							1
CO4	3	2		2	3							1
CO5	3		2	2	3							1

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<b>Year &amp; Sem</b>	<b>I Year – I Semester</b>					
<b>Course Code</b>	<b>22UCH03</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENVIRONMENTAL SCIENCE</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

### **COURSE OBJECTIVES**

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned Anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

### **COURSE OUTCOMES**

**CO1:** The natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources

**CO2:** The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web

**CO3:** The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity

**CO4:** Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices

**CO5:** About environmental assessment and the stages involved in EIA and the environmental audit.

### **UNIT-I:**

**Multidisciplinary nature of Environmental Studies:** Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects; Role of information technology in environment and human health.

**Ecosystems:** Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic

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ecosystems.

**UNIT-II:**

**Natural Resources:** Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

**UNIT-III:**

**Biodiversity and its conservation:** Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man- wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

**UNIT – IV:**

**Environmental Pollution:** Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his wellbeing.

**Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

**UNIT – V:**

**Social Issues and the Environment:** Urban problems related to energy -Water conservation, rain water harvesting - Resettlement and rehabilitation of people; its problems and concerns.

Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act - Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness. **Environmental Management:** Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and green politics. The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.



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**Text Books:**

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2<sup>nd</sup> Edition, 2011, Oxford University Press.
3. Environmental Studies, P.N.Palanisamy, P.Manikandan,  
A.Geetha, and K.Manjula Rani; Pearson Education, Chennai

**Reference:**

1. Text Book of Environmental Studies, Deeshita Dave & P.Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>			<b>3</b>			<b>2</b>	<b>3</b>					
<b>CO2</b>			<b>3</b>			<b>2</b>	<b>3</b>					
<b>CO3</b>			<b>3</b>			<b>2</b>	<b>3</b>					
<b>CO4</b>			<b>3</b>			<b>2</b>	<b>3</b>					
<b>CO5</b>			<b>3</b>			<b>2</b>	<b>3</b>					

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<b>Year &amp; Sem</b>	<b>I Year – II Semester</b>					
<b>Course Code</b>	<b>22UMT02</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>MATHEMATICS-II</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To illuminate the different numerical methods to solve nonlinear algebraic equations.
- To give a definition of Interpolation as it relates to mapping / surveying.
- To familiarize the Laplace, transform techniques in solving the Differential Equations.
- To familiarize the Fourier Series expansions for periodic functions.
- To furnish the learners with basic concepts Fourier Transform techniques to lead them into advanced level by handling various real-world applications.

**Course Outcomes:**

At the end of the course, the student will be able to

- **CO1:** Evaluate the approximate roots of polynomial and Transcendental equations by different algorithms
- **CO2:** Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals.
- **CO3:** Apply the Laplace transform for solving differential equations.
- **CO4:** Find or compute the Fourier series of periodic signals.
- **CO5:** Apply integral expressions for the forwards and inverse Fourier transform to arrange of non - Periodic wave forms.

**UNIT-I Iterative Methods**

Introduction– Bisection method–Secant method – Method of false position– Iteration method –Newton - Raphson method (One variable only) – Jacobi and Gauss-Seidel methods for solving system of equations numerically.

**UNIT-II Interpolation**

Introduction – Errors in polynomial interpolation – Finite differences – Forward differences–Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with an equal intervals –Lagrange's interpolation formula – Newton's divide difference formula.

**UNIT-III Laplace Transforms and Inverse Laplace Transforms**

Laplace transforms –Definition and Laplace transforms of some certain functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function –Dirac's delta function Periodic function – Inverse Laplace transforms – Convolution theorem (without proof). Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.



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Year & Sem	I Year – II Semester					
Course Code	22UPH03	L	T	P	SS	C
Course Name	ENGINEERING PHYSICS	3	1	0	0	3

It Provides a strong conceptual foundation of fundamental Physics upon which engineering applications are built. Knowledge of basic concepts of Physics for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

### **COURSE OUTCOMES**

- CO1. To identify the importance of the optical phenomenon i.e., interference, diffraction and polarization related to its Engineering applications
- CO2. Understand the mechanism of emission of light, utilization of lasers as coherent light sources for low and high energy applications, study of propagation of light through optical fibers and their implications in optical communications.
- CO3. Enlightenment of the concepts of Quantum Mechanics and to provide fundamentals of deBroglie matter waves, quantum mechanical wave equation and its application, the importance of free electron theory for metals and band theory for crystalline solids. Metals- Semiconductors-Insulators concepts utilization of transport phenomenon of charge carriers in semiconductors.
- CO4. To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
- CO5. Interpret various crystal systems and analyze the characterization of materials by. Identify the important properties of crystals like the presence of long-range order and periodicity.

### **Unit-I: Wave Optics**

**Interference:** Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

**Diffraction:** Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative).

**Polarization:** Introduction-Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

### **Unit-II: Lasers and Fiber optics**

**Lasers:** Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion – Lasing action - Pumping mechanisms – Ruby laser – He-Ne laser - Applications of lasers.

**Fiber optics:** Introduction –Principle of optical fiber- Acceptance Angle - Numerical Aperture - Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers - Applications.

### **Unit III: Dielectric and Magnetic Materials**

**Dielectric Materials:** Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative),

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Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation- Piezoelectricity.

**Magnetic Materials:** Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials- Eddy currents- Engineering applications.

**Unit IV: Acoustics & Ultrasonics**

**Acoustics:** Introduction to acoustics, Reverberation and Reverberation time, Sabine's formula, Absorption coefficient, Absorption coefficient determination, Factors affecting acoustics of buildings and their remedies

**Ultrasonics:** Introduction and Properties of Ultrasonics, Production of ultrasonics by Magnetostriction method, Production of ultrasonics by Piezoelectric method, Non-Destructive Testing: Pulse echo system through transmission and reflection modes, A, B and C – scan displays, Applications of Ultrasonics

**Unit-V: Crystallography and X-ray diffraction**

**Crystallography:** Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattice – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC

**X-ray diffraction:** Miller indices – separation between successive (hkl) planes- Bragg's law - X-ray Diffractometer

**Text books:**

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford University press.
3. Engineering Physics by P.K.Palanisamy SciTech publications.

**Reference Books:**

1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley & Sons
2. Engineering Physics – M.R.Srinivasan, New Age Publications
3. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
4. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
5. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson India Education services, 1<sup>st</sup> edition, 2008.
6. V. Rajendran, "Engineering Physics", Tata Mc-Graw Hill Publications, 2<sup>nd</sup> edition, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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<b>CO1</b>	<b>3-</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO2</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO4</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>CO5</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO-PO MAPPING**

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Year & Sem	I Year – II Semester					
<b>Course Code</b>	<b>22UME01</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENGINEERING MECHANICS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- The students about the concepts of force and friction, direction and its application.
- The students regarding the application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.
- The concepts of center of gravity, moment of inertia and polar moment of inertia including transfer methods and their applications.
- The understanding of motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
- The knowledge on rigid motion kinematics and kinetics.

**COURSE OUTCOMES:**

- **CO1:** Draw free body diagrams for particles and rigid bodies in plane and space and problems to solve the unknown forces, orientations and geometric parameters.
- **CO2:** Determine centroid for lines, areas and center of gravity for volumes and their composites.
- **CO3:** Determine area and mass moment of inertia for composite sections
- **CO4:** Analyze motion of particles and rigid bodies and apply the principles of motion, work energy and impulse – momentum.

**UNIT – I**

**Introduction to Engg. Mechanics** – Basic Concepts. Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems. Friction: Introduction, limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

**UNIT – II**

**Equilibrium of Systems of Forces:** Free Body Diagrams, , Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

**UNIT – III**

**Centroid:** Centroids of simple figures (from basic principles) – Centroids of Composite Figures Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorems.

**Area moments of Inertia:** Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product





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Year & Sem	I Year – II Semester					
<b>Course Code</b>	<b>22UEE05</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>BASIC ELECTRICAL ENGINEERING</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To understand the principle of operation, constructional details and operational characteristics of DC generators.
- To understand the principle of operation, characteristics of DC motor. Methods of starting and speed control methods of DC motors.
- To learn the constructional details, principle of operation and performance of transformers.
- To study the principle of operation, construction and details of synchronous generators.
- To learn the principle of operation, constructional details, performance, torque – slip characteristics and starting methods of 3-phase induction motors.
- To understand the principle of operation of different measuring instruments

**Course Outcomes:**

1. Able to explain the operation of DC generator and analyze the characteristics of DC generator.
2. Able to explain the principle of operation of DC motor and analyze their characteristics. Acquire the skills to analyze the starting and speed control methods of DC motors.
3. Ability to analyze the performance and speed – torque characteristics of a 3- phase induction motor and understand starting methods of 3- phase induction motor.
4. Able to explain the operation of Synchronous generators
5. Capability to understand the operation of various electrical measuring instruments.

**UNIT I**

**DC MACHINES:** Principle of operation of DC Machines- EMF equation – Types of generators –Magnetization and load characteristics of DC generators

**D.C. MOTORS:** Types of DC Motors – Torque Equation, Characteristics of DC motors – starters for DC shunt motor – Losses and efficiency – Swinburne's test – Speed control of DC shunt motor – Flux and Armature voltage control methods.

**UNIT II**

**TRANSFORMERS:** Principle of operation of single-phase transformer– Types and Constructional features, EMF Equation– No load and on load Phasor diagrams– Equivalent circuit-Losses and Efficiency of transformer and Regulation–OC and SC tests– Predetermination of efficiency and regulation.



