



**JAI SHRIRAM ENGINEERING COLLEGE, TIRUPPUR – 638 660**

**(An Autonomous Institution)**

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

Recognized by UGC & Accredited by NAAC and NBA (CSE and ECE)



## **REGULATION 2024**

# **B. E. MECHANICAL ENGINEERING**

**CURRICULUM FOR SEMESTERS I TO VIII**

**&**

**SYLLABUS FOR SEMESTERS I TO VI**





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**REGULATION 2024**  
**B.E.MECHANICAL ENGINEERING**  
**CHOICE BASED CREDIT SYSTEM**  
**CURRICULUM FOR SEMESTER I TO VIII**

**SEMESTER I**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	24UIP001	Induction Programme		-	-	-	0
<b>THEORY</b>							
2.	24UHS101	Professional English-I	HSM	3	0	0	3
3.	24UMA101	Matrices and Calculus	BS	3	1	0	4
4.	24UPH101	Engineering Physics	BS	3	0	0	3
5.	24UCY101	Engineering Chemistry	BS	3	0	0	3
6.	24UGE101	Problem Solving and Python Programming	ES	3	0	0	3
7.	24UHS102	தமிழர்மரபு / Heritage of Tamils	HSM	1	0	0	1
<b>PRACTICAL</b>							
8.	24UGE111	Problem Solving and Python Programming Laboratory	ES	0	0	4	2
9.	24UBS111	Physics and Chemistry Laboratory	BS	0	0	4	2
10.	24UHS111	English Laboratory	EE	0	0	2	1
<b>Total Credits</b>				<b>16</b>	<b>1</b>	<b>10</b>	<b>22</b>

**SEMESTER II**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>THEORY</b>							
1.	24UHS201	Professional English-II	HSM	2	0	0	2
2.	24UMA201	Statistical and Numerical Methods	BS	3	1	0	4
3.	24UME201	Engineering Mechanics	ES	3	1	0	4
4.	24UPH203	Material Science and Engineering	BS	3	0	0	3
5.	24UBE201	Basic Electrical and Electronics Engineering	ES	3	0	0	3
6.	24UHS202	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSM	1	0	0	1
<b>THEORY CUM PRACTICAL</b>							
7.	24UGEI201	Engineering Graphics and Drafting	ES	3	0	2	4
<b>PRACTICAL</b>							
8.	24UGE211	Engineering Fundamentals Laboratory	ES	0	0	4	2
9.	24UBE211	Basic Electrical and Electronics Engineering Laboratory	ES	0	0	4	2
10.	24UHS211	Communication Laboratory	EE	0	0	4	2
<b>Total Credits</b>				<b>18</b>	<b>2</b>	<b>14</b>	<b>27</b>

**SEMESTER III**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>THEORY</b>							
1.	24UMA301	Transforms and Partial Differential Equations	BS	3	1	0	4
2.	24UME301	Engineering Thermodynamics	PC	3	0	0	3
3.	24UME302	Manufacturing Processes	PC	3	0	0	3
4.	24UME303	Metrology and Measurements	PC	3	0	0	3
5.	24UME304	Computer Aided Design and Manufacturing	PC	3	0	0	3
<b>THEORY CUM PRACTICAL</b>							
6.	24UMEI301	Fluid Mechanics and Machinery	ES	2	1	2	4
<b>PRACTICAL</b>							
7.	24UME311	Computer Aided Machine Drawing	ES	1	0	2	2
<b>Total Credits</b>				<b>18</b>	<b>2</b>	<b>4</b>	<b>22</b>

**SEMESTER IV**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>THEORY</b>							
1.	24UME401	Hydraulics and Pneumatics	PC	3	0	0	3
2.	24UME402	Theory of Machines	PC	3	1	0	4
3.	24UME403	Manufacturing Technology	PC	3	0	0	3
4.	24UGE402	Environmental Science and Sustainability for Mechanical Engineers	BS	3	0	0	3
<b>THEORY CUM PRACTICAL</b>							
5.	24UMEI401	Strength of Materials	PC	2	1	2	4
6.	24UMEI402	Thermal Engineering	PC	3	0	2	4
<b>PRACTICAL</b>							
7.	24UME411	Manufacturing Technology Laboratory	PC	0	0	4	2
8.	24UME412	CAD/CAM Laboratory	PC	0	0	4	2
<b>Total Credits</b>				<b>17</b>	<b>2</b>	<b>12</b>	<b>25</b>

**SEMESTER V**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C	
<b>THEORY</b>								
1.	24UME501	Design of Machine Elements	PC	3	1	0	4	
2.	24UME502	Lean Manufacturing	PC	3	0	0	3	
3.	24UGE501	Human Values and Ethics	HSM	3	0	0	3	
4.		Professional Elective – I	PE	3	0	0	3	
5.		Open Elective – I	OE	3	0	0	3	
6.		Mandatory Course-I	Non credit					
<b>THEORY CUM PRACTICAL</b>								
7.	24UMEI501	Heat and Mass Transfer	PC	2	1	2	4	
<b>PRACTICAL</b>								
8.	24UME511	Metrology and Dynamics Laboratory	PC	0	0	4	2	
<b>Total Credits</b>				<b>17</b>	<b>2</b>	<b>6</b>	<b>22</b>	

**SEMESTER VI**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C	
<b>THEORY</b>								
1.	24UME601	Additive Manufacturing	PC	3	0	0	3	
2.	24UME602	Design of Transmission Systems	PC	3	0	0	3	
3.		Professional Elective – II	PE	3	0	0	3	
4.		Professional Elective – III	PE	3	0	0	3	
5.		Professional Elective – IV	PE	3	0	0	3	
6.		Open Elective – II	OE	3	0	0	3	
7.		Mandatory Course - II	Non Credit					
<b>PRACTICAL</b>								
8.	24UME611	Computer Aided Engineering Laboratory	PC	0	0	4	2	
9.	24UME612	Mini project	EE	0	0	4	2	
<b>Total Credits</b>				<b>18</b>	<b>0</b>	<b>8</b>	<b>22</b>	


**SEMESTER VII**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>THEORY</b>							
1.	24UME701	Industrial Automation and Smart Systems	PC	3	0	0	3
2.	24UMG701	Principles of Management	HSM	3	0	0	3
3.		Professional Elective – V	PE	3	0	0	3
4.		Professional Elective – VI	PE	3	0	0	3
5.		Open Elective - III	OE	3	0	0	3
<b>PRACTICAL</b>							
6.	24UME711	Summer Internship <sup>#</sup>	EE	0	0	0	2
<b>Total Credits</b>				<b>15</b>	<b>0</b>	<b>0</b>	<b>17</b>

#Two weeks Summer Internship carries one credit and it will be done during V and VI semester.

**SEMESTER VIII**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>PRACTICAL</b>							
1.	24UME811	Project Work/Internship	EE	0	0	20	10
<b>Total Credits</b>				<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>

  
**Head of the Department**  
 Department of Mechanical Engineering  
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 Tirupur-638 660. Tamil Nadu, India.

<b>PROFESSIONAL ELECTIVE-I</b>							
<b>S. No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	24UMEP501	Advanced Casting and Welding Processes	PE	3	0	0	3
2.	24UMEP502	Energy Storage Devices	PE	3	0	0	3
3.	24UMEP503	Power Plant Engineering	PE	3	0	0	3
4.	24UMEP504	Composite Materials	PE	3	0	0	3
5.	24UMEP505	Electrical Drives and Actuators	PE	3	0	0	3
6.	24UMEP506	Computer Numerical Control Technology	PE	3	0	0	3
<b>PROFESSIONAL ELECTIVE - II</b>							
1.	24UMEP601	Non-Destructive Testing	PE	3	0	0	3
2.	24UMEP602	Modern Robotics	PE	3	0	0	3
3.	24UMEP603	Smart Mobility and Intelligent Vehicles	PE	3	0	0	3
4.	24UMEP604	Gas Dynamics and Jet Propulsion	PE	3	0	0	3
5.	24UMEP605	Computer Integrated Manufacturing	PE	3	0	0	3
6.	24UMEP606	Electric Vehicle Technologies	PE	3	0	0	3
<b>PROFESSIONAL ELECTIVE-III</b>							
1.	24UMEP607	Micro and Nano Machining	PE	3	0	0	3
2.	24UMEP608	Product life Cycle management	PE	3	0	0	3
3.	24UMEP609	Renewable Energy technologies	PE	3	0	0	3
4.	24UMEP610	Turbo Machines	PE	3	0	0	3
5.	24UMEP611	Drone Technologies	PE	3	0	0	3
6.	24UMEP612	Logistics and Supply Chain Management	PE	3	0	0	3
<b>PROFESSIONAL ELECTIVE-IV</b>							
1.	24UMEP613	Mechatronics and IoT	PE	3	0	0	3
2.	24UMEP614	Non-Traditional Machining processes	PE	3	0	0	3
3.	24UMEP615	Process Planning and Cost Estimation	PE	3	0	0	3
4.	24UMEP616	Refrigeration and Air Conditioning	PE	3	0	0	3
5.	24UMEP617	Finite Element Analysis	PE	3	0	0	3
6.	24UMEP618	Operations Research	PE	3	0	0	3
<b>PROFESSIONAL ELECTIVE-V</b>							
1.	24UMEP701	Computational Fluid Dynamics	PE	3	0	0	3
2.	24UMEP702	Industrial Safety Engineering	PE	3	0	0	3
3.	24UMEP703	Bio Energy Conversion Technologies	PE	3	0	0	3
4.	24UMEP704	Automobile Engineering	PE	3	0	0	3
5.	24UMEP705	New Product Development	PE	3	0	0	3
6.	24UMEP706	Quality and Reliability Engineering	PE	3	0	0	3

PROFESSIONAL ELECTIVE-VI							
1.	24UMEP707	Design for Manufacturing and Assembly	PE	3	0	0	3
2.	24UMEP708	Equipment for Pollution Control	PE	3	0	0	3
3.	24UMEP709	Testing of Materials	PE	3	0	0	3
4.	24UMEP710	Sensors and Instrumentations	PE	3	0	0	3
5.	24UMEP711	Design of Production Tooling	PE	3	0	0	3
6.	24UMEP712	Maintenance Engineering	PE	3	0	0	3

MANDATORY COURSES I							
1.	24UMC801	Introduction to Women and Gender Studies	MC	3	0	0	0
2.	24UMC802	Automotive Safety	MC	3	0	0	0
3.	24UMC803	State, Nation Building and Politics in India	MC	3	0	0	0
4.	24UMC804	Disaster Risk Reduction and Management	MC	3	0	0	0
5.	24UMC805	Film Appreciation	MC	3	0	0	0
6.	24UMC806	Elements of Literature	MC	3	0	0	0
7.	24UMC807	Inclusive Work Culture	MC	3	0	0	0
8.	24UMC808	Quality Systems	MC	3	0	0	0
9.	24UMC809	Industrial Practices and Requirements	MC	3	0	0	0

MANDATORY COURSES II							
1.	24UMC901	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	0
2.	24UMC902	History of Science and Technology in India	MC	3	0	0	0
3.	24UMC903	Political and Economic Thought for a Humane Society	MC	3	0	0	0
4.	24UMC904	Industrial Safety	MC	3	0	0	0
5.	24UMC905	Quantitative and verbal proficiency	MC	3	0	0	0
6.	24UMC906	Industrial Hydraulic Circuits	MC	3	0	0	0
7.	24UMC907	Electrical Safety	MC	3	0	0	0

#### OPEN ELECTIVE

1.	24UCEO01	Augmented Reality /Virtual Reality	OE	3	0	0	3
2.	24UCEO02	Remote Sensing Concepts	OE	3	0	0	3
3.	24UCEO03	Geographical Information System	OE	3	0	0	3
4.	24UCEO04	Fire Safety Engineering	OE	3	0	0	3
5.	24UCSO01	Java Programming	OE	3	0	0	3
6.	24UCSO02	UI & UX Design	OE	3	0	0	3
7.	24UCSO03	Cloud Computing	OE	3	0	0	3
8.	24UCSO04	Data Science	OE	3	0	0	3
10.	24UEEO02	Hybrid Electric Vehicles	OE	3	0	0	3

11.	24UEEO03	PLC and SCADA	OE	3	0	0	3
12.	24UEEO04	Energy Conservation & Management	OE	3	0	0	3
13.	24UEEO05	Fundamentals of Electronic Devices	OE	3	0	0	3
14.	24UEEO06	Batteries and Management System	OE	3	0	0	3
15.	24UEEO07	Sensors and Actuators	OE	3	0	0	3
16.	24UEEO08	Electrical, Electronic & Magnetic Materials	OE	3	0	0	3
17.	24UECO01	Basics of Communication Technologies	OE	3	0	0	3
18.	24UECO02	Image Processing	OE	3	0	0	3
19.	24UECO03	Basics of IoT	OE	3	0	0	3
20.	24UECO04	Introduction to PLC Programming	OE	3	0	0	3
21.	24UECO05	Sensors for Engineering Applications	OE	3	0	0	3
22.	24UECO06	Industry 4.0 and Industrial IoT	OE	3	0	0	3
23.	24UFTO01	Basics of Textile Technology	OE	3	0	0	3
24.	24UFTO02	Fundamentals of Fashion Design	OE	3	0	0	3
25.	24UFTO03	Garment Manufacturing Technology	OE	3	0	0	3
26.	24UFTO04	Retail Management	OE	3	0	0	3
27.	24UFTO05	Industrial Engineering for Garment Industry	OE	3	0	0	3
28.	24UFTO06	Fashion Branding and Advertisement	OE	3	0	0	3
29.	24UMEO01	Fundamentals of Robotics	OE	3	0	0	3
30.	24UMEO02	Nano Technology	OE	3	0	0	3
31.	24UMEO03	Reverse Engineering	OE	3	0	0	3
32.	24UMEO04	Industrial Engineering	OE	3	0	0	3
33.	24UMEO05	Introduction to Additive Manufacturing	OE	3	0	0	3
34.	24UMEO06	Energy Conservation in Industries	OE	3	0	0	3
35.	24UITO01	Digital Image Processing and Its Applications	OE	3	0	0	3
36.	24UITO02	Fundamentals of Databases	OE	3	0	0	3
37.	24UITO03	Internet Programming	OE	3	0	0	3
38.	24UITO04	Fundamentals of Internet of Things	OE	3	0	0	3
39.	24UITO05	Fundamentals of Blockchain	OE	3	0	0	3

*Arun*

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**SUMMARY**

<b>B.E. MECHANICAL ENGINEERING</b>										
S. No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSM	4	3			3		3		13
2	BS	12	7	4	3					26
3	ES	5	15	6						26
4	PC			12	22	13	8	3		58
5	PE					3	9	6		18
6	OE					3	3	3		09
7	EE	1	2				2	2	10	17
8	Non-Credit /(Mandatory)					√	√			
<b>Total</b>		<b>22</b>	<b>27</b>	<b>22</b>	<b>25</b>	<b>22</b>	<b>22</b>	<b>17</b>	<b>10</b>	<b>167</b>

Total Credits for the entire Programme: 167

**COMPARISON OF CREDIT SUMMARY**

S. No	Course Components	AICTE Recommendation		Anna University Curriculum R2021		JSREC Autonomous Curriculum R2024	
		Credits	% Credits	Credits	% Credits	Credits	% Credits
1	Humanities, Social Science and Management (HSM)	12	8%	13	8%	13	8%
2	Basic Sciences (BS)	29	18%	25	15%	26	16%
3	Engineering Sciences (ES)	27	17%	24	14%	26	16%
4	Professional Core (PC)	58	36%	56	34%	58	35%
5	Professional Electives (PE)	9	6%	21	13%	18	11%
6	Open Electives (OE)	9	6%	12	7%	09	5%
7	Employment Enhancement Course (EE)	16	10%	13	8%	17	10%
8	Mandatory (Non-Credit Course (MC)	-	-	-	-	√	√
<b>TOTAL CREDITS</b>		<b>160</b>	<b>100%</b>	<b>167</b>	<b>100%</b>	<b>167</b>	<b>100%</b>



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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR I SEMESTER**



24UHS101	PROFESSIONAL ENGLISH I (Common to all Branches)	L	T	P	C
		3	0	0	3

**Prerequisites:**

- Basic Knowledge in Language usage

**COURSE OBJECTIVES:**

- To improve the communicative competence of learners
- To learn to use basic grammatical structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals

<b>UNIT-I</b>	<b>INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION</b>	<b>9</b>
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).		
<b>UNIT-II</b>	<b>NARRATION AND SUMMATION</b>	<b>9</b>
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar -Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.		
<b>UNIT-III</b>	<b>DESCRIPTION OF A PROCESS / PRODUCT</b>	<b>9</b>
Reading - Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).		
<b>UNIT-IV</b>	<b>CLASSIFICATION AND RECOMMENDATIONS</b>	<b>9</b>
Reading - Newspaper articles; Journal reports -and Non Verbal Communication (tables, pie charts etc., ). Writing - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) Grammar - Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.		
<b>UNIT-V</b>	<b>EXPRESSION</b>	<b>9</b>
Reading - Reading editorials; and Opinion Blogs; Writing - Essay Writing (Descriptive or narrative). Grammar - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, 27 Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions - Content vs Function words.		

L: 45	T: 00	P: 00	Total : 45 Periods
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**TEXT BOOKS**

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

**REFERENCES**

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

**WEB RESOURCES**

- [https://www.lisedunetwork.com/the-fundamentals-of-communication/#google\\_vignette](https://www.lisedunetwork.com/the-fundamentals-of-communication/#google_vignette)
- <http://hdl.handle.net/10603/58170>
- <https://www.vedantu.com/english/narration>
- <https://asana.com/resources/product-development-process>
- <https://onlinelibrary.wiley.com/doi/10.1155/2019/8043905>

**COURSE OUTCOMES**

**At the end of the course students should be able to**

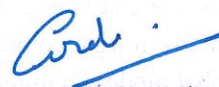
CO1 To use appropriate words in a professional context

CO2 To gain understanding of basic grammatical structures and use them in right context

CO3 To read and infer the denotative and connotative meanings of technical texts

CO4 To read and interpret information presented in tables, charts and other graphic forms

CO5 To write definitions, descriptions, narrations and essays on various topics



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24UMA101	MATRICES AND CALCULUS (Common to All Branches)	L	T	P	C
		3	1	0	4

**Prerequisites:**

- Knowledge in Basic Calculus

**COURSE OBJECTIVES:**

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

<b>UNIT-I</b>	<b>MATRICES</b>	<b>9 + 3</b>
Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.		

<b>UNIT-II</b>	<b>DIFFERENTIAL CALCULUS</b>	<b>9 + 3</b>
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.		

<b>UNIT-III</b>	<b>FUNCTIONS OF SEVERAL VARIABLES</b>	<b>9 + 3</b>
Partial differentiation – Homogeneous functions and Euler’s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers.		

<b>UNIT-IV</b>	<b>INTEGRAL CALCULUS</b>	<b>9 + 3</b>
Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.		

<b>UNIT-V</b>	<b>MULTIPLE INTEGRALS</b>	<b>9 + 3</b>
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.		

<b>L:45</b>	<b>T: 15</b>	<b>P: 00</b>	<b>Total : 60 Periods</b>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.</li> <li>2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44<sup>th</sup> Edition, 2018.</li> <li>3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8<sup>th</sup> Edition, New Delhi, 2015. [For Units II &amp; IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].</li> </ol>
<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10<sup>th</sup> Edition, 2016</li> <li>2. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.</li> <li>3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5<sup>th</sup> Edition, 2016.</li> <li>4. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.</li> <li>5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.</li> <li>6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics "Oxford University Press, 2015.</li> <li>7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus ", 14<sup>th</sup> Edition, Pearson India, 2018.</li> </ol>
<b>WEB RESOURCES</b>
<ul style="list-style-type: none"> <li>• <a href="http://explained.ai/matrix-calculus/index.html">http://explained.ai/matrix-calculus/index.html</a></li> <li>• <a href="https://www.comp.nus.edu.sg/~cs5240/lecture/matrix-differentiation.pdf">https://www.comp.nus.edu.sg/~cs5240/lecture/matrix-differentiation.pdf</a></li> <li>• <a href="https://github.com/LynnHo/Matrix-Calculus">https://github.com/LynnHo/Matrix-Calculus</a></li> <li>• <a href="https://nptel.ac.in/">https://nptel.ac.in/</a></li> </ul>
<b>COURSE OUTCOMES</b>
<p>At the end of the course students should be able to</p> <p>CO1 Use the matrix algebra methods for solving practical problems.</p> <p>CO2 Apply differential calculus tools in solving various application problems.</p> <p>CO3 Able to use differential calculus ideas on several variable functions.</p> <p>CO4 Apply different methods of integration in solving practical problems.</p> <p>CO5 Apply multiple integral ideas in solving areas, volumes and other practical problems.</p>



**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UPH101	ENGINEERING PHYSICS (Common to All Branches)	L	T	P	C
		3	0	0	3

**Prerequisites:**

Nil

**COURSE OBJECTIVES:**

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

<b>UNIT-I</b>	<b>MECHANICS</b>	<b>9</b>
<p>Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.</p>		

<b>UNIT-II</b>	<b>ELECTROMAGNETIC WAVES</b>	<b>9</b>
<p>The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.</p>		

<b>UNIT-III</b>	<b>OSCILLATIONS, OPTICS AND LASERS</b>	<b>9</b>
<p>Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.</p>		

<b>UNIT-IV</b>	<b>BASIC QUANTUM MECHANICS</b>	<b>9</b>
<p>Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.</p>		

<b>UNIT-V</b>	<b>APPLIED QUANTUM MECHANICS</b>	<b>9</b>
<p>The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.</p>		

L:45	T: 00	P: 00	Total : 45 Periods
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**TEXT BOOKS**

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M. Purcell and D.J. Morin, Electricity and Magnetism, Cambridge Univ. Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.

**REFERENCES**

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N. Garcia, A.Damask and S. Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

**WEB RESOURCES**

- <https://www.youtube.com/watch?v=caitynfev64>
- <https://youtu.be/SqhWxOjBb74>
- <https://youtu.be/F11MHPDd5D8>
- <https://youtu.be/NGGSROr3Tlc>
- <https://youtu.be/b-w4TSkhlhE>

**COURSE OUTCOMES**

At the end of the course, students should be able to

CO1 Understand the importance of mechanics.

CO2 Express their knowledge in electromagnetic waves.

CO3 Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4 Understand the importance of quantum physics.

CO5 Compare and apply quantum mechanical principles towards the formation of energy bands.

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UCY101	ENGINEERING CHEMISTRY (Common to all Branches)	L	T	P	C
		3	0	0	3

<b>Prerequisites:</b>
Nil

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>To inculcate sound understanding of water quality parameters and water treatment techniques.</li> <li>To impart knowledge on the basic principles and preparatory methods of nanomaterials.</li> <li>To introduce the basic concepts and applications of phase rule and composites</li> <li>To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.</li> <li>To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.</li> </ul>

<b>UNIT-I</b>	<b>WATER AND ITS TREATMENT</b>	<b>9</b>
<p>Water: Sources and impurities, Water quality parameters: Definition and significance of- color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &amp; foaming. Treatment of boiler feed water: Internal treatment (Phosphate, Colloidal, Sodium aluminate and Calgon conditioning) and External treatment—Ion exchange demineralization and Zeolite process.</p>		

<b>UNIT-II</b>	<b>NANO CHEMISTRY</b>	<b>9</b>
<p>Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.</p>		


<b>UNIT-III</b>	<b>PHASE RULE AND COMPOSITES</b>	<b>9</b>
<p>Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition &amp; Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.</p>		

<b>UNIT-IV</b>	<b>FUELS AND COMBUSTION</b>	<b>9</b>
<p>Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil- cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO<sub>2</sub> emission and carbon footprint.</p>		

UNIT-V	ENERGY SOURCES AND STORAGE DEVICES	9
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; Electric vehicles - working principles; Fuel cells: H <sub>2</sub> -O <sub>2</sub> fuel cell, microbial fuelcell; Super capacitors: Storage principle, types and examples.		