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Year & Sem	I Year – II Semester					
Course Code	22UME03	L	T	P	SS	C
Course Name	<b>COMPUTER AIDED ENGINEERING DRAWING PRACTICE</b>	<b>1</b>	<b>-</b>	<b>4</b>	<b>0</b>	<b>3</b>

**Course Objectives:** To impart

- The knowledge of projections of solids and significance in 3D modeling and animation. The student will be able to draw projections of solids. The objective is to enhance the skills they already acquired in their earlier course in drawing of projection.
- The knowledge of sections of solids and development of surfaces is required in designing and manufacturing of the objects. Whenever two or more solids combine, a definite curve is seen at their intersection.
- The intersection of solids also plays an important role in designing and manufacturing. The objective is to impart this knowledge through this topic. A perspective view provides a realistic 3D View of an object. The objective is to make the students learn the methods of Isometric and Perspective views.
- The various commands in Auto CAD, to draw the geometric entities and to create 2D and 3D wire frame models.
- The understanding to create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.

**Course outcomes:** student will be able to

CO1: Get exposed on working of sheet metal with help of development of surfaces.

CO2: Understands how to know the hidden details of machine components with the help of sections and interpenetrations of solids.

CO3: Understand the use of modeling commands for generating 2D and 3D objects using computer aided drafting tools which are useful to create machine elements for computer aided analysis.

**UNIT-I:**

**PROJECTIONS OF SOLIDS:** Projections of Regular Solids inclined to both planes – Auxiliary Views.

**UNIT-II:**

**SECTIONS OF SOLIDS:** Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

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**DEVELOPMENT AND INTERPENETRATION OF SOLIDS:** Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid, Cone and their parts

**UNIT-III:**

**INTERPENETRATION OF RIGHT REGULAR SOLIDS:** Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone, Prism Vs Cone.

**PERSPECTIVE PROJECTIONS:** Perspective View: Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods (General Method only).

*In part B computer aided drafting is introduced*

**UNIT IV:**

**INTRODUCTION TO COMPUTER AIDED DRAFTING:** Generation of points, lines, curves, polygons, dimensioning. Types of modeling: object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modeling, 3D wire frame modeling,

**VIEW POINTS AND VIEW PORTS:** view point coordinates and view(s) displayed, examples to exercise different options like save, restore, delete, joint, single option.

**UNIT V:**

**COMPUTER AIDED SOLID MODELING:** Isometric projections, orthographic projections of isometric projections, modeling of simple solids, Modeling of Machines & Machine Parts.

**TEXT BOOKS:**

1. Engineering drawing by N.D Bhatt, Charotarpublications.
2. Engineering Graphics, K.C. john, PHIPublications

**REFERENCES:**

1. Mastering Auto CAD 2013 and Auto CAD LT 2013 – George Omura, Sybex
2. Auto CAD 2013 fundamentals- Elisemoss, SDCPubl.
3. Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas
4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, NewAge
5. Engineering Drawing – RK Dhawan, SChand
6. Engineering Drawing – MB Shaw, BC Rana, Pearson
7. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
8. Text book of Engineering Drawing with auto-CAD, K.venkatareddy/B.S .publications.
9. Engineering Drawing with Auto CAD/ James D Bethune/Pearson Publications

End Semester examination shall be conducted for Four hours with the following pattern:

- a) Two hours – Conventional drawing
- b) Two hours – Computer Aided Drawing

**Contribution of Course Outcomes (CO's) towards the achievement of programme**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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**outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

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<b>CO1</b>	2	3	2	1	1	-	-	-	-	-	-	1
<b>CO2</b>	3	2	2	1	1	-	-	-	-	-	-	-
<b>CO3</b>	3	2	3	2	2	-	-	-	2	-	-	2
<b>CO4</b>	2	3	2	1	1	-	-	-	-	-	-	1
<b>CO5</b>	3	2	3	2	2	-	-	-	2	-	-	2

<b>Year &amp; Sem</b>	<b>I Year – II Semester</b>						
<b>Course Code</b>	<b>22UPH04</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENGINEERING PHYSICS LAB</b>		<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**List of Engineering Physics Experiments**

1. Laser: Determination of wavelength using diffraction grating.
2. Young's modulus of given material by Strain gauge method.
3. Study of variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
4. Determination of ultrasonic velocity in given liquid (Acoustic grating).
5. Determination of dielectric constant using charging and discharging method.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Estimation of Planck's constant using photoelectric effect.
8. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).
9. Determination of numerical aperture and acceptance angle of an optical fiber.
10. Determination of thickness of thin object by wedge method.
11. Determination of radius of curvature of given Plano convex lens by Newton's rings.
12. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
13. Determination of dispersive power of the prism.
14. Sonometer: Verification of laws of string.
15. Measurement of magnetic susceptibility by Kundt's tube method.

**References:**

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO-PO MAPPING**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	-	-	-	3	-	-	-	-	-	-	-

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CO2	3	-	-	-	3	-	-	-	-	-	-	-	
<b>Year &amp; Sem</b>	<b>I Year – II Semester</b>												
<b>Course Code</b>	<b>22UEE07</b>						<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>		
<b>Course Name</b>	<b>BASIC ELECTRICAL ENGINEERING LAB</b>						<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>		
CO3	2	-	-	-	3	-	-	-	-	-	-	-	
CO4	3	-	-	-	3	-	-	-	-	-	-	-	

**Course Objectives:**

- To demonstrate the usage of measuring equipment
- To train the students in setting up simple wiring circuits
- To impart methods in electrical machine wiring

**List of Experiments: (Any Ten Experiments)**

1. Magnetization characteristics of D.C. Shunt generator
2. Speed control of D.C. shunt motor.
3. Brake test on DC shunt motor.
4. Swinburne's test on DC machine
5. Load test on DC shunt generator
6. Load test on DC series generator
7. Separation of losses in DC Shunt motor
8. OC & SC tests on single- phase transformer
9. Sumpner's test on single phase transformer
10. Brake test on 3-phase Induction motor.
11. Regulation of alternator by synchronous impedance method.

**Course Outcomes:**

- CO1: Determine and predetermine the performance of DC machines and transformers
- CO2: Control the DC shunt machines
- CO3: Compute the performance of 1-phase transformer

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CO4: Perform tests on 3-phase induction motor and alternator to

CO5: Determine their performance characteristics.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	2	-	-	-	2	-	3
CO2	1	2	-	-	-	1	-	-	-	-	-	1
CO3	2	2	-	-	-	2	-	-	-	-	-	3
CO4	2	2	-	-	-	2	-	-	-	-	-	2

**Contribution of Course Outcomes (CO's) towards the achievement of programme**

**Out comes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPINGS:**

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<b>Year &amp; Sem</b>	<b>I Year – II Semester</b>					
<b>Course Code</b>	<b>22UME04</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>WORKSHOP PRACTICE LAB</b>	<b>-</b>	<b>-</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**Course Objective:**

To impart hands-on practice on basic engineering trades and skills.

**Course outcomes: student will be able to**

CO1: use and conduct experiments on carpentry trade

CO2: use and conduct experiments on fitting trade

CO3: use and conduct experiments on black smithy trade

CO4: use and conduct experiments on electrical wiring

CO5: use and conduct experiments on sheet metal trade

CO6: use and conduct experiments on foundry

**Note:** At least two exercises to be done from each trade.

**Trade:**

**I. Carpentry**

1. T-Lap Joint
2. Cross Lap Joint
3. Dovetail Joint
4. Mortise and Tenon Joint

**II. Fitting**

1. V- Fit
2. Square Fit
3. Half Round Fit
4. Dovetail Fit



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**III. Black Smithy**

1. Round rod to Square
2. S-Hook
3. Round Rod to Flat Ring
4. Round Rod to Square headed bolt

**IV. House Wiring**

1. Parallel / Series Connection of three bulbs
2. Stair Case wiring
3. Florescent Lamp Fitting
4. Measurement of Earth Resistance

**V. Tin Smithy**

1. Taper Tray
2. Square Box without lid
3. Open Scoop
4. Funnel

**VI. Foundry**

1. Stepped pattern
2. Split pattern

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	2	1	1	2	2	1	-	-	-	-	-	2
<b>CO2</b>	2	1	1	2	2	1	-	-	-	-	-	2
<b>CO3</b>	2	1	1	2	2	1	-	-	-	-	-	2
<b>CO4</b>	2	1	1	2	2	1	-	-	-	-	-	2
<b>CO5</b>	2	1	1	2	2	1	-	-	-	-	-	2
<b>CO6</b>	2	1	1	2	2	1	-	-	-	-	-	2

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<b>Year &amp; Sem</b>	<b>I Year – II Semester</b>					
<b>Course Code</b>	<b>22UEN03</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>CONSTITUTION OF INDIA</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Course Objectives:**

- To Enable the student to understand the importance of Constitution
- To understand the structure of Executive, Legislature and Judiciary
- To understand philosophy of Fundamental Rights and Duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and High Court Controller and Auditor General of India and Election Commission of India.
- To understand the Central and State relation Financial and Administrative.