L:45	T: 00	P: 00	Total : 45 Periods
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TEXT BOOKS
<ol style="list-style-type: none"> <li>1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17<sup>th</sup> Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.</li> <li>2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.</li> <li>3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12<sup>th</sup> Edition, 2018.</li> </ol>
REFERENCES
<ol style="list-style-type: none"> <li>1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.</li> <li>2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2<sup>nd</sup> Edition, 2017.</li> <li>3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.</li> <li>4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.</li> <li>5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2<sup>nd</sup> Edition, 2013.</li> </ol>
WEB RESOURCES
<ul style="list-style-type: none"> <li>• <a href="https://testbook.com/ias-preparation/water-treatment">https://testbook.com/ias-preparation/water-treatment</a></li> <li>• <a href="https://onlinelibrary.wiley.com/doi/full/10.1002/nano.202300038">https://onlinelibrary.wiley.com/doi/full/10.1002/nano.202300038</a></li> <li>• <a href="https://www.pratapsir.com/2023/01/notes-on-phase-rule_21.html">https://www.pratapsir.com/2023/01/notes-on-phase-rule_21.html</a></li> <li>• <a href="https://en.wikipedia.org/wiki/Fuel">https://en.wikipedia.org/wiki/Fuel</a></li> </ul>
COURSE OUTCOMES
<p><b>At the end of the course students should be able</b></p> <p>CO1 To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.</p> <p>CO2 To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.</p> <p>CO3 To apply the knowledge of phase rule and composites for material selection requirements.</p> <p>CO4 To recommend suitable fuels for engineering processes and applications.</p> <p>CO5 To recognize different forms of energy resources and apply them for suitable applications in energy sectors.</p>

  
 Head of the Department  
 Department of Mechanical Engineering  
 Jai Shriram Engineering College  
 Dharapuram Road, Avinashpalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UGE101	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to All Branches)	L	T	P	C
		3	0	0	3

<b>Prerequisites:</b>
Nil

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>● To understand the basics of algorithmic problem solving.</li> <li>● To learn to solve problems using Python conditionals and loops.</li> <li>● To define Python functions and use function calls to solve problems.</li> <li>● To use Python data structures - lists, tuples, dictionaries to represent complex data.</li> <li>● To do input/output with files in Python.</li> </ul>

<b>UNIT-I</b>	<b>COMPUTATIONAL THINKING AND PROBLEM SOLVING</b>	<b>9</b>
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		

<b>UNIT-II</b>	<b>DATA TYPES, EXPRESSIONS, STATEMENTS</b>	<b>9</b>
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		

<b>UNIT-III</b>	<b>CONTROL FLOW, FUNCTIONS, STRINGS</b>	<b>9</b>
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		

<b>UNIT-IV</b>	<b>LISTS, TUPLES, DICTIONARIES</b>	<b>9</b>
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		

<b>UNIT-V</b>	<b>FILES, MODULES, PACKAGES</b>	<b>9</b>
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total: 45 PERIODS</b>
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**TEXT BOOKS**

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2<sup>nd</sup> Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1<sup>st</sup> Edition, BCS Learning & Development Limited, 2017.

**REFERENCES**

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1<sup>st</sup> Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1<sup>st</sup> Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2<sup>nd</sup> Edition, No Starch Press, 2019.
5. Martin C. Brown, "Python: The Complete Reference", 4<sup>th</sup> Edition, Mc-Graw Hill, 2018.


**WEB RESOURCES**

- <https://www.python.org/>
- <https://nptel.ac.in/courses/106106145/>

**COURSE OUTCOMES**

Upon completion of the course, the students will be able to

- CO1 Develop algorithmic solutions to simple computational problems and execute simple Python programs.
- CO2 Write simple Python programs using conditionals and loops for solving problems.
- CO3 Decompose a Python program into functions.
- CO4 Represent compound data using Python lists, tuples, dictionaries etc.
- CO5 Read and write data from/to files in Python programs.

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UHS102	HERITAGE OF TAMILS (Common to All Branches)	L	T	P	C
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**Prerequisites:**

Nil

**COURSE OBJECTIVES:**

- Appreciate weaving and ceramic technology.
- Learn the design and construction technology of ancient times.
- Understand the engineering principles of manufacturing technology.
- Introduce the methods of irrigation and agricultural technology.
- Learn the scientific tamil and tamil computing.

<b>UNIT I</b>	<b>LANGUAGE AND LITERATURE</b>	<b>3</b>
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Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

<b>UNIT II</b>	<b>HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE</b>	<b>3</b>
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Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yash and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

<b>UNIT III</b>	<b>FOLK AND MARTIAL ARTS</b>	<b>3</b>
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Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

<b>UNIT IV</b>	<b>THINAI CONCEPT OF TAMILS</b>	<b>3</b>
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Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

<b>UNIT V</b>	<b>CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE</b>	<b>3</b>
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Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

L:15	T: 00	P: 00	Total : 15 Periods
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### TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே .பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் -முனைவர் இல .சுந்தரம்.(விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K.Pillay) A Joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The classical Period (Dr. S. Singaravelu) (Published by: International institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: Institute of Tamil Studies).
8. The Contribution of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: Institute of Tamil Studies).
9. Keeladi – Sangam City Civilization on the banks of banks of river Vaigai' (Jointly Published by: Department of archaeology & Tamil Nadu Text book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (published by: The Author).
11. Porunai Civilization (jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UHS102	Heritage of Tamils / தமிழர் மரபு (Common to All Branches)	L	T	P	C
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அலகு I	மொழி மற்றும் இலக்கியம்	3
<p>இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள் , தமிழகத்தில் சமண, பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம் , ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.</p>		

அலகு II	மரபு- பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை	3
<p>நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.</p>		

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3
<p>தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.</p>		

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3
<p>தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி</p>		

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3
<p>இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு .</p>		

L:15	T: 00	P: 00	Total : 15 Periods
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### TEXT-CUM-REFERENCE BOOKS

13. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே .பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
14. கணினித் தமிழ் -முனைவர் இல .சுந்தரம்.(விகடன் பிரசுரம்).
15. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
16. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
17. Social Life of Tamils (Dr. K. K.Pillay) A Joint publication of TNTB & ESC and RMRL – (in print)
18. Social Life of the Tamils – The classical Period (Dr. S. Singaravelu) (Published by: International institute of Tamil Studies).
19. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: Institute of Tamil Studies).
20. The Contribution of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: Institute of Tamil Studies).
21. Keeladi – Sangam City Civilization on the banks of banks of river Vaigai' (Jointly Published by: Department of archaeology & Tamil Nadu Text book and Educational Services Corporation, Tamil Nadu)
22. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (published by: The Author).
23. Porunai Civilization (jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
24. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UBS111	PHYSICS AND CHEMISTRY LABORATORY (Common to All Branches)	L	T	P	C
		0	0	4	2

### PHYSICS EXPERIMENTS (Any Seven Experiments)

<b>Prerequisites:</b>
Nil

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>• To learn the proper use of various kinds of physics laboratory equipment.</li> <li>• To learn how data can be collected, presented and interpreted in a clear and concise manner.</li> <li>• To learn problem solving skills related to physics principles and interpretation of experimental data.</li> <li>• To determine error in experimental measurements and techniques used to minimize such error.</li> <li>• To make the student an active participant in each part of all lab exercises.</li> </ul>

<ol style="list-style-type: none"> <li>1. Torsion pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.</li> <li>2. Simple harmonic oscillations of cantilever.</li> <li>3. Non-uniform bending - Determination of Young's modulus.</li> <li>4. Uniform bending -- Determination of Young's modulus.</li> <li>5. Laser- Determination of the wave length of the laser using grating.</li> <li>6. Air wedge - Determination of thickness of a thin sheet/wire.</li> <li>7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle. b) Compact disc- Determination of width of the groove using laser.</li> <li>8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.</li> <li>9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.</li> <li>10. Post office box -Determination of Band gap of a semiconductor.</li> <li>11. Photoelectric effect.</li> <li>12. Michelson Interferometer.</li> <li>13. Melde's string experiment.</li> <li>14. Experiment with lattice dynamics kit.</li> </ol>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Marko Pinteric, Building Physics, Springer 2017.</li> <li>2. D.S.Mathur. Elements of Properties of Matter. S Chand &amp; Company, 2010.</li> <li>3. Hugo Hens, Building Physics: Heat, Air and Moisture, Wiley, 2017.</li> </ol>

<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. W.R.Stevens. Building Physics: Lighting. Pergamon Press, 2013.</li> <li>2. Hugo Hens, Applied Building Physics, Wiley, 2016.</li> <li>3. K.G.Budinski and M.K.Budinski. Engineering Materials: Properties and Selection. Pearson Education, 2016.</li> <li>4. Peter A. Claisse, Civil Engineering Materials, Elsevier, 2016.</li> </ol>

24UGE111	<b>PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY</b> (Common to All Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		0	0	4	2

<b>Prerequisites:</b>
Nil

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>● To understand the basics of algorithmic problem solving.</li> <li>● To learn to solve problems using Python conditionals and loops.</li> <li>● To define Python functions and use function calls to solve problems.</li> <li>● To use Python data structures - lists, tuples, dictionaries to represent complex data.</li> <li>● To do input/output with files in Python.</li> </ul>

S.No.	LIST OF EXERCISES:
1	I/O statements, operators, expressions
2	Decision-making constructs: if-else, goto, switch-case, break-continue
3	Loops: for, while, do-while
4	Arrays: 1D and 2D, Multi-dimensional arrays
5	Strings: operations
6	Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7	Recursion
8	Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9	Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10	Files: reading and writing, file operations, Sequential Access ,Random Access

<b>L:0</b>	<b>P:60</b>	<b>T:0</b>	<b>Total: 60 PERIODS</b>
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<b>COURSE OUTCOMES</b>
Upon completion of the course, the students will be able to
CO1: Demonstrate knowledge on C programming constructs develop programs in C using basic constructs.
CO2: Develop programs in C using arrays.
CO3: Develop applications in C using strings, pointers, functions.
CO4: Develop applications in C using structures.
CO5: Develop applications in C using file processing.
<b>LIST OF EQUIPMENTS REQUIRED</b>
<b>HARDWARE REQUIREMENTS</b>
Standard PC
<b>SOFTWARE REQUIREMENTS</b>
1. Windows 7 or higher
2. Python latest version

**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

**COURSE OUTCOMES**

Upon completion of the course, the students should be able to

- CO1 Understand the functioning of various physics laboratory equipment.
- CO2 Use graphical models to analyze laboratory data.
- CO3 Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- CO4 Access, process and analyze scientific information.
- CO5 Solve problems individually and collaboratively.

**TOTAL: 30 PERIODS**

**CHEMISTRY EXPERIMENTS**

(Any Seven Experiments to be conducted)

**COURSE OBJECTIVES:**

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.

1. Preparation of  $\text{Na}_2\text{CO}_3$  as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in a water sample. Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using a flame photometer.
13. Preparation of nanoparticles ( $\text{TiO}_2/\text{ZnO}/\text{CuO}$ ) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

**TEXT BOOKS**

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

**WEB RESOURCES**

- <https://en.wikipedia.org/wiki/Titration>
- [https://en.wikipedia.org/wiki/Conductivity\\_\(electrolytic\)](https://en.wikipedia.org/wiki/Conductivity_(electrolytic)).

**COURSE OUTCOMES**

At the end of the course students should be able

CO1 To analyse the quality of water samples with respect to their acidity, alkalinity and hardness.

CO2 To determine the amount of metal ions through volumetric and spectroscopic techniques

CO3 To analyse and determine the composition of alloys.

CO4 To learn simple method of synthesis of nanoparticles.

CO5 To quantitatively analyse the impurities in solution by electroanalytical Techniques.

**TOTAL: 30 PERIODS**

<b>L: 00</b>	<b>T: 00</b>	<b>P: 60</b>	<b>Total : 60 Periods</b>
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**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashpalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UHS111	ENGLISH LABORATORY (Common to all Branches)	L	T	P	C
		0	0	2	1

**Prerequisites:**

- Basic Knowledge in Language usage

**COURSE OBJECTIVES:**

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts
- To use language efficiently in expressing their opinions via various media

<b>UNIT-I</b>	<b>INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION</b>	<b>6</b>
Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - 42 politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions( filling out a bank application for example).		

<b>UNIT-II</b>	<b>NARRATION AND SUMMATION</b>	<b>6</b>
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings engaging in small talk- describing requirements and abilities.		

<b>UNIT-III</b>	<b>DESCRIPTION OF A PROCESS / PRODUCT</b>	<b>6</b>
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.		

<b>UNIT-IV</b>	<b>CLASSIFICATION AND RECOMMENDATIONS</b>	<b>6</b>
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation.		