**Course Outcomes:**

1. At the end of the semester/course, the student will be able to have a clear knowledge on the following:
2. Understand Historical Background of the Constitution Making and its importance for building a Democratic India.
3. Understand the functioning of three wings of the Government i.e., Executive, Legislative and Judiciary.
4. Understand the value of the Fundamental Rights and Duties for becoming good citizen of India.
5. Analyze the decentralization of power between Central, State and local Self-Government.
6. Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining Democracy.

**UNIT-I**

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and Constitutional History, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

**Learning outcomes:**

After completion of this unit student will

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- Understand the concept of Indian Constitution
- Apply the knowledge on Directive Principle of State Policy
- Analyze the History, Features of Indian Constitution
- Evaluate Preamble Fundamental Rights and Duties

### **UNIT-II**

Union Government and its Administration Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, Power and Position, PM and Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions

**Learning outcomes:** -After completion of this unit student will

- Understand the structure of Indian Government
- Differentiate between the State and Central Government
- Explain the role of President and Prime Minister
- Know the Structure of Supreme Court and High court

### **UNIT-III**

State Government and its Administration Governor - Role and Position - CM and Council of Ministers, State Secretariat: Organization, Structure and Functions

**Learning outcomes:** -After completion of this unit student will

- Understand the structure of State Government
- Analyze the role of Governor and Chief Minister
- Explain the role of State Secretariat
- Differentiate between Structure and Functions of State Secretariat

### **UNIT-IV**

A. Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation  
Pachayati Raj: Functions PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root Democracy

**Learning outcomes:** -After completion of this unit student will

- Understand the Local Administration
- Compare and contrast District Administration role and importance
- Analyze the role of Mayor and elected representatives of Municipalities
- Evaluate Zilla panchayat block level organization

### **UNIT-V**

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women

**Learning outcomes:** -After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election Commissioner and Commissionerate
- Analyze role of State Election Commission

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- Evaluate various commissions of viz SC/ST/OBC and women

**References:**

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt.Ltd.. NewDelhi
2. Subash Kashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice –Hall of India Pvt. Ltd. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

**E-resources:**

1. [nptel.ac.in/courses/109104074/8](http://nptel.ac.in/courses/109104074/8)
2. [nptel.ac.in/courses/109104045/](http://nptel.ac.in/courses/109104045/)
3. [nptel.ac.in/courses/101104065/](http://nptel.ac.in/courses/101104065/)
4. [www.hss.iitb.ac.in/en/lecture-details](http://www.hss.iitb.ac.in/en/lecture-details)
5. [www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution](http://www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution)

**Contribution of Course Outcomes (CO's) towards the achievement of programme outcomes (PO's) (Strong – 3, Moderate – 2, Weak – 1)**

**CO – PO MAPPING:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	-	-	-	-	-	<b>2</b>	-	-	-	-	-	-
<b>CO2</b>	-	-	-	-	-	<b>1</b>	-	-	-	-	-	-
<b>CO3</b>	-	-	-	-	-	-	-	<b>2</b>	-	-	-	-
<b>CO4</b>	-	-	-	-	-	-	-	<b>1</b>	-	-	-	-
<b>CO5</b>	-	-	-	-	-	<b>1</b>	-	-	-	-	-	-

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<b>Year &amp; Sem</b>	<b>II Year – I Semester</b>					
<b>Course Code</b>	<b>22UMB01</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>MANAGERIAL ECONOMICS &amp; FINANCIAL ANALYSIS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting,
2. To understand the cost analysis like Cost-Output relationship and Cost-Volume-Profit Analysis.
3. To understand the nature of markets, Methods of Pricing in the different market structures
4. To know the different forms of Business organization and the concept of Business Cycles.
5. To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.

**UNIT – I**

**Introduction to Managerial Economics:** Definition, micro and macroeconomics, demand analysis - demand determinants, law of demand and its exceptions, elasticity of demand; demand forecasting - survey methods, statistical methods.

**UNIT – II**

**Cost Analysis:** Cost concepts - opportunity cost, fixed vs. variable costs, explicit vs. implicit costs, out of pocket vs. imputed costs; Break Even Analysis -determination of break-even point (simple problems).

**UNIT – III**

**Introduction to Markets, Theories of the Firm & Pricing Policies:**

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing.

**UNIT – IV**



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1	1	1	-	-	-	-	-	-	1	2	1	1	3	1	-	-
2	2	1	-	-	-	-	-	-	1	2	1	1	3	1	-	-
3	1	1	-	-	-	-	-	-	1	2	1	1	2	1	-	-
4	1	1	-	-	-	-	-	-	1	2	1	1	2	1	-	-
5	1	1	-	-	-	-	-	-	1	2	1	1	3	1	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – I Semester							
Course Code	22UME05			L	T	P	SS	C
Course Name	METALLURGY AND MATERIAL SCIENCE			3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria
2. To provide a detailed interpretation of equilibrium phase diagrams.
3. To study the properties of ferrous and non-ferrous metals and alloys.
4. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys
5. Learning about powder metallurgy process to useful in modern industrial applications

**UNIT-I**

**Structure of Metals and Constitution of alloys:** Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor - SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the Properties of metal / alloys – determination of grain size. Imperfections – point, line, surface and volume- Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

**UNIT – II**

**Equilibrium Diagrams:** Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe<sub>3</sub>C.

**UNIT – III**

**Ferrous metals and alloys:** Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

**Non-ferrous Metals and Alloys:** Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys and Magnesium and its alloys.

**UNIT-IV**

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**Heat treatment of Alloys:** Effect of alloying elements on Fe-Fe<sub>3</sub>C system, Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, Age hardening treatment.

**UNIT – V**

**Powder Metallurgy:** Basic processes- Methods of producing metal powders- milling atomization- Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Sintering Secondary Operations-Sizing, coining, machining -Factors determining the use of powder metallurgy-Application of this process.

**TEXT BOOKS:**

1. Introduction to Physical Metallurgy - Sidney H. Avener -McGraw Hill
2. Essential of Materials science and engineering - Donald R. Askeland -Cengage.

**REFERENCES:**

1. Material Science and Metallurgy – Dr. V.D.kodgire- Everest PublishingHouse
2. Materials Science and engineering – Callister and Balasubrahmanyam- Wiley Publications
3. Material Science for Engineering students – Fischer – Elsevier Publishers
4. Material science and Engineering - V. Rahghavan- PHI Publishers
5. Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press
6. Material Science and Metallurgy – A V K Suryanarayana – B S Publications
7. Material Science and Metallurgy – U. C. Jindal – Pearson Publications

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
CO-1	<b>Analyze</b> the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.	Analyzing	<b>L4</b>
CO-2	<b>Explain</b> the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and <b>identification</b> of phase diagrams and reactions.	Understanding and identify	<b>L2</b>
CO-3	<b>Study</b> the behavior of ferrous and non-ferrous metals and alloys and their application in different domains.	Remembering	<b>L1</b>
CO-4	<b>Understand</b> and suggest the heat treatment process & types. Introduce the concept of hardenability & demonstrate the test used to find hardenability of steels	Understanding and evaluating	<b>L2, L4</b>
CO-5	<b>Explain</b> the methods of making of metal powders and applications of powder metallurgy	Explain	<b>L3</b>

**MAPPING OF CO'S VS PO'S & PSO'S:**

	PO'S	PSO'S
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<b>CO</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	-	-	-	-	-	<b>1</b>	-	<b>1</b>	-	-	-	-
<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>2</b>	-	<b>1</b>	-	-	-	<b>1</b>	-	<b>2</b>	-	-	-	-
<b>3</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>2</b>	-	<b>1</b>	<b>1</b>	-	-	<b>1</b>	-	<b>2</b>	-	-	<b>2</b>	-
<b>4</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	-	-	<b>1</b>	-	<b>2</b>	-	-	<b>2</b>	-
<b>5</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	-	-	<b>1</b>	-	<b>2</b>	-	-	<b>2</b>	<b>2</b>

(1-Low, 2-Medium, 3-High)

<b>Year &amp; Sem</b>	<b>II Year – I Semester</b>							
<b>Course Code</b>	<b>22UME06</b>			<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>ENGINEERING THERMODYNAMICS</b>			<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To learn about work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about application of I law to various energy conversion devices.
3. To evaluate the changes in properties of substances in various processes.
4. To understand the difference between high grade and low-grade energies and II law limitations on energy conversion.
5. To develop the skills to analyze and design thermodynamic systems.

**UNIT – I**

**Introduction to Basic Concepts:** System, boundary, Surrounding, Universe, control volume, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process - Reversible, Quasi static & Irreversible Processes, cycle, Causes of Irreversibility. Energy in State and in Transition - Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature.

**UNIT – II**

Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system –Energy balance for closed systems-Specific heatsInternal energy, Enthalpy and Specific heats of Solids, liquids and Ideal gases, some steady flow energy equation applied to Nozzle, Turbine, Compressor and heat exchanger devices, PMM-I.

**UNIT – III**

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, Corollaries, PMM of Second kind, Carnot cycle and its specialties, Carnot's theorem, Thermodynamic scale of Temperature. Clausius Inequality, Entropy, Principle of Entropy Increase, Availability and Irreversibility (Basic definitions) –

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Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

**UNIT – IV**

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point and critical point, properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation, Property tables. Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

**UNIT – V**

Ideal Gas equation of state- Compressibility factor- Van der Waals equation of state-compressibility charts – variable specific heats. Mixtures of perfect Gases – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes- Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heat and Entropy of Mixture of Perfect Gases and Vapour.

Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

**TEXT BOOKS:**

1. Engineering Thermodynamics, PK Nag 6 th Edn , McGraw Hill.
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke, Van Wylen, 6 th Edn, Wiley

**REFERENCES:**

1. Thermodynamics by Prasanna Kumar, Pearson Publishers
2. Engineering Thermodynamics – Jones & Dugan PHI
3. Thermodynamics, an Engineering Approach, Yunus A Cengel, Michael A Boles, 8 th Edn SI Units, McGraw Hill.
4. Thermodynamics – J.P.Holman , McGrawHill
5. An Introduction to Thermodynamics - Y.V.C.Rao – Universities press.
6. Thermodynamics – W.Z.Black & J.G.Hartley, 3 rd Edn Pearson Publ.
7. Engineering Thermodynamics – D.P.Misra, Cengage Publ.

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	To <b>understand</b> the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium; <b>define</b> energy transfer through mass, heat and work for closed and control volume systems.	Understand	2
2	To <b>understand and apply</b> the first Law of Thermodynamics on closed and control volume systems and to <b>analyse</b> preliminary problems	Understand Apply Analyse	2, 3, 4
3	To <b>understand and apply</b> Second Law of Thermodynamics and entropy concepts in analysing the thermal efficiency of a system and to <b>analyse</b> preliminary problems of change in entropy in various thermodynamic processes	Apply Analyse	3, 4

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4	To <b>identify</b> the properties of substances on property diagrams and obtain the data from property tables	Apply	3
5	To <b>apply</b> concept of chemical thermodynamics, with emphasis on the first and second laws, to predict physical changes and reaction outcomes based on Gibbs energies	Apply	3

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	2	-	-	-	-	-	-	1	-	2	3	1	-	-
2	3	3	2	1	-	-	-	-	-	1	-	2	3	1	-	-
3	3	2	3	1	-	-	-	-	-	1	-	2	2	1	-	-
4	3	3	2	3	-	-	-	-	-	1	-	2	2	1	-	-
5	3	NC	2	-	-	-	-	-	-	1	-	2	3	1	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – I Semester							
Course Code	22UME07			L	T	P	SS	C
Course Name	FLUID MECHANICS AND HYDRAULIC MACHINERY			3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. The concept of fluid and its properties, manometry, hydrostatic forces acting on different surfaces and also problem-solving techniques.
2. To understanding the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.
3. To understanding the concepts related to boundary layer theory, flow separation, basic concepts of velocity profiles, dimensionless numbers and dimensional analysis.
4. Know the hydrodynamic forces acting on vanes and performance evaluation of hydraulic turbines
5. understand the characteristic curves of hydraulic turbines and also evaluate the performance characteristics of hydraulic pumps

**UNIT-I**

**Fluid statics:** Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

**Buoyancy and floatation:** Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

**UNIT – II**

**Fluid kinematics:** Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortexflow.

**Fluid dynamics:** Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its applications, force on pipe bend.

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**Closed conduit flow:** Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

**UNIT – III**

**Boundary Layer Theory:** Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

**Dimensional Analysis:** Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

**UNIT-IV**

**Basics of turbo machinery:** hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

**Hydraulic Turbines:** Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube- theory- functions and efficiency

**UNIT – V**

**Performance of hydraulic turbines:** Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations and applications.

**Centrifugal pumps:** classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

**Reciprocating pumps:** Working, Discharge, slip, indicator diagrams.

**TEXT BOOKS:**

1. Fluid Mechanics- Fundamentals and Applications by Y.A. Cengel, J.M.Cimbala, 6thEdn,McGrawHill.
2. Hydraulics, fluid mechanics and Hydraulic machinery- Modi and Seth.

**REFERENCES:**

1. Fluid Mechanics and Hydraulic Machines - RK Bansal- Laxmi Publications (P)Ltd.
2. Fluid Mechanics and Hydraulic Machines –Rajput
3. Fluid Mechanics and Fluid Power Engineering - D.S. Kumar, Kotaria&Sons.
4. Fluid Mechanics and Machinery - D. Rama Durgaiyah, New AgeInternational.
5. Fluid Mechanics - Dixon, 7thEdn, Elesvier

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
CO-1	Develop basic <b>understanding</b> of the fundamental equations of fluid mechanics. <b>Analyze</b> hydrostatic forces in submerged bodies	Understanding and Analyze	<b>L2, L4</b>
CO-2	<b>Apply</b> the Bernoulli equation to solve problems in fluid flows.	Applying	<b>L3</b>
CO-3	Identify and <b>analyse</b> the laminar and turbulent boundary layer. <b>Create</b> prototypes with the help of dimensional analysis	Analyze and Create	<b>L4, L6</b>

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CO-4	<b>Understand</b> the Working Principles Hydraulic turbines	Understanding	L2
CO-5	<b>Understand</b> the Working Principles Centrifugal pump and reciprocating pumo performance evaluation	Understanding	L2

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	3	1	1	1	2	-	-	-	-	-	1	3	2	-	2
2	2	3	1	1	1	2	-	-	-	-	-	1	3	2	-	2
3	2	3	1	1	1	2	-	-	-	-	-	1	3	2	-	2
4	2	3	1	1	1	2	-	-	-	-	-	1	3	2	-	2
5	2	3	1	1	1	2	-	-	-	-	-	1	3	2	-	2

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – I Semester							
Course Code	22UME08			L	T	P	SS	C
Course Name	MECHANICS OF SOLIDS			3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To acquaint with the basic terms like stress, strain, Poisson's ratio and deformation in solids.
2. To practice the methodologies to analyse different stresses and deflections induced in bars, beams, thin cylinders, thick cylinders, and columns.
3. Draw and calculate shear force and bending moment diagrams of beam under given loading
4. Understanding the shear stresses due to torsion in circular shaft
5. To compute the stress distribution in beams, pressure vessels and shafts

**UNIT-I**

**Simple Stresses and Strains:** Elasticity and plasticity – Types of stresses & strains– Hooke's law – stress – strain diagram for **mild** steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses. Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings

**UNIT – II**

**Shear Force and Bending Moment:** Definition of beam, Types of beams, Types of loads, Types of supports; bending moment and shear force diagrams for for cantilever, simply supported and overhanging beams subjected to three types of loads: i) concentrated loads ii) uniformly distributed loads iii) uniformly varying loads couples and their combinations; Point of contraflexure, point & magnitude of maximum bending moment, maximum shear force.

**UNIT – III**

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**Stresses in Beams:** Flexural stresses – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I and T sections

**Shear stresses:** Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I and T sections.

**UNIT-IV**

**Deflection of Beams:** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, statically indeterminate Beams and solution methods.

**UNIT – V**

**Thin and Thick cylinders:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, length and volume of thin cylinders – Riveted boiler shells – Thin spherical shells. Lamé's equation – cylinders subjected to inside & outside pressures – compound cylinders.

**Theory of columns:** Buckling theory –Euler's formula for long columns– assumptions and limitations – effect of end conditions – slenderness ratio – Rankin's formula for intermediate columns.

**TEXT BOOKS:**

1. Strength of materials by GH Ryder- Mc Millan publishers IndiaLtd.
2. Strength of materials by B.C. Punmia - lakshmi publications pvt.Ltd, NewDelhi.

**REFERENCES:**

1. R. C. Hibbeler, Mechanics of Materials, Pearson Education,2008
2. F. Beer, E. R. Johnston, J. T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2011
3. R. K. Bansal, Mechanics of solids, Laxmi Publications, 2004
4. James M.Gere, Stephen Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, New Delhi,2012
5. E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, Pearson Education, 2012
6. I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2006
7. P. N. Singh, P. K. Jha, Elementary Mechanics of Solids, Wiley Eastern Limited, 2012

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
CO-1	<b>Understand</b> basic concepts of stress and strain in solids and <b>apply</b> this knowledge during the analysis of thermal stresses and statically indeterminate structures.	Understanding and Apply	<b>L2, L3</b>
CO-2	<b>Apply</b> the stress- strain distributions, diagrammatically representation of shear force & bending moment for different beams under various load conditions by using suitable methods.	Applying	<b>L3</b>

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CO-3	<b>Determine</b> the bending stress and shear stress in beams and can select the appropriate geometry for the requirement.	Evaluate	<b>L5</b>
CO-4	<b>Analyze</b> the slope and deflections for different cross-sectional beams and columns, torsion effect for shaft and springs under different load conditions	Analyze and evaluating	<b>L4, L5</b>
CO-5	<b>Evaluate</b> the deflection of beams and shafts under static loading and stresses in thin walled cylindrical and spherical vessels	Evaluate	<b>L5</b>

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
2	3	2	3	-	-	3	-	-	-	-	-	3	2	3	-	-
3	3	3	2	-	-	3	-	-	-	-	-	2	2	3	-	-
4	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
5	3	2	2	-	-	3	-	-	-	-	-	2	2	3	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – I Semester							
Course Code	22UEN05			L	T	P	SS	C
Course Name	ENVIRONMENT HEALTH AND SAFETY			1	0	0	0	0

**COURSE OBJECTIVES:**

1. To introduce the different types of hazards in industries and the management of hazards.
2. To learn the Radiation and Industrial Hazards
3. To learn the various types of water pollution.
4. To learn the various types of air pollution.

**UNIT – I**

**Occupational Health and Toxicology:** occupational related diseases, silicosis, asbestosis, pneumoconiosis, etc. lead, nickel, chromium and manganese toxicity, effects and prevention –Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects. Industrial Hygiene.