<b>UNIT-V</b>	<b>EXPRESSION</b>	<b>6</b>
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking -making predictions- talking about a given topic-giving opinions-understanding a website-describing processes		

<b>L: 00</b>	<b>T: 00</b>	<b>P: 30</b>	<b>Total : 30 Periods</b>
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### WEB RESOURCES

- [https://www.lisedunetwork.com/the-fundamentals-of-communication/#google\\_vignette](https://www.lisedunetwork.com/the-fundamentals-of-communication/#google_vignette)
- <http://hdl.handle.net/10603/58170>
- <https://www.vedantu.com/english/narration>
- <https://asana.com/resources/product-development-process>
- <https://onlinelibrary.wiley.com/doi/10.1155/2019/8043905>

### COURSE OUTCOMES

**At the end of the course students should be able to**

CO1 To listen to and comprehend general as well as complex academic information

CO2 To listen to and understand different points of view in a discussion

CO3 To speak fluently and accurately in formal and informal communicative contexts

CO4 To describe products and processes and explain their uses and purposes clearly and accurately

CO5 To express their opinions effectively in both formal and informal discussions



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai  
Recognized by UGC & Accredited by NAAC and NBA (CSE and ECE)



**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR II SEMESTER**



24UHS201	PROFESSIONAL ENGLISH II (Common to all Branches)	L	T	P	C
		2	0	0	2

**Prerequisites:**

- Basic Knowledge in Language usage

**COURSE OBJECTIVES:**

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

<b>UNIT-I</b>	<b>MAKING COMPARISONS</b>	<b>6</b>
Reading – Reading comprehension task :Reading strategies, Methods - skimming, scanning, paraphrasing vs summarizing, Reading advertisements, user manuals, brochures; Proforma invoices Writing – Professional emails, Email etiquette, Creative Writing-Content writing, blog writing , Grammar –Preposition & Prepositional phrases Vocabulary – Words on Engineering materials		

<b>UNIT-II</b>	<b>EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING</b>	<b>6</b>
Reading - Reading longer technical texts, Reading short articles& Journals Writing -Writing responses to complaints, Letters / emails of complaint, writing a travelogue, Agenda with Minutes of meeting(MoM), Cause and Effect Essays, Grammar - If conditional sentences, Active & Passive Voice transformations,		

<b>UNIT-III</b>	<b>PROBLEM SOLVING</b>	<b>6</b>
Reading - Case Studies, excerpts from literary texts, etc. Writing – Letter to the Editor, Sequence of Jumbled paragraph, Checklists, Hints Development - Problem solution essay / Argumentative Essay. Grammar – Error correction; Modals Vocabulary – Idioms and phrases.		

<b>UNIT-IV</b>	<b>REPORTING OF EVENTS AND RESEARCH</b>	<b>6</b>
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Structure of Reports-Accident Report, Survey Report, Project Report Grammar – Reported Speech, Vocabulary – Conjunctions.		

<b>UNIT-V</b>	<b>THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY</b>	<b>6</b>
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Business communication letters, Grammar – Numerical adjectives, Relative Clauses, Vocabulary – Infinitive and Gerunds.		

<b>L:30</b>	<b>T: 00</b>	<b>P: 00</b>	<b>Total : 30 Periods</b>
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**TEXT BOOKS**

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

**REFERENCES**

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003.
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

**WEB RESOURCES**

- <https://academicguides.waldenu.edu/writingcenter/grammar/comparisons#:~:text=Adjectives%20and%20adverbs%20can%20be,to%20hedge%20or%20boost%20language.>
- <https://www.linkedin.com/pulse/causality-expressed-natural-language-text-vivek-khetan>
- <https://www.sessionlab.com/blog/problem-solving-techniques/>

**COURSE OUTCOMES**

**At the end of the course students should be able to**

- CO1 Compare and contrast products and ideas in technical texts  
CO2 Identify cause and effects in events, industrial processes through technical texts  
CO3 Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format  
CO4 Report events and the processes of technical and industrial nature  
CO5 Present their opinions in a planned and logical manner, and draft effective resumes in context of job search



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMA201	STATISTICS AND NUMERICAL METHODS (Common to All Branches)	L	T	P	C
		3	1	0	4

**Prerequisites:**

- Basic Knowledge in Scientific Calculator usage

**COURSE OBJECTIVES:**

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems?
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical
- Techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

<b>UNIT-I</b>	<b>TESTING OF HYPOTHESIS</b>	<b>9 + 3</b>
Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes. Application of chi square test.		

<b>UNIT-II</b>	<b>DESIGN OF EXPERIMENTS</b>	<b>9 + 3</b>
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design. Application of Design of experiment SPSS software (Practical oriented).		

<b>UNIT-III</b>	<b>SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS</b>	<b>9 + 3</b>
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.		

<b>UNIT-IV</b>	<b>INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION</b>	<b>9 + 3</b>
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		

<b>UNIT-V</b>	<b>NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS</b>	<b>9 + 3</b>
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.		

<b>L:45</b>	<b>T: 15</b>	<b>P: 00</b>	<b>Total : 60 Periods</b>
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### TEXT BOOKS

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

### REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7<sup>th</sup> Edition, 2007.
4. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12<sup>th</sup> Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4<sup>th</sup> Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9<sup>th</sup> Edition, Pearson Education, Asia, 2010.

### WEB RESOURCES

- <http://www.davidmlane.com/hyperstat/index.html>
- <http://www.robertniles.com/stats/>
- <http://webserv.jcu.edu/math/ISEP/ISEP.htm>
- <http://rt.uits.iu.edu/visualization/analytics/stats/spss-getting-started-windows.php>
- <http://www.ats.ucla.edu/stat/>

### COURSE OUTCOMES

At the end of the course students should be able to

- CO1 Apply the concept of testing of hypothesis for small and large samples in real life problems.
- CO2 Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- CO3 Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- CO4 Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
- CO5 Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.



Head of the Department  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME201	ENGINEERING MECHANICS (Common to B. E. Civil & Mechanical)	L	T	P	C
		3	1	0	4

<b>Prerequisites:</b>
Nil

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>To determine the resultant and equivalent systems of forces in engineering applications.</li> <li>To introduce the equilibrium of rigid bodies, vector methods and free body diagram.</li> <li>To study and understand the distributed forces, surface, loading on beam and intensity.</li> <li>To learn the principles of friction, forces and to determine the concepts of frictional forces at the contact surfaces of various engineering systems.</li> <li>To develop basic dynamics concepts – force, momentum, work and energy.</li> </ul>

<b>UNIT-I</b>	<b>STATICS OF PARTICLES</b>	12
Introduction - Systems of Units, Statics of Particles -Laws of Mechanics – Lami’s theorem, Parallelogram and triangular Law of forces – Vectors –Vectorial representation of forces and moments – Vector operations on forces - Coplanar Forces –Resultant of several concurrent forces - Equilibrium of a forces – Forces in space – Equilibrium of particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force.		

<b>UNIT-II</b>	<b>EQUILIBRIUM OF RIGID BODIES</b>	12
Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples– Scalar components of a moment – Varignon’s theorem - Equilibrium of Rigid bodies in two dimensions -Equilibrium of Rigid bodies in three dimensions.		

<b>UNIT-III</b>	<b>DISTRIBUTED FORCES</b>	15
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus - Guldinus, Centre of Gravity of a Three Dimensional Body, Centroid of a Volume, Composite Bodies, Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.		

<b>UNIT-IV</b>	<b>FRICITION</b>	9
Frictional force – Laws of Coloumb friction – Cone of friction – Angle of repose – Wheel friction – Wedge friction - Ladder friction - Rolling resistance.		

<b>UNIT-V</b>	<b>MECHANISMS FOR CONTROL</b>	12
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton’s Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.		

<b>L:45</b>	<b>T:15</b>	<b>P:0</b>	<b>Total :60 Periods</b>
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**TEXT BOOKS**

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12<sup>th</sup> Edition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
3. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7<sup>th</sup> edition, Wiley student edition, 2013.

**REFERENCES**

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeler, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13<sup>th</sup> edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4<sup>th</sup> Edition, Pearson Education Asia Pvt. Ltd., 2005.
4. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5<sup>th</sup> Edition, McGraw Hill Higher Education, 2013.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

CO1 Illustrate the resultant and equivalent systems of forces.

CO2 Analyse the rigid body in equilibrium.

CO3 Evaluate the properties of distributed forces.

CO4 Determine the friction and the effects by the laws of friction.

CO5 Calculate dynamic forces exerted in rigid body.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UPH203	MATERIALS SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

**Prerequisites:**

- Engineering Physics

**COURSE OBJECTIVES:**

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

<b>UNIT-I</b>	<b>CRYSTALLOGRAPHY</b>	<b>9</b>
Structure of metals and alloys – Molecules and bonding – Crystal structure inter atomic distance and ionic radii, polymorphism, Miller indices of atomic planes, Bragg's law, crystal defects – point, line and plane defects – Effect of crystal imperfection on mechanical properties- strengthening mechanism for improvement of mechanical properties – Allotropy, grain and grain boundaries – problems.		

<b>UNIT-II</b>	<b>MECHANICAL PROPERTIES AND ELASTIC DEFORMATION</b>	<b>9</b>
<b>Mechanical properties:</b> Stress strain curve- elastic deformation – characteristics of elastic deformation – Atomic mechanism of elastic deformation – elastic deformation of an isotropic material – Modulus of elastic resilience. <b>Elastic deformation:</b> strain time curves – Damping capacity – viscous deformation – Plastic deformation – Dislocation and stress – strain curves, Schmid's law. Critical resolved shear stress, Work hardening, Grain boundary hardening, solution hardening, Dispersion hardening.		

<b>UNIT-III</b>	<b>FRACTURE AND ITS PREVENTION</b>	<b>9</b>
Mechanism of brittle fracture – ideal fracture stress (Griffith's theory) – Ductile fracture- Difference between brittle and ductile fracture – fracture toughness – Cup and cone type of fracture – fatigue failure and its prevention – Creep – various stages in creep curve – factors affecting creep resistant materials – Mechanism of creep fracture.		

<b>UNIT-IV</b>	<b>METALLURGY, FERROUS AND NON FERROUS ALLOYS</b>	<b>9</b>
<b>Metallurgy:</b> Solid solution – Intermetallic compound – Cooling curves – Non equilibrium – Phase rule – Interpretation of equilibrium diagram of Cu-Ni, Cu –Zn, Cu – Sn, Cu –Al. <b>Ferrous alloys:</b> Phase diagram and its significance – Allotropy and phase change of pure iron – steel and cast iron classifications – Equilibrium diagram for iron –Carbon, Microstructure representation for iron and steel – Application of ferrous alloys – Factors affecting mechanical properties. TTT diagram – cooling curves superimposed on I.T. diagram.		

<b>UNIT-V</b>	<b>SURFACE ENGINEERING</b>	<b>9</b>
<b>Heat treatment:</b> Definition – annealing and normalizing. Types of annealing. Hardenability, Jominy end quench test, Austempering, mar tempering. Surface heat treatment – Diffusion methods – Carburizing – Nitriding – Cyaniding and carbonitriding – Applications – Thermal methods – flame hardening – induction hardening and their applications – Laser surface hardening – Brinell, Rockwell and Vickers's Hardness test.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. G.E.Dieter, Mechanical Metallurgy, McGraw Hill ISE, 1999.
2. Raghavan, Material Science and Engineering, Prentice Hall of India Pvt. Ltd., 2004.

**REFERENCES**

1. D.Callister-Material Science And Engineering.
2. Arumugam, M.Material Science, Anuradha Publishers, 1997.
3. R.A.Flinn&P.K.Trojan, Engineering Materials and their Applications
4. Rajan, T.V. Sharma and Ashok Sharma, Heat Treatment – Principles and their techniques, Prentice Hall of India Pvt. Ltd., 2004.
5. [www.studynama.com/.../315-Engineering-materials-metallurgy-lecture-n...](http://www.studynama.com/.../315-Engineering-materials-metallurgy-lecture-n...)

**COURSE OUTCOMES:**

**At the end of the course, the students should be able to**

- CO1 Know basics of crystallography and its importance for varied materials properties
- CO2 Gain knowledge on the electrical and magnetic properties of materials and their applications
- CO3 Understand clearly of semiconductor physics and functioning of semiconductor devices
- CO4 Understand the optical properties of materials and working principles of various optical devices
- CO5 Appreciate the importance of functional nano electronic devices.