**UNIT – II**

Noise, noise exposure regulation. Ionizing radiation, types, effects. Chemical hazards-dust, fumes, mist, vapour, fog, gases, Methods of Control. Biological hazards-Classification of Biohazardous agents – bacterial agents, viral agents, fungal, parasitic agents, infectious diseases.

**UNIT – III**

Radiation and Industrial Hazards, Types and effects of radiation on human body, disposal of radioactive waste Air Pollution - air pollutants from industries, effect on human health,



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animals, Plants and Materials - concept of clean coal combustion technology - depletion of ozone.

**UNIT – IV**

**Water Pollution** -water pollutants-health hazards - effluent quality standards, tannery, textile effluents Hazardous Waste Management -waste identification, characterization and classification, health hazards-toxic and radioactive wastes recycling and reuse.

**UNIT – V**

**Pollution Control in Process Industries** - Pollution control in process industries like cement, paper, petroleum products-textile, tanneries thermal power plants – dyeing and pigment industries - eco-friendly energy.

**TEXT BOOKS:**

1. Gerard Kiely, Environmental Engineering, McGraw hill Education
2. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi (2006)

**REFERENCES:**

1. Mackenzie L Davis, Introduction to Environmental Engineering, McGraw hill Education (India)
2. S. P. Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing Company, New Delhi, 1993
3. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York
4. National Safety Council, Hand book of Occupational Safety and Health, Chicago, 1982



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<b>Year &amp; Sem</b>	<b>II Year – I Semester</b>					
<b>Course Code</b>	<b>22UME09</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>FLUID MECHANICS AND HYDRAULIC MACHINERY LAB</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**COURSE OBJECTIVES:**

To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

***NOTE: The students have to conduct at least 10 Experiments***

**List of Experiments:**

1. Calibration of Venturi meter.
2. Calibration of Orifice meter.
3. Impact of jets on Vanes.
4. Determination of friction factor for a given pipeline.
5. Determination of loss of head due to sudden contraction in a pipeline.
6. Turbine flow meter.
7. Performance Test on Pelton Wheel.
8. Performance Test on Francis Turbine.
9. Performance Test on Kaplan Turbine.

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10. Performance Test on Single Stage Centrifugal Pump.
11. Performance Test on Multi Stage Centrifugal Pump.
12. Performance Test on Reciprocating Pump.

Upon completion of this course, students will gain the ability to:

CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	Identify the need and use of various flow measuring devices	Analyze	4
2	Determine the friction losses of fluid flow through different pipes	Analyze	4
3	Determine the efficiencies of various pumps and draw the characteristic curves.	Analyze	4
4	Determine the impact of jet on different types of vanes.	Analyze	4
5	Determine the efficiencies of various turbines and draw the characteristic curves.	Analyze	4

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
2	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
3	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
4	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
5	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-

(1-Low, 2-Medium, 3-High)

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<b>Year &amp; Sem</b>	<b>II Year – I Semester</b>					
<b>Course Code</b>	<b>22UME10</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>MECHANICS OF SOLIDS AND METALLURGY LAB</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**COURSE OBJECTIVES:**

impart practical exposure on the microstructures of various materials and their hardness evaluation. Also, to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

**NOTE: NOTE: Any 6 experiments from each section A and B.**

**A) MECHANICS OF SOLIDS LAB:**

1. Direct tensile test.
2. Compression test.
3. Impact test.
4. Torsion test.
5. Test on helical spring
6. Bending test on simple supported beam.
7. Bending test on cantilever beam.
8. Brinell hardness test.

**(B) METALLURGYLAB:**

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9. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
10. Preparation and study of the Microstructure of Gray Cast Iron and White Cast Iron
11. Study of the Micro Structures of Ductile and Malleable Cast Irons.
12. Preparation and study of the Microstructure of Mild steel, medium carbon steels, High carbon steels.
13. Study of the Micro Structures of Non-Ferrous alloys.
14. Study of the Micro structures of Heat-treated steels.
15. To find out the hardness of various treated and untreated steels.

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	To determine the tensile and compressive strength of mild steel and concrete cube	Analyze	4
2	To determine the Modulus of rigidity of steel using torsion test and spring test	Analyze	4
3	To analyse the toughness of a specimen using Impact testing machine	Analyze	4
4	Understand the Microstructure of Mild steel, medium carbon steels, High carbon steel.	Understand	4
5	Understand the Microstructure of Non-Ferrous alloys.	Understand	4

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
2	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
3	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
4	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
5	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-

(1-Low, 2-Medium, 3-High)

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<b>Year &amp; Sem</b>	<b>II Year – I Semester</b>					
<b>Course Code</b>	<b>22UME11</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>MACHINE DRAWING PRACTICE</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To familiarize the students with the standard conventions for different materials and machine parts in working drawings.
2. To make part drawings including sectional views for various machine elements.
3. To prepare assembly drawings, given the details of part drawings
4. Recognize to use modern engineering tools, software and equipment to analyze problems.

**SYLLABUS**

**Machine Drawing Conventions:**

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

**Drawing of Machine Elements and simple parts:**

Selection of Views, additional views for the following machine elements and parts with every drawing proportion

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- Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
- Keys, cottered joints and knuckle joint.
- Riveted joints for plates.
- Shaft coupling, spigot and socket pipe joint.
- Journal, pivot, collar and foot step bearings.

**Assembly Drawings:**

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportion.

- Steam Engine parts – Stuffing boxes, Eccentrics.
- Machine tool parts – Tailstock, Tool Post, Machine Vices.
- Other machine parts – Screws jacks, Petrol engine connecting rod, Piston Assembly, Plummer block.

**Manufacturing Drawing**

- Introduction of Limits and fits, fundamental deviations for Hole based and Shaft based systems, alpha numeric designation of limits & fits. Types of Fits. Form and positional tolerances.
- Conventional practices of indicating limits and fits, geometrical form and position tolerances, surface finish and surface treatments requirements. Study of Examples involving selection of fits and calculation of limits. Suggestion of suitable fits for mating parts.
- Representation of limits fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

**TEXT BOOKS:**

1. K L Narayana, P Kannaiah and K Venkata Reddy, Machine Drawing, 3rd edition, New Age Publications, 2006.
2. N D Bhatt, Engineering Drawing, Charotar Publications, 2000.
3. K L Narayana, P Kannaiah and K Venkata Reddy, Production Drawing, 2nd edition, New Age Publications, 2009.

**REFERENCES:**

1. N Sidheswar, P Kannaiah and V V S Sastry, Machine Drawing, Tata McGraw Hill, 1980.
2. Machine Drawing – B Battacharya, Oxford
3. P S Gill, A Textbook of Machine Drawing, S.K. Kataria & Sons Publishers, 2013
4. K C John, Textbook of Machine Drawing, PHI Publications, 2009
5. Basudev Bhattacharyya, Machine Drawing, Oxford University Press, 2011.

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
CO-1	Prepare engineering and working drawings with dimensions following proper conventions.	Remember and Apply	L1, L3
CO-2	Draw and represent standard dimensions of different mechanical fasteners, bearings, joints and Couplings	Remember and Apply	L1, L3

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CO-3	Assemble components of a machine part and draw the sectional assembly drawing showing the dimensions of all the components of the assembly as per bill of materials	Analyze and create	L4, L6
CO-4	Select and represent fits and geometrical form of different mating parts in assembly drawings	Apply	L3
CO-5	To prepare manufacturing drawings indicating fits, tolerances, surface finish and surface treatment requirements	Apply	L3

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	-	-	-	-	-	2	-	-	2	3	-	-
2	3	2	3	-	-	-	-	-	-	3	-	-	2	3	-	-
3	3	3	2	-	-	-	-	-	-	2	-	-	2	3	-	-
4	3	2	2	-	-	-	-	-	-	2	-	-	2	3	-	-
5	3	2	2	-	-	-	-	-	-	2	-	-	2	3	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – I Semester							
Course Code	22UME12			L	T	P	SS	C
Course Name	MODELING AND DRAFTING LAB			1	0	2	0	2

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. Various commands used in drafting packages for creating 2D and 3D drawings.
2. Representation of dimensioning and tolerances for the different part and assembly drawings.
3. Different tools used in the various fields of engineering to improve the output of product.
4. Various tools used in the industries to solve some real time problems.

**COURSE SYLLABUS:**

**A. DRAFTING:**

Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances, Study of DXE, IGES files.

**B. SURFACE MODELING:**

Generation of various Surfaces using surface modeling. The following contents to be done by any 3D software package:

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- i. **PART MODELING:** Generation of various 3D models through Pad, revolve, shell, sweep, parent child relation, Boolean operations and various standard translators.
- ii. **ASSEMBLY DRAWINGS:** (Any four of the following using solid model software) Generation of various Parts/assemblies: like Screw Jack, Oldham's Coupling, Foot step bearing, Couplings, knuckle and cotter joints, Crankshaft, Connecting Rod, Piston and Cylinder.

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	<b>Create</b> the 2D & 3D drawings by using Computer Aided drafting packages.	Creating	6
2	<b>Use</b> the tools for representation of dimensioning and tolerances for the different part and assembly drawings	Apply	3
3	<b>Utilize</b> the tools to improve the output of a product in various fields of engineering	Apply	3
4	<b>Use</b> the tools to <b>Solve</b> some real time problems in industries.	Apply & Analyze	2, 3

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	--	3	--	--	--	--	--	--	2	3	3	3	1
2	3	2	1	--	3	--	--	--	--	--	--	2	3	3	3	1
3	3	2	1	2	3	--	--	--	--	--	--	2	3	3	3	3
4	3	3	1	2	3	--	--	--	--	--	--	2	3	3	3	3

(1-Low, 2-Medium, 3-High)



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<b>Year &amp; Sem</b>	<b>II Year – II Semester</b>					
<b>Course Code</b>	<b>22UMT04</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>PROBABILITY &amp; STATISTICS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

1. To impart understanding of fundamental knowledge in probability and statistical techniques for gathering, organizing, displaying, and analyzing the significant data.
2. To infuse the importance of random variables and distributions in decision making in order to carry out the necessary random experiments and identify the potential outcomes in a specific instance
3. To provide the knowledge of Fitting the Appropriate Curves, Correlation and Regression Analysis to the data and estimate the future values.
4. To enable the students for comprehending the Sampling Theory to estimate unknown population parameters using sample studies with the aid of statistical methodologies
5. To analyze the concepts of Sampling, tests based on hypothesis to make an inference about the population of interest on the basis of a Random sample taken from the population.

**Course Outcomes:**

At the end of the course, the student will be able to

- CO1: Demonstrate the basic knowledge on fundamental probability concepts, and various statistical methods of collecting data to interpret.
- CO2: Understand the basic principles of distribution theory, mathematical

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expectation and various applications.

- CO3: Interpret the association of Characteristics and through correlation and Regression tools.
- CO4: Estimate the confidence intervals for the mean of a population and Test a Hypothesis concerning means.
- CO5: Design the components of a classical Hypothesis tests and derive the statistical inferential methods based on Small and Large Sampling tests.

**UNIT-I Probability and Introductory Statistical Methods**

Probability – Probability Axioms – Addition Law and Multiplicative, Law of Probability - Conditional probability - Baye's theorem. Measures of Central Tendency – Measures of Dispersion – Skewness – Kurtosis.

**UNIT-II Random Variables and Probability Distributions**

Random variables (Discrete and continuous) – Probability Density Function - Probability Distribution function - Binomial, Poisson and Normal distribution – Related properties.

**UNIT-III Correlation, Regression**

Correlation – Correlation Coefficient – Rank Correlation – Regression - Lines of Regression – Regression Coefficients – Method of Least Squares - Straight Line - Parabola - Exponential - Power Curves.

**UNIT-IV Sampling Theory and Estimation**

Sampling Theory Introduction – Population and Samples – Sampling Distribution of Means and Variance (Definitions Only) – Central Limit Theorem (Without Proof) - Introduction to t,  $\chi^2$  Distributions. Estimation: Point Estimation - Interval Estimation.

**UNIT-V Tests of Hypothesis**

Tests of Hypothesis Introduction – Hypothesis - Null Hypothesis - Alternative Hypothesis – Type-I and Type-II Errors - Level of Significance – One Tail and Two Tail Tests – Tests concerning one mean and two means (Large and Small Samples) – Tests on Proportions.

**Text Books:**

1. Probability and Statistics by Dr.T.K.V.Iyengar, Dr. B.Krishna Gandhi, S.Ranganadham, Dr. M.V.S.S.N. Prasad, S.Chand Publications.
2. Fundamentals of Mathematical Statistics, S.C.Gupta and V.K.Kapoor, Sultan Chand Publications, Tenth revised edition, 2002.

**Reference Books:**

1. Probability and Statistics for Engineers, Miller and John E. Freund, Prentice Hall of India, Eighth Edition, 2011.
2. Probability and Statistics (Schaum's Outline Series) by Murray Spiegel, John Schiller, McGraw Hill Education, 2005.
3. Probability, Statistics and Random processes. T. Veerajan, Tata Mc.Graw Hill, India,

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Third Edition, 2009.

<b>Year &amp; Sem</b>	<b>II Year – II Semester</b>					
<b>Course Code</b>	<b>22UME13</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>MANUFACTURING PROCESSES</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To study basic definitions associated with casting terminology, its classification and various steps involved in it.
2. To understand the different types of gating systems and casting processes.
3. To understand the application of the different joining techniques, and be able to select an appropriate technique according to a specific requirement
4. To understand the fundamentals of metal working process
5. To study the various process involved in sheet metal forming

**UNIT-I**

**CASTING:** Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding – molding methods - ingredients of molding sand –. Molding materials, Properties of molding sand, Testing of molding sand. Types of molding – Hand molding – Machine molding. Core – different types of cores – materials – properties of core sand – core manufacturing

**UNIT – II**

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Principles of Gating, Gating ratio and design of Gating systems. Risers – Types, function and design, casting design considerations. Methods of melting and types of furnaces - cupola, electric arc, resistance and induction furnace. Solidification of castings- Solidification of pure metals and alloys-Short & long freezing range alloys. Fettling. Casting defects. Basic principles and applications of special casting processes - Centrifugal casting – True, semi and centrifuging, Die casting, Investment casting and shell molding.

**UNIT – III**

**Welding:** Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, Submerged arc welding, TIG & MIG welding.

Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering & Brazing.

**UNIT-IV**

**Plastic deformation in metals and alloys**-recovery, recrystallization and grain growth. Hot working and Cold Working-Strain hardening and Annealing. Bulk forming processes: Forging - Types of Forging, Smith forging, Drop Forging, roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

**UNIT – V**

**Sheet metal forming** - Blanking and piercing, Forces and power requirement in these operations, Deep drawing, stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

**TEXT BOOKS:**

1. Manufacturing Processes for Engineering Materials – Kalpakjian S and Steven R Schmid- Pearson Publ , 5thEdn.
2. Manufacturing Technology -Vol I- P.N. Rao-TMH.

**REFERENCES:**

1. Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt.Ltd
2. Process and materials of manufacture- Lindberg-PHI
3. Production Technology- R.K. Jain-Khanna
4. Production Technology-P C Sharma-S.Chand
5. Manufacturing Processes- H.S. Shaun-Pearson
6. Manufacturing Processes- J.P. Kaushish-PHI
7. Workshop Technology -WAJ Chapman/CBS Publishers&DistributorsPvt.Ltd.

Upon completion of this course, students will gain the ability to:			
<b>CO NO.</b>	<b>COURSE OUTCOMES</b>	<b>BLOOM'S TAXONOMY</b>	<b>LEVEL</b>

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CO-1	Understand the basics of manufacturing processes and concerned behavior of material properties.	Understanding	L2
CO-2	Explain various casting processes for different molding designs and forming techniques for metal works.	Applying	L3
CO-3	Understand welding methods and analyze solid or liquid state joining.	Evaluate	L5
CO-4	Develop process for metal forming processes using plasticity principles	Analyze and evaluating	L4, L5
CO-5	Distinguish the various process involved in sheet metal forming and understand the high energy rate forming processes	Evaluate	L5

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
2	3	2	3	-	-	3	-	-	-	-	-	3	2	3	-	-
3	3	3	2	-	-	3	-	-	-	-	-	2	2	3	-	-
4	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
5	3	2	2	-	-	3	-	-	-	-	-	2	2	3	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – II Semester						
Course Code	22UME14		L	T	P	SS	C
Course Name	INDUSTRIAL ENGINEERING AND MANAGEMENT		3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, and the domain knowledge of Industrial Management and Engineering.
2. To produce graduates with the ability to adopt a system approach to design, develop, implement and innovate integrated plant Layouts systems that include people, materials, information, equipment and energy.
3. To enable students to understand the concepts of Work Study measurements.
4. To enable students to understand the concepts of SQC & TQM.
5. To enable students to understand the aspects of Industrial accident and Industrial safety and Industrial health.

**UNIT – I**

**ST.ANN'S COLLEGE OF ENGINEERING & TECHNOLOGY: CHIRALA  
(AUTONOMOUS)  
ME - UG – R22**

**INTRODUCTION:** Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.

**UNIT – II**

**PLANT LAYOUT:** Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and break down maintenance.

**UNIT – III**

**WORK STUDY:** Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

**RESOURCE MANAGEMENT:** Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types.

**UNIT – IV**

**STATISTICAL QUALITY CONTROL:** Quality control, Queing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts – X and R – charts X and S charts and their applications, numerical examples.

**TOTAL QUALITY MANAGEMENT:** Zero defect concept, quality circles, implementation, applications, ISO quality systems. six sigma – definition, basic concepts.

**UNIT – V**

**INDUSTRIAL ACCIDENT, INDUSTRIAL SAFETY AND INDUSTRIAL HEALTH:** Introduction, types of accidents, Safety Programme, Remedies and General safety measures, Investigation and Accident report.

**Industrial Health:** Introduction, Factors affecting workers Health, Protection against Health Hazard, Health services rendered by Government.

**TEXT BOOKS:**

1. Industrial Engineering and Management / O.P Khanna/Khanna Publishers
2. Industrial Engineering and Production Management/ M.Mahajan / Dhanpati Rai Publications.
3. Plant Layout & Materail handling/G.K.Agarwal /Jain Brothers Publications/New Delhi.