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UBE201	<b>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</b> (Common to B.E. Civil, Mechanical & B. Tech. FT)	L	T	P	C
		3	0	0	3

<b>PREREQUISITES</b>
Engineering Physics and Mathematics

<b>COURSE OBJECTIVES</b>
<ul style="list-style-type: none"> <li>To introduce the basics of electric circuits and analysis</li> <li>To impart knowledge of working principles and application of electrical machines</li> <li>To introduce analog devices and their characteristics</li> <li>To educate on the fundamental concepts of digital electronics</li> <li>To introduce the functional elements and working of measuring instruments</li> </ul>

<b>UNIT-I</b>	<b>ELECTRICAL CIRCUITS</b>	<b>9</b>
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Simple problems- Nodal Analysis, Mesh analysis Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.		

<b>UNIT-II</b>	<b>ELECTRICAL MACHINES</b>	<b>9</b>
Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer and Three Phase Induction Motor.		

<b>UNIT-III</b>	<b>ANALOG ELECTRONICS</b>	<b>9</b>
PN Junction Diodes, Zener Diode – Characteristics and Applications – Bipolar Junction Transistor - Types, I-V Characteristics and Applications – Rectifiers.		

<b>UNIT-IV</b>	<b>DIGITAL ELECTRONICS</b>	<b>9</b>
Review of number systems, binary codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (4 Variable Problems only) – Multiplexer and Demultiplexer.		

<b>UNIT-V</b>	<b>MEASUREMENTS &amp; INSTRUMENTATION</b>	<b>9</b>
Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers - CT and PT.		

<b>L: 45</b>	<b>T: 00</b>	<b>P: 00</b>	<b>Total: 45 Periods</b>
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**TEXT BOOKS**

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2<sup>nd</sup> Edition, McGraw Hill, 2020
2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, 2<sup>nd</sup> Edition, 2017.
3. Sedha R.S., "A text book book of Applied Electronics", S. Chand & Co., 2008
4. James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

**REFERENCES**

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", 4th Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, 'Digital Fundamentals', 11<sup>th</sup> Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill; 7<sup>th</sup> edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

**WEB RESOURCES**

1. <https://archive.nptel.ac.in/courses/108/105/108105112/>
2. <https://archive.nptel.ac.in/courses/108/101/108101091/>
3. <https://nptel.ac.in/courses/108108076>

**COURSE OUTCOMES**

After completing this course, the students will be able to:

CO1: Compute the electric circuit parameters for simple problems.

CO2: Explain the working principle and applications of electrical machines.

CO3: Analyze the characteristics of analog electronic devices.

CO4: Explain the basic concepts of digital electronics.

CO5: Explain the operating principles of measuring instruments.

**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UHS202	<b>TAMILS AND TECHNOLOGY</b> (Common to All Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>

<b>Prerequisites:</b>
Nil

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>• Appreciate weaving and ceramic technology.</li> <li>• Learn the design and construction technology of ancient times.</li> <li>• Understand the engineering principles of manufacturing technology.</li> <li>• Introduce the methods of irrigation and agricultural technology.</li> <li>• Learn the scientific tamil and tamil computing.</li> </ul>

<b>UNIT I</b>	<b>WEAVING AND CERAMIC TECHNOLOGY</b>	<b>3</b>
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		

<b>UNIT II</b>	<b>DESIGN AND CONSTRUCTION TECHNOLOGY</b>	<b>3</b>
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period		

<b>UNIT III</b>	<b>MANUFACTURING TECHNOLOGY</b>	<b>3</b>
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.		

<b>UNIT IV</b>	<b>AGRICULTURE AND IRRIGATION TECHNOLOGY</b>	<b>3</b>
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		

<b>UNIT V</b>	<b>SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</b>	<b>3</b>
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		

<b>L:15</b>	<b>T: 00</b>	<b>P: 00</b>	<b>Total : 15 Periods</b>
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**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே .பிள்ளை (வெளியீடு:
2. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
3. கணினித் தமிழ் -முனைவர் இல .சுந்தரம்.(விகடன் பிரசுரம்).
4. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
6. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
7. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
8. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
9. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.) 55
10. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
11. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
12. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
13. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.

**COURSE OUTCOMES**

At the end of the course students should be able

- CO1 Explain the principles behind weaving and ceramic technology of ancient tamils.  
CO2 Correlate the present and ancient design and construction technology.  
CO3 Apply engineering principles to ancient manufacturing technology.  
CO4 Apply engineering principles to irrigation and agricultural technology.  
CO5 Develop scientific tamil and new techniques in tamil computing.



**Head of the Department**  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UHS202	தமிழரும் தொழில்நுட்பமும் (Common to All Branches)	L	T	P	C
		1	0	0	1

அலகு I	தெசவு மற்றும் பாணைத்தொழில்நுட்பம்	3
சங்க காலத்தில் நெசவுத்தொழில்- பாணைத்தொழில் நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.		

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் கோவில்களும் மாமல்லபுரம் சிற்பங்களும், சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் நாயக்கர் காலக் கோயில்கள் மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் செட்டிநாட்டு வீடுகள் பிசிட்டிஷ் காலத்தில் சென்னையில் இத்தோ - சாரோசெனிக் கட்டிடக் கலை.		

அலகு III	உற்பத்தி தொழில்நுட்பம்	3
கப்பல் கட்டும் கலை உலோகவியல் - இரும்பு தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் மணி உருவாக்கும் தொழிற்சாலைகள் மணிகள் துண்டுகள் - கல்மணிகள், கண்ணாடி சுடுமண் மணிகள் சங்கு மணிகள் எலும்புத் தொல்லியல் சான்றுகள் -. சிலப்பதிகாரத்தில் மணிகளின் வகைகள்		

அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்	3
அணை, ஏரி, குளங்கள், மதகு - சோழர் காலக் குழுமித் தூம்பின் முக்கியத்துவம் கால்நடை பராமரிப்பு கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் முத்து மற்றும் முத்துக்குளித்தல் -பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.		

அலகு V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3
அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்கள் மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத்திட்டம்		

L:15	T: 00	P: 00	Total : 15 Periods
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### TEXT-CUM-REFERENCE BOOKS

- 1) தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே .பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
- 2) கணினித் தமிழ் -முனைவர் இல .சுந்தரம்.(விகடன் பிரசுரம்).
- 3) கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
- 4) பொருளை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
- 5) Social Life of Tamils (Dr. K. K. Pillay) A Joint publication of TNTB & ESC and RMRL – (in print)
- 6) Social Life of the Tamils – The classical Period (Dr.S.Singaravelu) (Publishid by: International institute of Tamil Studies).
- 7) Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.k.D.Thirunavukkarasu) (Published by: Institute of Tamil Studies).
- 8) The Contribution of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: Institute of Tamil Studies).
- 9) Keeladi – Sangam City Civilization on the banks of banks of river Vaigai' (Jointly Published by: Department of archaeology & Tamil Nadu Text book and Educational Services Corporation, Tamil Nadu)
- 10) Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (published by: The Author).
- 11) Porunai Civilization (jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- 12) Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.



**Head of the Department**  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UGE1201	ENGINEERING GRAPHICS AND DRAFTING (Common to B.E. Civil, ECE, EEE, Mechanical & B. Tech. FT)	L	T	P	C
		3	0	2	4

**Prerequisites:**

Nil

**COURSE OBJECTIVES:**

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids.
- Drawing isometric and perspective projections of simple solids.

<b>UNIT-I</b>	<b>PLANE CURVES AND FREEHAND SKETCHING</b>	<b>6+12</b>
<p>Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.</p> <p>Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.</p>		

<b>UNIT-II</b>	<b>PROJECTION OF POINTS, LINES AND PLANE SURFACES</b>	<b>6+12</b>
<p>Orthographic projection- principles-Principal planes-First angle projection-projection of points (All Quadrants).</p> <p>Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.</p>		

<b>UNIT-III</b>	<b>PROJECTION OF SOLIDS AND SECTION OF SOLIDS</b>	<b>6+12</b>
<p>Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Solids suspended from corner and real time application of projection of solids.</p> <p>Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section.</p> <p>Practicing three-dimensional modeling of simple objects by CAD Software.</p>		

<b>UNIT-IV</b>	<b>DEVELOPMENT OF SURFACES</b>	<b>6+12</b>
<p>Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Development of lateral surfaces of simple solids with square and cylindrical cut-outs — Prisms, pyramids cylinders and cones. Practicing three-dimensional modeling of simple objects by CAD Software.</p>		

<b>UNIT-V</b>	<b>ISOMETRIC AND PERSPECTIVE PROJECTIONS</b>	<b>6+12</b>
<p>Principles of isometric projection — Isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three-dimensional modeling of isometric projection of simple objects by CAD Software. Engineering Applications of isometric, orthographic and perspective projections</p>		

<b>L:30</b>	<b>T:0</b>	<b>P:60</b>	<b>Total :90 Periods</b>
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**TEXT BOOKS**

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53<sup>rd</sup> Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

**REFERENCES**

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2<sup>nd</sup> Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Publications, Bangalore, 27<sup>th</sup> Edition, 2017.
3. Luzzader, Warren. J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2<sup>nd</sup> Edition
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited 2008, 2<sup>nd</sup> Edition, 2009.

**COURSE OUTCOMES:**

- On successful completion of this course, the student will be able to**
- CO1 Use BIS conventions and specifications for engineering drawing.
  - CO2 Construct the conic curves, involutes and cycloid.
  - CO3 Solve practical problems involving projection of lines.
  - CO4 Draw the orthographic, isometric and perspective projections of simple solids.
  - CO5 Draw the development of simple solids.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UGE211	Engineering Fundamentals Lab (Common to All branches)	L	T	P	C
		0	0	4	2

**Prerequisites:**

Nil

**COURSE OBJECTIVES:**

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.
- Understand the component parts of computer systems.
- Understand the master programming constructs, and develop, test, and debug programs.
- Identify and analyze problems, and design and implement solutions.

**Part – A (Civil and Mechanical)**  
(Students will be offered any 10 experiments)

1.	Land documents reading and understanding
2.	Material identification and testing as per BIS & NBC
3.	Basic surveying and land area measurement
4.	Water analysis
5.	Basic vasthu
6.	Make a Butt/Lap/Tee joint of MS plate using Arc welding and also make Lap joint using riveting
7.	Prepare T/L/Lap joint from the given wooden workpiece and make a Box /Tray out of plywood using modern power tools
8.	Perform the simple turning, drilling, tapping using lathe
9.	Demonstration of basic foundry operations
10.	Making a square tray using sheet metal
11.	Study of various metals and alloys
12.	Hands on training to use measuring instruments
13.	Study of 3-D printer / Robotics architecture / Mechatronics system

**Part – B (Electrical and Electronics)**

Students will be offered any 07 experiments

1.	Study of electrical switches, fuses, indicators, circuit breakers, contactors and relays
2.	Wiring circuit for fluorescent lamp and Stair case wiring
3.	Wiring Circuit of ceiling fan
4.	Measurement of Earth Resistance
5.	House wiring with energy meter, RCCB and ELCB
6.	Study of electronic components resistor, diode, transistors, measuring devices

7.	Soldering and Assembly of Simple Circuits and trouble shooting
8.	Assembly and dismantle of smartphone
<b>Part- C (Computer Technologies)</b>	
1.	Office automation tools - Word processing
2.	Office automation tools –Spread sheets
3.	Office automation tools - Presentation preparation
4.	Network topology configuration
5.	Network crimping & I/O outlet termination
6.	Types of operating systems and installation

<b>L:0</b>	<b>T:0</b>	<b>P:60</b>	<b>Total :60 Periods</b>
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<b>LIST OF EQUIPMENTS REQUIRED</b>
Plumbing Equipments
Welding Machine-Set up
Electrical and Electronics Kit
Hardware Requirements
<ul style="list-style-type: none"> <li>• Standard PC</li> </ul>
Software Requirements
<ul style="list-style-type: none"> <li>• Windows 7 or higher</li> <li>• Python latest version</li> </ul>

<b>COURSE OUTCOMES:</b>
<b>Upon completion of this course, the students will be able to:</b>
CO1 Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2 Wire various electrical joints in common household electrical wire work.
CO3 Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
CO4 Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
CO5 Evaluate the performance of different types of CPU scheduling algorithm.
CO6 Use different systems calls for writing application programs.



**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UBE211	<b>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY</b> (Common to B.E. Civil, Mechanical)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		0	0	4	2

#### PREREQUISITES

Engineering Physics

#### COURSE OBJECTIVES

- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices

#### LIST OF EXPERIMENTS

1. Verification of ohms Laws and Kirchhoff's Laws.
2. Load test on DC Series Motor.
3. Load test on DC Shunt Motor.
4. Load test on DC Generator.
5. Load test on Single phase Transformer.
6. Load Test on Three Phase Induction Motor.
7. Characteristics of PN and Zener Diodes.
8. Characteristics of BJT.
9. Half wave and Full Wave rectifiers.
10. Verification of Logic Gates.
11. Implementation of Binary Adder and Subtractor.
12. Measurement of three phase power.

<b>L: 00</b>	<b>T: 00</b>	<b>P: 60</b>	<b>Total: 60 Periods</b>
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#### LIST OF EQUIPMENTS REQUIRED

(for batch of 30 students)

1. DC Shunt Motor/Generator, Single Phase Induction Motor – 1 Each
2. Rheostat / Variable Resistors – Necessary Quantity
3. Tachometer – 3 No's
4. PN Diode / Zener Diode and BJT – 10 No's
5. Resistor, Capacitor, CRO & Transformer (6V) - Necessary Quantity
6. Regulated Power Supply (0-30V ) – 15 No's
7. AC/DC – Voltmeters of required rating – 10 No's
8. AC/DC -Ammeters of required rating - 10 No's
9. Multimeters (Digital) - 10 No's
10. Single Phase Wattmeter of suitable rating - 5 No's
11. Circuit Connection Boards / Bread Board – 20 No's
12. Connecting Wires / Patch Chords - Necessary Quantity
13. Digital IC Trainer with IC 7400, 7402, 7404, 7408, 7432, 7486 – 5 Each
14. Three phase star & delta connected load / Single phase load of suitable rating - 3 No's
15. Necessary Quantities of Resistors, Inductors, Capacitors of various capacities  
(Quarter Watt to 10 Watt)

**COURSE OUTCOMES**

After completing this course, the students will be able to:

- CO1: Use experimental methods to verify the Ohm's and Kirchhoff's Laws.
- CO2: Analyze experimentally the load characteristics of electrical machines.
- CO3: Analyze the characteristics of basic electronic devices.
- CO4: Use experimental methods to verify the logic gates and operations.
- CO5: Use power measurement meters to measure the various parameters.



**Head of the Department**  
Department of Mechanical Engineering  
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Tirupur-638 660. Tamil Nadu, India.

24UHS211	<b>COMMUNICATION LABORATORY</b> (Common to all Branches)	L	T	P	C
		0	0	4	2

**Prerequisites:**

- Basic Knowledge in Language usage

**COURSE OBJECTIVES:**

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays
- To give instructions and recommendations that are clear and relevant to the context

<b>UNIT-I</b>	<b>MAKING COMPARISONS</b>	<b>12</b>
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition discussing progress toward goals-talking about experiences- talking about events in life-discussing past events-Writing: writing emails ( formal & semi-formal).		
<b>UNIT-II</b>	<b>EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING</b>	<b>12</b>
Speaking: discussing news stories-talking about frequency-talking about travel problems discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.		
<b>UNIT-III</b>	<b>PROBLEM SOLVING</b>	<b>12</b>
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages- making comparisons-discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.		
<b>UNIT-IV</b>	<b>REPORTING OF EVENTS AND RESEARCH</b>	<b>12</b>
Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules - (example- discussing rental arrangements) - understanding technical instructions-Writing: writing instructions-writing a short article.		
<b>UNIT-V</b>	<b>THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY</b>	<b>12</b>
Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.		

L: 00	T: 00	P: 60	Total : 60 Periods
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## WEB RESOURCES

- <https://academicguides.waldenu.edu/writingcenter/grammar/comparisons#:~:text=Adjectives%20and%20adverbs%20can%20be,to%20hedge%20or%20boost%20language.>
- <https://www.linkedin.com/pulse/causality-expressed-natural-language-text-vivek-khetan>
- <https://www.sessionlab.com/blog/problem-solving-techniques/>

## COURSE OUTCOMES

**At the end of the course students should be able to**

- CO1 Speak effectively in group discussions held in formal/semi formal contexts.
- CO2 Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
- CO3 Write emails, letters and effective job applications.
- CO4 Write critical reports to convey data and information with clarity and precision
- CO5 Give appropriate instructions and recommendations for safe execution of tasks



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR III SEMESTER**



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**Department of Mechanical Engineering**

**III Semester Syllabus**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>THEORY</b>							
1.	24UMA301	Transforms and Partial Differential Equations	BS	3	1	0	4
2.	24UME301	Engineering Thermodynamics	PC	3	0	0	3
3.	24UME302	Manufacturing Processes	PC	3	0	0	3
4.	24UME303	Metrology and Measurements	PC	3	0	0	3
5.	24UME304	Computer Aided Design and Manufacturing	PC	3	0	0	3
<b>THEORY CUM PRACTICAL</b>							
6.	24UMEI301	Fluid Mechanics and Machinery	ES	2	1	2	4
<b>PRACTICAL</b>							
7.	24UME311	Computer Aided Machine Drawing	ES	1	0	2	2
<b>Total Credits</b>				<b>18</b>	<b>2</b>	<b>4</b>	<b>22</b>



24UMA301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

**COURSE OBJECTIVES:**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier, transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

<b>UNIT-I</b>	<b>PARTIAL DIFFERENTIAL EQUATIONS</b>	9+3
Formation of partial differential equations – Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types		

<b>UNIT-II</b>	<b>FOURIER SERIES</b>	9+3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.		

<b>UNIT-III</b>	<b>APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS</b>	9+3
Classification of PDE – Method of separation of variables - Fourier series solutions of onedimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only)		

<b>UNIT-IV</b>	<b>FOURIER TRANSFORMS</b>	9+3
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.		

<b>UNIT-V</b>	<b>Z - TRANSFORMS AND DIFFERENCE EQUATIONS</b>	9+3
Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms		

L:45	T:15	P:0	Total :60 Periods
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**TEXT BOOKS**

1. Grewal B.S., "Higher Engineering Mathematics", 44<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10<sup>th</sup> Edition, John Wiley, New Delhi, India, 2018.

**REFERENCES**

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd, 2021.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4. Narayanan. S., Manicavachagom Pillay. T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6. Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6<sup>th</sup> Edition, New Delhi, 2012.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one- and twodimensional heat flow problems and one-dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME301	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand basic thermodynamics concepts like heat, work, energy, and temperature.
- To learn how engines, refrigerators, and heat pumps work using the laws of thermodynamics.
- To use charts and formulas to find properties of steam, gases, and moist air for real-life problems.

<b>UNIT-I</b>	<b>BASICS OF THERMODYNAMICS</b>	9
Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.		

<b>UNIT-II</b>	<b>SECOND LAW AND ENTROPY</b>	9
Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.		

<b>UNIT-III</b>	<b>AVAILABILITY AND APPLICATIONS</b>	9
Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency.		

<b>UNIT-IV</b>	<b>PROPERTIES OF PURE SUBSTANCES</b>	9
Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.		

<b>UNIT-V</b>	<b>GAS MIXTURES, PSYCHROMETRICS AND THERMODYNAMIC RELATIONS</b>	9
Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. Vander Waal's relation - Compressibility factor - Generalized Compressibility Chart. Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule Thomson experiment - Clausius-Clapeyron equation. Properties of moist air – Specific humidity – Relative humidity – Dew point temperature – Enthalpy of moist air – Psychrometric chart – Sensible and latent heat processes – Applications.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Nag. P.K., "Engineering Thermodynamics", 6<sup>th</sup> Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2<sup>nd</sup> Edition (2014), Anuragam Publications, Chennai.

**REFERENCES**

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill, 9<sup>th</sup> Edition, 2019.
2. Chattopadhyay, P, "Engineering Thermodynamics", 2<sup>nd</sup> Edition Oxford University Press, 2016.
3. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2<sup>nd</sup> Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10<sup>th</sup> Edition, Wiley Eastern, 2019.
5. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain basic thermodynamic terms, systems, and laws.
- Understand how heat engines, refrigerators, and heat pumps work using the second law.
- Calculate energy changes, efficiency, and losses in different processes.
- Use steam tables and charts to find properties and solve steam-related problems.
- Analyze gas mixtures and moist air using psychrometric charts and basic equations.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME302	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To introduce the fundamentals and applications of various metal casting and joining processes.
- To develop knowledge of bulk deformation and sheet metal forming processes.
- To familiarize students with manufacturing methods of plastic and ceramic components.

<b>UNIT-I</b>	<b>METAL CASTING PROCESSES</b>	9
Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Core making–Types and applications – Molding processes-hand molding,machine molding,high pressure molding,Shell molding,investment casting–Melting furnaces – Pressure die casting – low pressure, gravity- high pressure die casting- Centrifugal Casting – CO <sub>2</sub> casting – Vacuum mould casting, Evaporative pattern casting (EPC) Micro injection molding - Defects in Sand casting process-remedies		

<b>UNIT-II</b>	<b>METAL JOINING PROCESSES</b>	9
Material Preparation-Fusion welding processes – Oxy fuel welding – Filler and Flux materials—Arc welding, Electrodes, Coating and specifications – TIG –MIG - Submerged arc welding – Electro slag welding– Plasma arc welding — Resistance welding Processes -Electron beam welding –Laser beam Welding. Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects –inspection & remedies – Brazing – soldering, special welding process.		

<b>UNIT-III</b>	<b>BULK DEFORMATION PROCESSES</b>	9
Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Rod and wire drawing – Tube drawing –Extrusion – Types – Hot and Cold extrusion. Introduction to shaping operations.		

<b>UNIT-IV</b>	<b>SHEET METAL PROCESSES</b>	9
Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming - Forming limit diagram		

<b>UNIT-V</b>	<b>MANUFACTURE OF PLASTIC AND CERAMIC COMPONENTS</b>	9
Molding of thermoplastics & Thermosetting polymers– working principles and typical applications Injection molding– introduction to blow molding – Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics- duff moulding- Inspection methods, defect analysis- Manufacturing of ceramic components.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 4<sup>th</sup> Edition, 2013.
2. P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5<sup>th</sup> edition, 2018.

**REFERENCES**

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eighth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997.
4. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004
5. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand different metal casting methods, materials, and common casting defects with solutions.
- Learn various welding and joining techniques, materials used, and how to inspect and fix weld defects.
- Understand how metals are shaped through processes like forging, rolling, drawing, and extrusion.
- Explain sheet metal forming processes and advanced methods like hydroforming and superplastic forming.
- Know the basic methods of manufacturing plastic and ceramic parts and how to check for defects.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME303	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>To introduce the fundamentals of measurement and metrology systems.</li> <li>To provide knowledge of measuring tools and techniques for dimensional and geometric features.</li> <li>To familiarize students with tolerance analysis and modern metrology techniques.</li> </ul>

<b>UNIT-I</b>	<b>BASICS OF METROLOGY</b>	<b>9</b>
Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.		

<b>UNIT-II</b>	<b>MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS</b>	<b>10</b>
Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescopic gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector – Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads and gears		

<b>UNIT-III</b>	<b>TOLERANCE ANALYSIS</b>	<b>9</b>
Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.		

<b>UNIT-IV</b>	<b>METROLOGY OF SURFACES</b>	<b>8</b>
Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.		

<b>UNIT-V</b>	<b>ADVANCES IN METROLOGY</b>	<b>9</b>
Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM –Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and inprocess monitoring in production.		

<b>L:45</b>	<b>T: 0</b>	<b>T: 45 PERIODS</b>
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**TEXT BOOKS**

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

**REFERENCES**

1. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5<sup>th</sup> revised edition, 1990.
3. National Physical Laboratory Guide No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. <http://www.npl.co.uk>.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5. Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley & Sons, 2015.

**COURSE OUTCOMES:**

- Understand the purpose of measurement, types of errors, and how to estimate measurement uncertainty.
- Use basic and advanced instruments to measure linear, angular dimensions, threads, and gears.
- Apply limits, fits, and tolerance concepts to analyze and design accurate manufacturing parts.
- Measure surface finish and geometric features like flatness and roundness using various methods.
- Learn modern metrology tools like lasers, CMM, and machine vision systems used in automated inspection.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME304	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To introduce the fundamentals of CAD and CAM systems, including software and hardware components.
- To develop the proficiency in using CAD software tools for creating 2D drawings and 3D models of engineering components.
- To understand the CNC machining, tool path generation, and post-processing in a CAM environment.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>9</b>
Introduction to CAD/CAM concepts, Computer aided design - Standards for computer graphics. GD & T; its 14 symbols, Special characteristics & Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting. Revision / ECN status of drawings –Types of production, manufacturing planning and control.		