**REFERENCES:**

1. Industrial Management / Bhattacharya DK/Vikaspublishers
2. Operations Management / J.G Monks/McGrawHillPublishers.
3. Industrial Engineering and Management Science/T.R. Banga, S.C.Sharma, N. K. Agarwal / Khanna Publishers
4. Principles of Management /Koontz O' Donnel/McGraw Hill Publishers.
5. Statistical Quality Control /Gupta/KhannaPublishers
6. Industrial Engineering and Management /NVS Raju/Cengage Publisher

Upon completion of this course, students will gain the ability to:
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CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	Able to use and select industrial engineering techniques for enhancing productivity in an organization	Understand	1,2
2	<b>Select, identify and design</b> a system, component, or process, and synthesize solutions to achieve desired needs.	Understand, Evaluate	2, 5
3	<b>Use</b> the techniques, skills, and modern engineering tools necessary for engineering practice and implement various work study and job evaluation methods.	Understand, Apply	2,3
4	Able to <b>apply</b> the information to effective project management to produce Quality outcomes.	Understand, Apply	2,3
5	Will be able to <b>use</b> the knowledge in Industry from Hazards.	Understand, Apply	2,3

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	
1	3	3	3	-	-	3	-	-	3	-	3	-	-	-	-	-	3
2	3	3	3	3	-	3	-	-	3	-	-	-	-	-	-	-	3
3	3	3	3	-	3		-	-	3	-	-	-	-	-	-	-	3
4	3	3	3	-	-	3	-	-	3	-	-	-	-	-	-	-	3
5	3	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – II Semester							
Course Code	22UME15			L	T	P	SS	C
Course Name	THERMAL ENGINEERING			3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. To make the student learn and understand the reasons and affects of various losses that occur in the actual engine operation.
2. To familiarize the student with the various engine systems along with their function and necessity.
3. To learn about normal combustion phenomenon and knocking in S.I. and C.I. Engines and to find the several engine operating parameters that affect the smooth engine operation
4. To make the student learn to perform testing on S.I and C.I Engines for the calculations of performance and emission parameters

**UNIT-I**

**ST.ANN'S COLLEGE OF ENGINEERING & TECHNOLOGY: CHIRALA  
(AUTONOMOUS)  
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**Air standard Cycles:** otto, diesel and dual cycles, its comparison, Brayton cycle Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

**UNIT – II**

**I. C. ENGINES:** Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of wankle engine, principles of supercharging and turbocharging.

**UNIT – III**

**Combustion in S.I. Engines:** Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types. Combustion in C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

**UNIT-IV**

**Measurement, Testing and Performance:** Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

**UNIT – V**

**GAS TURBINES:** Simple gas turbine plant – ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –closed cycle type gas turbines.

**JET PROPULSION:** Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on t-s diagram - thrust, thrust power and propulsion efficiency – turbo jet engines – needs and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation (Definitions and Simple Problems).

**ROCKETS:** Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines.

**TEXT BOOKS:**

1. I.C. Engines - V. Ganesan- Tata McGraw Hill Publishers
2. Gas Turbines – V. Ganesan – Tata McGraw Hill Publishers.

**REFERENCES:**

1. Thermal Engineering - Mahesh Rathore- McGraw Hillpublishers
2. I.C. Engines–Applied Thermosciences – C.R.Ferguson &A.T.Kirkpatrick -2 nd Edition Wiley Publ
3. I.C. Engines - J.B.Heywood/McGrawHill
4. Heat engines, Vasandani& Kumar – Thermalpublications
5. Gas Turbine Theory – HIH Saravanamuttoo, Cohen, Rogers –Pearson Publishers

Upon completion of this course, students will gain the ability to:			
<b>CO NO.</b>	<b>COURSE OUTCOMES</b>	<b>BLOOM'S TAXONOMY</b>	<b>LEVEL</b>



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CO-1	Derive the actual cycle from fuel-air cycle and air-standard cycle for all practical applications.	Understanding	<b>L2</b>
CO-2	Explain working principle and various components of IC engine.	Applying	<b>L3</b>
CO-3	Explain combustion phenomenon of CI and SI engines and their impact on engine variables	Evaluate	<b>L5</b>
CO-4	Analyze the performance of an IC engine based on the performance parameters	Analyze and evaluating	<b>L4, L5</b>
CO-5	Explain the cycles and systems of a gas turbine and determine the efficiency of gas turbine and working principle of rockets and jet propulsion	Evaluate	<b>L5</b>

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
2	3	2	3	-	-	3	-	-	-	-	-	3	2	3	-	-
3	3	3	2	-	-	3	-	-	-	-	-	2	2	3	-	-
4	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
5	3	2	2	-	-	3	-	-	-	-	-	2	2	3	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – II Semester							
Course Code	22UME16			L	T	P	SS	C
Course Name	KINEMATICS OF MACHINES			3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. Purpose of kinematics, kinematic joints & mechanisms and also to study the relative motion of parts in a machine without considering forces.
2. Various mechanisms for Exact and Approximate straight-line motion and their applications including steering mechanisms.
3. Velocity & acceleration concepts for using graphical methods for different mechanisms.
4. Theories involved in cams, working principles and their applications and the various power transmission mechanisms and to study about their merits & demerits.
5. Different types of gears used in power transmissions, their profiles and Applications.

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**UNIT – I**

**MECHANISMS:** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – kinematic chain – inversion of mechanism – inversions of quadric cycle, single and double slider crank chains.

**UNIT – II**

**LOWER PAIR MECHANISM:** Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper, Watt, T. Chebicheff and Robert Mechanisms – Pantograph, Condition for correct steering – Types of steering gear mechanisms – Davis & Ackerman's steering gear mechanisms.

**UNIT – III**

**KINEMATICS:** Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Klein's construction, determination of Coriolis component of acceleration.

**PLANE MOTION OF BODY:** Instantaneous center of rotation, relative motion between two bodies – Three centers in line theorem – Graphical determination of instantaneous center, diagrams for simple mechanisms and determination of angular velocity of points and links.

**UNIT – IV**

**CAMS:** Definitions of cam and followers and their uses – Types of followers and cams – Terminology – Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Layout of cam profiles, Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

**BELT DRIVES:** Introduction, Belt and rope drives - types of belt drives, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, Length of open & cross belt drive, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Problems.

**UNIT – V**

**GEARS:** Higher pairs, friction wheels and toothed gears–types – law of gearing, Form of teeth: cycloidal and involute profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact, contact ratio, Problems, Introduction to Helical, Bevel and worm gearing.

**GEAR TRAINS:** Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

**TEXT BOOKS:**

1. Theory of Machines – S. S Rattan- TMH Publishers
2. Theory of Mechanisms & Machines - Dr. Jagdish lal – Metropolitan Book Co. Pvt. Ltd.

**REFERENCES:**

1. Theory of Machines – Thomas Bevan – CBS Publishers
2. Theory of Mechanisms and machines – A. Ghosh & A.K. Malik – East West Press Pvt. Ltd.
3. Mechanism and Machine theory – Ashok G. Ambekar – PHI Publishers

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4. Kinematics and dynamics of Machinery – R.L Norton – TMH Publishers

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	Use the different types of kinematic links, pairs and joints to produce relative motion between the parts in a mechanism.	Understand	2
2	Select a mechanism to obtain desired straight-line motion and also choose proper steering mechanism for an automobile.	Understand	2
3	Analyze & draw the velocity and acceleration diagrams using graphical methods for different mechanisms	Analyze	4
4	Select, identify and design the cam profile for various applications and choose a proper power transmission drive for the application by considering their merits & demerits	Understand & Evaluate	2, 5
5	Select and design the required gear for the power transmission based on the application	Understand & Evaluate	2, 5

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	NC	NC	NC	1	NC	1	NC	NC	1	2	3	1	1	1
2	3	3	NC	NC	NC	1	NC	1	NC	NC	1	2	3	1	1	1
3	3	3	1	NC	1	1	NC	1	NC	NC	1	2	3	3	2	1
4	3	3	3	NC	1	1	NC	1	NC	NC	1	2	3	3	2	1
5	3	3	3	NC	1	1	NC	1	NC	NC	1	2	3	3	2	1

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – II Semester							
Course Code	22UME17			L	T	P	SS	C
Course Name	RENEWABLE ENERGY SOURCES			3	1	0	0	3

**COURSE OBJECTIVES:**

The objective of this course is to make student understand the

1. Learn the fundamental concepts about solar energy systems and devices.
2. Design wind turbine blades and know about applications of wind energy for water pumping and electricity generation.
3. To know about Biomass energy, mini-micro hydro systems
4. Understand the working of OTEC system and different possible ways of extracting energy from ocean.
5. To understand the concepts of geothermal energy.

**UNIT-I**

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**SOLAR ENERGY:** Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar Pond electric power plant.

**Solar electric power generation-** Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.

**UNIT – II**

**WIND ENERGY:** Introduction, History of Wind Energy, Wind Energy Scenario of World and India. Basic principles of Wind Energy Conversion Systems (WECS), Types and Classification of WECS, Parts of WECS, Power, torque and speed characteristics, Electrical Power Output and Capacity Factor of WECS, stand alone, grid connected and hybrid applications of WECS, Economics of wind energy utilization, Site selection criteria, Wind farm, Wind rose diagram.

**UNIT – III**

**BIOMASS ENERGY:** Photosynthesis process, Biomass fuels, Biomass energy conversion technologies and applications, Urban waste to Energy Conversion, Biomass Gasification, Types and application of gasifier, Biomass to Ethanol Production, Biogas production from waste biomass, Types of biogas plants, Factors affecting biogas generation, Energy plantation, Environmental impacts and benefits, Future role of biomass, Biomass programs in India.