<b>UNIT-II</b>	<b>CURVES AND SURFACES</b>	<b>9</b>
Representation of curves- Hermite curves- Bezier curves – B-spline curves –Techniques for surface modeling surface patch and bicubic patch. Bezier curves – B-spline surfaces.		

<b>UNIT-III</b>	<b>SOLID MODELING</b>	<b>9</b>
Solid modeling technique, CSG and B-Rep,3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages –Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc. Basics of Assembly modeling, Purpose of Assembly modeling& amp; its advantages – Top to Down & Bottom Up-modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis –Cumulative effect of Tolerances in after assembly conditions		

<b>UNIT-IV</b>	<b>FUNDAMENTS OF CNC AND PART PROGRAMING</b>	<b>9</b>
Introduction to NC system and CNC Machining – 3, 4 & 5 Axis machines - CNC machine tools principle of operation. CNC construction features including structure – Drives and CNC controls – 2D and 3D machining on CNC – Introduction to part Programing, types – detailed manual part programing on lathe and Milling machines using G codes and M codes – cutting cycles, Loops, Sub program and macros- Introduction of CAM package.		

<b>UNIT-V</b>	<b>CELLULAR AND FLEXIBLE MANUFACTURING SYSTEMS.</b>	<b>9</b>
Group technology (GT), part family- parts classification and coding- simple programs in optiz part coding system-production flow analysis- cellular manufacturing – types of flexibility- FMS- FMS concepts – FMS Application & Benefits FMS Planning and control – quantitative analysis.		

<b>L:45</b>	<b>T: 0</b>	<b>T: 45 PERIODS</b>
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**TEXT BOOKS**

1. **Ibrahim Zeid**, *Mastering CAD/CAM*, McGraw Hill Education, Latest Edition
2. **Mikell P. Groover**, *Automation, Production Systems, and Computer-Integrated Manufacturing*, Pearson Education, Latest Edition

**REFERENCES**

1. **Chris McMahon and Jimmie Browne**, *CAD/CAM: Principles, Practice and Manufacturing Management*, Pearson Education
2. **P.N. Rao**, *CAD/CAM Principles and Applications*, McGraw Hill Education
3. **Warren S. Seames**, *Computer Numerical Control: Concepts and Programming*, Delmar Cengage Learning
4. **Yoram Koren and Stephen Shpitalni**, *Design of Reconfigurable Manufacturing Systems*, Springer
5. **Kusiak Andrew**, *Intelligent Manufacturing Systems*, Prentice Hall

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the basic concepts of CAD/CAM, drawing standards, GD&T symbols, and prepare 2D drawings with BOM.
- Explain and apply different types of curves and surface modeling techniques like Hermite, Bezier, and B-spline for design applications.
- Create solid models using CSG and B-Rep, and perform assembly modeling with analysis of clearances, interferences, and tolerance stack-up.
- Describe CNC machines and their operations, and develop manual part programs for lathe and milling using G and M codes.
- Understand Group Technology, part coding systems, and analyze Flexible Manufacturing Systems (FMS) and their applications in modern production.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEI301</b>	<b>FLUID MECHANICS AND MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>1</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

- To introduce the fundamental properties and behavior of fluids in motion.
- To develop knowledge on flow through pipes, boundary layers, and performance analysis using dimensional analysis.
- To provide understanding of hydraulic machines such as turbines and pumps.

<b>UNIT-I</b>	<b>FLUID PROPERTIES AND FLOW CHARACTERISTICS</b>	<b>9</b>
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Introduction to fluid Mechanics-Properties of fluids –mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity.  
Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

<b>UNIT-II</b>	<b>FLOW THROUGH PIPES AND BOUNDARY LAYER</b>	<b>9</b>
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Reynold's Experiment- Laminar flow through circular conduits -Darcy Weisbach equation-friction factor- Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

<b>UNIT-III</b>	<b>DIMENSIONAL ANALYSIS AND MODEL STUDIES</b>	<b>9</b>
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Fundamental dimensions -Dimensional homogeneity -Rayleigh's method and Buckingham Pi theorem  
Dimensionless parameters- Similitude and model studies- Distorted and un-distorted models.

<b>UNIT-IV</b>	<b>TURBINES</b>	<b>9</b>
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Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube Specific speed - Performance curves for turbines - Governing of turbines.

<b>UNIT-V</b>	<b>PUMPS</b>	<b>9</b>
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Definitions of Heads - Efficiencies and Work done of a Centrifugal pump – Velocity Triangles – Working principles of Single acting and Double Acting Reciprocating pump – Basic principles of indicator diagram – Cavitation – Specific Speed of Pumps.

<b>L:30</b>	<b>T:15</b>	<b>P:15</b>	<b>Total :60 Periods</b>
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### LIST OF EXPERIMENTS

1. Determination of coefficient of discharge of a venturi meter.
2. Determination of friction factor for flow through pipes.
3. Determination of coefficient of discharge of Flow through a circular Orifice.
4. Determination of metacentric height.
5. Characteristics of centrifugal pumps.
6. Characteristics of Pelton wheel turbine.

### TEXT BOOKS

1. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
2. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016

### REFERENCES

1. Bansal, R.K. Fluid Mechanics Laxmi Publications Pvt. Ltd., 2020. ISBN: 978-8131802946
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010

### COURSE OUTCOMES:

#### At the end of the course the students would be able to

- Understand fluid properties and apply basic flow equations like continuity, energy, and momentum.
- Analyze laminar and turbulent flow in pipes, calculate head losses, and understand boundary layer behaviour.
- Use dimensional analysis and model studies to solve and simplify fluid flow problems.
- Explain the working of different turbines and calculate work done and efficiency
- Understand the operation of pumps and calculate head, efficiency, and work done.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME311	COMPUTER AIDED MACHINE DRAWING	L	T	P	C
		1	0	2	2

**COURSE OBJECTIVES:**

- To develop skills in manual and CAD-based engineering drawing, including drawing, editing, dimensioning, layering, and detailing of machine components.
- To understand and create detailed drawings of various machine elements such as bearings, valves, couplings, joints, and engine parts.
- To practice assembly drawing techniques both manually and using CAD software, ensuring proficiency in interpreting and creating mechanical assemblies.

<b>PART I</b>	<b>DRAWING STANDARDS &amp; FITS AND TOLERANCES</b>	<b>12</b>
Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions IS919- Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning &Tolerancing.		

<b>PART II</b>	<b>2D DRAFTING</b>	<b>48</b>
Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.		
1. Bearings – Bush Bearing,		
2. Valves – Safety and Non-return Valves.		
3. Couplings – Flange, Oldham’s, Muff, Gear couplings.		
4. Joints – Universal, Knuckle, Gib& Cotter, Strap, Sleeve &Cotter joints.		
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch.		
6. Machine Components – Screw Jack, Machine Vice, LatheTail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.		
Total: 20% of classes for theory classes and 80% of classes for practice		
Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D CAD software		

<b>L:12</b>	<b>P:48</b>	<b>T:0</b>	<b>T: 60 PERIODS</b>
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**TEXT BOOKS**

1. Gopalakrishna K.R., “Machine Drawing”, 17<sup>th</sup> Edition, Subhas Stores Books Corner, Bangalore,2003.
2. N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 51<sup>st</sup> Edition, Charator Publishers,2022.

## REFERENCES

1. K. L Narayana, P.Kannaiah, K.Venkata Reddy, Machine Drawing , 15 Edition , New Age International Publication
2. Goutam Pohit and Goutam Ghosh, "Machine Drawing with AutoCAD", 1<sup>st</sup> Edition, Pearson Education, 2004
3. Junnarkar, N.D., "Machine Drawing", 1<sup>st</sup> Edition, Pearson Education, 2004
4. N. Siddeshwar, P. Kanniah, V.V.S. Sastri," Machine Drawing" , published by Tata McGrawHill,2006
5. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

## COURSE OUTCOMES:

**At the end of the course the students would be able to**

- Perform drawing, editing, dimensioning, layering, hatching, and detailing manually and using CAD.
- Draw and understand different types of bearings and valves through detailed sketches and CAD.
- Create drawings for various couplings and mechanical joints accurately.
- Prepare detailed drawings of engine components like pistons, connecting rods, crossheads, and stuffing boxes.
- Develop assembly drawings of machine components manually and using CAD software with 75% focus on CAD.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR IV SEMESTER**



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**IV Semester Syllabus**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
<b>THEORY</b>							
1.	24UME401	Hydraulics and Pneumatics	PC	3	0	0	3
2.	24UME402	Theory of Machines	PC	3	1	0	4
3.	24UME403	Manufacturing Technology	PC	3	0	0	3
4.	24UGE402	Environmental Science and Sustainability for Mechanical Engineers	BS	3	0	0	3
<b>THEORY CUM PRACTICAL</b>							
5.	24UMEI401	Strength of Materials	PC	2	1	2	4
6.	24UMEI402	Thermal Engineering	PC	3	0	2	4
<b>PRACTICAL</b>							
7.	24UME411	Manufacturing Technology Laboratory	PC	0	0	4	2
8.	24UME412	CAD/CAM Laboratory	PC	0	0	4	2
<b>Total Credits</b>				<b>17</b>	<b>2</b>	<b>12</b>	<b>25</b>



24UME401	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To introduce the principles of fluid power and hydraulic pumps.
- To provide knowledge of hydraulic and pneumatic actuators, control components, and circuits.
- To develop skills in troubleshooting, designing, and applying fluid power systems in real-world applications.

<b>UNIT-I</b>	<b>FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS</b>	9
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory— Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps		

<b>UNIT-II</b>	<b>HYDRAULIC ACTUATORS AND CONTROL COMPONENTS</b>	9
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters – types and selection- Applications – Fluid Power ANSI Symbols		

<b>UNIT-III</b>	<b>HYDRAULIC CIRCUITS AND SYSTEMS</b>	9
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, – Problems- Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems -		

<b>UNIT-IV</b>	<b>PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS</b>	9
Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic Circuits -KV map method		

<b>UNIT-V</b>	<b>TROUBLE SHOOTING AND APPLICATIONS</b>	9
Conditioning of hydraulic fluids -Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits - Problems– Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics- Simulation practices		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

**REFERENCES**

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., "Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance", Tata McGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3<sup>rd</sup> Edition, 2019.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the basics of fluid power and different types of hydraulic pumps.
- Identify hydraulic actuators and control valves and explain their working.
- Design and analyze common hydraulic circuits used in industry.
- Explain the components and design of pneumatic and electro-pneumatic circuits.
- Apply knowledge to troubleshoot fluid power systems and design circuits for practical applications.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME402	THEORY OF MACHINES	L	T	P	C
		3	1	0	4

**COURSE OBJECTIVES:**

- To understand the fundamental concepts of mechanisms and kinematics analysis.
- To develop knowledge of cams, followers, and friction in machine elements.
- To familiarize students with gears, balancing, and vibration analysis in machines.

<b>UNIT-I</b>	<b>KINEMATICS OF MECHANISMS</b>	<b>9+3</b>
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar chain and slider crank mechanism – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods.		
<b>UNIT-II</b>	<b>CAMS</b>	<b>9+3</b>
Types of cams and followers - Follower motion - Uniform, Parabolic, SHM and cycloidal. Cam terminology - Cam profiles construction for roller, flat faced and knife edge follower types - pressure angle - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.		
<b>UNIT-III</b>	<b>FRICTION IN MACHINE ELEMENTS</b>	<b>9+3</b>
Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes– Friction in vehicle propulsion and braking.		
<b>UNIT-IV</b>	<b>GEARS AND GEAR TRAINS</b>	<b>9+3</b>
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains –automotive transmission gear trains- Governors and Gyroscopes principles.		
<b>UNIT-V</b>	<b>BALANCING AND VIBRATION</b>	<b>9+3</b>
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines –free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.		

L:45	T: 15	T: 60 PERIODS
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**TEXT BOOKS**

1. Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 3<sup>rd</sup> Edition 2019.
2. Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 5<sup>th</sup> Edition 2019.