**UNIT-IV**

**TIDAL ENERGY:** Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation.

**UNIT – V**

**GEOHERMAL ENERGY:** Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications, MHD Power generation: concept and working principle, Environmental impacts, Economic and social considerations, Financing mechanisms, Carbon credits, clean development mechanisms.

**TEXT BOOKS:**

1. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
2. Nonconventional Energy sources, G D Rai, Khanna Publication, Fourth Edition.
3. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH.

**REFERENCES:**

1. Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New Age international.
2. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth & John F Kreider /Taylor & Francis.
3. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd.
4. Renewable Energy Technologies -Ramesh & Kumar /Narosa.
5. Non-conventional Energy Source- G.D Roy/Standard Publishers.
6. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd.

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7. Fuel Cell Technology -Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd.

Upon completion of this course, students will gain the ability to:			
CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
CO-1	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation.	Understanding And evaluate	L2, L5
CO-2	Understand the conversion principles of wind energy.	Understanding	L2
CO-3	Understand the concept of biomass energy resources.	Understanding	L2
CO-4	Acquire the basic knowledge of ocean thermal energy conversion and hydrogen energy	Understanding	L2
CO-5	Utilize the concepts of geothermal energy	Evaluate	L5

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
2	3	2	3	-	-	3	-	-	-	-	-	3	2	3	-	-
3	3	3	2	-	-	3	-	-	-	-	-	2	2	3	-	-
4	3	2	2	-	-	2	-	-	-	-	-	2	2	3	-	-
5	3	2	2	-	-	3	-	-	-	-	-	2	2	3	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – II Semester						
Course Code	22UMB02		L	T	P	SS	C
Course Name	PROFESSIONAL ETHICS AND HUMAN VALUES		1	0	0	0	0

**COURSE OBJECTIVES:**

1. To understand the concepts of human values.
2. To gain knowledge about the principles of engineering ethics.
3. To interpret engineering as social experimentation.
4. To understand engineers' responsibility for safety and risk.

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5. To gain knowledge about the engineers' rights and responsibilities.

**COURSE OUTCOMES:**

- CO1: Judge the concepts of human values.
- CO2: Justify knowledge about the principles of engineering ethics.
- CO3: Interpret engineering as social experimentation.
- CO4: Realize engineers' responsibility for safety and risk.
- CO5: Learn about the engineers' rights and responsibilities.

**UNIT – I**

**HUMAN VALUES:** Morals, Values and Ethics – Integrity – Work Ethics – Service Learning –Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time – Co-operation – Commitment – Empathy –Self-confidence – Spirituality- Character.

**UNIT – II**

**ENGINEERING ETHICS:** The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics-Consensus and Controversy –Professional and Professionalism – Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Types of Inquiry – Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

**UNIT – III**

**ENGINEERING AS SOCIAL EXPERIMENTATION:** Comparison with Standard Experiments – Knowledge gained –Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering.

**UNIT – IV**

**ENGINEERS' RESPONSIBILITY FOR SAFETY AND RISK:** Safety and Risk, Concept of Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk-Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

**UNIT – V**

**ENGINEERS' RESPONSIBILITIES AND RIGHTS:** Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty-obligations of Loyalty-misguided Loyalty – professionalism and Loyalty-Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self-interest, Customs and Religion- Ethical egoism-Collective bargaining-Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe-examples of Gifts v/s Bribes-problem solving-interests in other companies-Occupational Crimes-industrial espionage-price fixing-endangering lives-Whistle Blowing-types of whistle blowing-when should it be attempted-preventing whistle blowing.

**TEXT BOOKS:**

1. Engineering Ethics and Human Values by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. Professional Ethics and Morals by Prof.A.R.Aryasri, Dharanikota, Suyodhana-Maruthi Publications.

**REFERENCES:**

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1. Professional Ethics and Human Values by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications.
2. Professional Ethics and Human Values by Prof. D. R. Kiran, TMH.
3. Indian Culture, Values and Professional Ethics by P.S.R. Murthy-BS Publication.
4. Ethics in Engineering by Mike W. Martin and Roland Schinzinger– Tata McGraw-Hill – 2003.
5. Engineering Ethics by Harris, Pritchard and Robins, CENGAGE Learning, Indian Edition, 2009

<b>Year &amp; Sem</b>	<b>II Year – II Semester</b>					
<b>Course Code</b>	<b>22UME18</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>SS</b>	<b>C</b>
<b>Course Name</b>	<b>MANUFACTURING PROCESS LAB</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>1.5</b>

**COURSE OBJECTIVES:**

1. Examine the principles associated with basic operations involving the casting, forming and welding of engineering materials.
2. Interpret the advantages and limitations of each process and its influence on the properties of the material in the finished component

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3. To know the basic processes used in performing forming and welding operations on engineering materials

***NOTE: The students have to conduct at least 12 Experiments***

**List of Experiments:**

1. Design and making of pattern.
  - i. Single piece pattern
  - ii. Split pattern
2. Sand properties testing.
  - i. Sieve analysis (dry sand)
  - ii. Clay content test
  - iii. Moisture content test
  - iv. Strength test (Compression test & Shear test)
  - v. Permeability test
3. Mould preparation.
  - i. Dumble
  - ii. Gear blank
4. Gas cutting.
5. Gas welding
6. Manual metal arcwelding.
  - i. Lap joint
  - ii. Butt joint
7. Injection Molding.
8. Blow Molding.
9. Simple models using sheet metal operations.
10. Study of deep drawing and extrusion operations.
11. Study of Basic powder compaction and sintering.
12. Study of TIG Welding
13. Study of MIG Welding.
14. Study of Resistance Spot Welding.
15. Study of Brazing and soldering.

Upon completion of this course, students will gain the ability to:
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CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	Design and making of pattern and moulding	Analyze	4
2	Test the properties of moulding sands	Analyze	4
3	Understand the powder compaction and sintering process	Analyze	4
4	Fabricate joints using TIG, MIG and Arc welding	Analyze	4
5	Develop process maps for metal forming processes using plasticity principles.	Analyze	4

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
2	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
3	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
4	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
5	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-

(1-Low, 2-Medium, 3-High)

Year & Sem	II Year – II Semester						
Course Code	22UME19		L	T	P	SS	C
Course Name	THERMAL ENGINEERING LAB		0	0	3	0	1.5

**COURSE OBJECTIVES:**

1. To demonstrate the characteristics of two stroke and four stroke compression and spark ignition engines.
2. To determine flash point, fire point, calorific value of different fuels using various apparatus

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3. To determine engine friction, heat balance test, volumetric efficiency, load test of petrol and diesel engines
4. To demonstrate speed test, performance test and cooling temperature on petrol and diesel engines
5. To demonstrate performance test and determine efficiency of air compressor.
6. To understand the principles through assembly and disassembly of 2/3 wheelers, 2/4 stroke engines, tractor, heavy duty engines and boilers and their mountings and accessories.

**List of Experiments:**

1. To determine the actual Valve Timing diagram of a four stroke Compression/Spark Ignition Engine.
2. To determine the actual Port Timing diagram of a two stroke Compression/Spark Ignition Engine.
3. Determination of Flash & Fire points of Liquid fuels / Lubricants using (i) Abels Apparatus; (ii) Pensky Martin's apparatus and (iii) Cleveland's apparatus.
4. Determination of Viscosity of Liquid lubricants/Fuels using (i) Saybolt Viscometer and (ii) Redwood Viscometer.
5. Determination of Calorific value of Gaseous Fuels using Junkers Gas Calorimeter.
6. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol/diesel engine.
7. Evaluation of Engine Friction by Motoring/Retardation Test on a Single Cylinder 4 Stroke Petrol/Diesel Engine.
8. To perform the Heat Balance Test on Single Cylinder four Stroke Petrol/Diesel Engine.
9. Determination of Air/Fuel Ratio and Volumetric Efficiency on a four Stroke Petrol/Diesel Engine.
10. . To conduct a load test on a single cylinder Petrol/Diesel engine to study its performance under various loads.
11. To determine the optimum cooling temperature of a Petrol/Diesel engine.
12. To conduct economical speed test on a four stroke Petrol/Diesel engine.
13. To conduct a performance test on a VCR engine, under different compression ratios and determine its heat balance sheet.
14. To conduct a performance test on an air compressor and determine its different efficiencies
15. Dis-assembly / assembly of different parts of two wheelers. 3 wheelers & 4 wheelers. Tractor & Heavy-duty engines covering 2-stroke and 4 stroke, SI and CI engines

Upon completion of this course, students will gain the ability to:
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CO NO.	COURSE OUTCOMES	BLOOM'S TAXONOMY	LEVEL
1	Understand the characteristics of two stroke and four stroke compression and spark ignition engines	Understand	4
2	Analyze the flash point, fire point, calorific value of different fuels using various apparatus	Analyze	4
3	Conduct and analyze the speed test, performance test and cooling temperature on petrol and diesel engines.	Analyze	4
4	Determine efficiency of air compressor.	Analyze	4
5	Determine the efficiencies of various turbines and draw the characteristic curves.	Analyze	4

**MAPPING OF CO'S VS PO'S & PSO'S:**

CO	PO'S												PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
2	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
3	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
4	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-
5	3	3	-	-	-	-	-	-	2	3	1	2	3	-	-	-

(1-Low, 2-Medium, 3-High)