## REFERENCES

1. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
2. Rao. J.S. and Dukkupati. R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2<sup>nd</sup> Edition, 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.
5. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.
6. R. S. Khurmi & J. K Gupta, Theory of Machines, S. Chand publishing

## COURSE OUTCOMES:

- Understand and analyze the motion, velocity, and acceleration in simple mechanisms.
- Explain different cam types and follower motions and construct cam profiles.
- Identify friction effects in machine parts like clutches, brakes, and drives.
- Understand gear tooth action and analyze different types of gear trains.
- Explain balancing methods and basic vibration concepts in machines.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME403	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To impart a comprehensive understanding of the mechanics of metal cutting
- To familiarize students with the operations and applications of conventional and special-purpose machine tools
- To introduce the principles and programming of CNC machine tools

<b>UNIT-I</b>	<b>MECHANICS OF METAL CUTTING</b>	9
Mechanics of chip formation, forces in machining, Types of chips, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life – Calculation - Surface finish, cutting fluids and Machinability.		
<b>UNIT-II</b>	<b>TURNING MACHINES</b>	9
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface finish in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.		
<b>UNIT-III</b>	<b>RECIPROCATING MACHINE TOOLS</b>	9
Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation.		
<b>UNIT-IV</b>	<b>FINISHING PROCESSES</b>	9
Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: Grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods		
<b>UNIT-V</b>	<b>CNC MACHINE TOOLS AND PROGRAMMING</b>	9
Introduction to CNC technology - History & development of CNC technology - Types of CNC machines (VMC, HMC, VTC, HTC) - CNC Tooling, Selection of tools - Numerical control on CNC machine tools - CNC Control and types of CNC control - CNC clamping - Application Numerical Control, Merits & Demerits, Adaptive Control System - CNC programming for lathe and milling machines - G & M Codes, Interpolations, Canned Cycles and Subprograms, Tool compensations – Inspection - Coolant systems, Safety features.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India,7th Edition, 2018.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018

## REFERENCES

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.
3. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw-Hill, New Delhi, 2009.
4. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
5. Peter Smid, CNC Programming Handbook, Industrial Press Inc., Third edition, 2007.

## COURSE OUTCOMES:

### At the end of the course the students would be able to

- Understand the mechanics of metal cutting processes including chip formation, cutting forces, tool materials, tool wear, tool life, surface finish, and machinability.
- Apply knowledge of turning machines and their operations to perform taper turning, thread cutting, and estimate machining time and power requirements.
- Identify and describe the operations of reciprocating machine tools, hole-making processes, and milling operations including types of cutters and attachments.
- Explain gear manufacturing and finishing methods, abrasive machining processes, grinding types, and micro-finishing techniques.
- Develop and write CNC part programs for lathe and milling machines using G & M codes, apply interpolation, canned cycles, and understand CNC tooling, clamping, and safety systems.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UGE402	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>• To understand the basics of environment, biodiversity, and their importance in mechanical industries.</li> <li>• To learn about pollution, safety, renewable energy, and green technologies used in mechanical engineering.</li> <li>• To study sustainability concepts, management practices, and tools for reducing environmental impact in engineering.</li> </ul>

<b>UNIT-I</b>	<b>ENVIRONMENTAL SYSTEMS &amp; BIODIVERSITY IN INDUSTRIAL CONTEXT</b>	9
<p>Definition, scope and importance of environment – need for public awareness. Understanding environment and biodiversity with a focus on industrial ecosystems, resource extraction, and material sourcing in mechanical engineering. Ecosystem energy cycles, ecological succession, and their analogues in industrial supply chains. Biodiversity types and values relate to raw material resilience and manufacturing ecosystems. India as a biodiversity hotspot, threats and importance of biodiversity for sustainable engineering practice. Conservation strategies (in-situ, ex-situ) and their relevance to sustainable sourcing.</p>		

<b>UNIT-II</b>	<b>INDUSTRIAL POLLUTION &amp; REGULATORY FRAMEWORKS</b>	9
<p>Pollution types (air, water, soil, noise) with real-world examples from mechanical and manufacturing operations. Management of industrial solid, hazardous, and e-waste—best practices in manufacturing services and facilities. Occupational Health and Safety Management Systems (OHSMS) case studies in industry. Overview of relevant laws and environmental regulation compliance for engineering firms.</p>		

<b>UNIT-III</b>	<b>RENEWABLE ENERGY &amp; GREEN ENGINEERING TECHNOLOGIES</b>	9
<p>Energy footprint in mechanical systems, energy efficiency, and conservation strategies. Current innovations in renewable energy: hydrogen fuel cells, tidal and ocean energy, geothermal systems in industrial design. Integration of green design principles such as design for disassembly, lifecycle-oriented modelling, net-zero target compatibility, and embodied carbon accounting - Emerging role of soft robotics powered by renewable energy in sustainable manufacturing and environmental restoration.</p>		

<b>UNIT-IV</b>	<b>SUSTAINABILITY AND MANAGEMENT</b>	9
<p>Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. CBAM Environmental management in industry-A case study.</p>		

<b>UNIT-V</b>	<b>SUSTAINABILITY PRACTICES</b>	<b>9</b>
Zero waste and R6 concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socioeconomical and technological change		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6<sup>th</sup> Edition, New Age International Publishers ,2018.</li> <li>2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.</li> </ol>
<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.</li> <li>2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.</li> <li>3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.</li> <li>4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.</li> <li>5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.</li> </ol>
<b>COURSE OUTCOMES:</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Understand how environment and biodiversity affect mechanical industries.</li> <li>• Learn about pollution types and how to control them in industries.</li> <li>• Know different renewable energy sources and green engineering ideas.</li> <li>• Understand sustainability, climate change, and how industries can help.</li> <li>• Apply ways to reduce waste, save energy, and make engineering more eco-friendly.</li> </ul>

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**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UME1401	STRENGTH OF MATERIALS	L	T	P	C
		2	1	2	4

**COURSE OBJECTIVES:**

- To understand the fundamental concepts of stress, strain, and deformation in solids.
- To analyze stresses in beams, thin shells, and biaxial stress conditions.
- To study deflections, torsion, and spring mechanics in structural members.

<b>UNIT-I</b>	<b>DEFORMATION OF SOLIDS</b>	9
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Relation between Elastic constants - Volumetric strains		
<b>UNIT-II</b>	<b>ANALYSIS OF STATE OF STRESSES</b>	9
Biaxial State of Stress-Thin Cylinders and Shells-Deformation in Thin Cylinders and Spherical Shells. Biaxial Stresses: Stresses at a Point on Inclined Planes-Principal Planes and Stresses-Mohr's Circle for Biaxial Stress-Maximum Shear Stress.		
<b>UNIT-III</b>	<b>TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM</b>	9
Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity		
<b>UNIT-IV</b>	<b>DEFLECTION OF BEAMS</b>	9
Elastic curve – Governing differential equation - Double integration method - Macaulay's method - for computation of slope and deflection of determinant beams. Columns: End condition – Equivalent Length of Column – Euler's Equation – Slenderness Ratio		
<b>UNIT-V</b>	<b>TORSION AND SPRINGS</b>	9
Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.		

L:30	T:15	P:15	Total :60 Periods
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**LIST OF EXPERIMENTS**

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Compression test on helical spring
5. Deflection test on carriage spring

**TEXT BOOKS**

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7<sup>th</sup> Edition, 2018
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.

## REFERENCES

1. Singh. D.K., "Strength of Materials", Ane Books Pvt Ltd., New Delhi, 2021.
2. Egor P Popov, "Engineering Mechanics of Solids", 2<sup>nd</sup> edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019.
4. Vazirani. V.N, Ratwani. M.M, Dugga .S.K "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.

## COURSE OUTCOMES:

### At the end of the course the students would be able to

- Understand stresses and deformation in bars under tension, compression, and shear.
- Analyze stresses at a point using principal stresses and Mohr's circle.
- Calculate shear force, bending moment, and bending stress in beams.
- Determine slope and deflection in beams using different methods.
- Analyze torsion in shafts and understand the behavior of springs.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEI402	THERMAL ENGINEERING	L	T	P	C
		3	0	2	4

**COURSE OBJECTIVES:**

- To understand and analyze various thermodynamic cycles used in engines and power plants.
- To learn the working principles and performance of compressors, turbines, and internal combustion engines.
- To gain knowledge of refrigeration and air-conditioning systems and their performance calculations.

<b>UNIT-I</b>	<b>THERMODYNAMIC CYCLES</b>	9
Air Standard Cycles – Carnot, Otto, Diesel, Dual, – Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles.		

<b>UNIT-II</b>	<b>COMPRESSORS</b>	9
Compressors: Classification of compressors – Radial and axial compressors – Performance characteristics: Volumetric efficiency, Isothermal efficiency and Isentropic efficiency – Effect of clearance volume – Multi stage air compressor with intercooling – Surging and stalling, Slip		

<b>UNIT-III</b>	<b>STEAM AND GAS TURBINES</b>	9
Types, Impulse and reaction principles, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.		

<b>UNIT-IV</b>	<b>INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION</b>	9
IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms		

<b>UNIT-V</b>	<b>REFRIGERATION AND AIR-CONDITIONING</b>	9
Refrigeration & air conditioning system: Vapour compression system – Effect of Super heat and Sub cooling – Performance calculations - Vapour absorption system - Ammonia water, Lithium bromide water – Psychrometric processes – Air conditioning system – Working principles and concept of RSHE, GSHE, ESHF- Cooling load calculations.		

L:30	T:15	P:15	Total :60 Periods
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<b>LIST OF EXPERIMENTS</b>
<ol style="list-style-type: none"> <li>1. Performance Test on four – stroke Diesel Engine.</li> <li>2. Heat Balance Test on 4 – stroke Diesel Engine.</li> <li>3. Morse Test on Multi-Cylinder Petrol Engine.</li> <li>4. Retardation Test on a Diesel Engine.</li> <li>5. Determination of COP of a Refrigeration system</li> </ol>
<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Mahesh. M. Rathore, “Thermal Engineering”, 1<sup>st</sup> Edition, Tata McGraw Hill, 2010.</li> <li>2. Ganesan.V, " Internal Combustion Engines" 4<sup>th</sup> Edition, Tata McGraw Hill, 2012.</li> </ol>
<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. Ballaney. P, “Thermal Engineering”, 25<sup>th</sup> Edition, Khanna Publishers, 2017.</li> <li>2. Domkundwar, Kothandaraman, &amp; Domkundwar, “A Course in Thermal Engineering”, 6<sup>th</sup> Edition, Dhanpat Rai &amp; Sons, 2011.</li> <li>3. Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2<sup>nd</sup> Edition Prentice Hall of India, 2013.</li> <li>4. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3<sup>rd</sup> Edition, Jain Brothers Pvt. Ltd, 2017.</li> <li>5. Soman. K, “Thermal Engineering”, 2<sup>nd</sup> Edition, Prentice Hall of India, 2011.</li> </ol>
<b>COURSE OUTCOMES:</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Understand and compare different thermodynamic cycles used in engines and power plants.</li> <li>• Explain the working and performance of different types of compressors.</li> <li>• Describe the operation and efficiency of steam and gas turbines.</li> <li>• Understand the components, working, and combustion process of IC engines.</li> <li>• Explain refrigeration and air conditioning systems and perform related calculations.</li> </ul>

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**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UME411	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

**COURSE OBJECTIVES:**

- To develop hands-on skills in basic machining operations and metal cutting techniques.
- To provide practical experience in gear manufacturing and welding processes.
- To introduce measurement of cutting forces and enhance understanding of machining performance.

**LIST OF EXPERIMENTS**

1. Fabricating simple structural shapes using Gas metal arc welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using radial drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Study of metal forming machine
11. Grinding components using cylindrical and centerless grinding machine.
12. Grinding components using surface grinding machine.
13. Cutting force calculation using dynamometer in lathe machine
14. Study of Injection Moulding machine

**L:0**

**P:60**

**T:0**

**T: 60 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Fabricate simple metal parts using welding and prepare sand moulds for casting.
- Perform taper turning, eccentric turning, knurling, and thread cutting on lathe machine.
- Machine square and hexagonal heads using shaper and carry out drilling and reaming operations.
- Mill contours and cut spur and helical gears using milling, hobbing, and shaping machines.
- Grind components using grinding machines and measure cutting forces during machining.

24UME412	CAD/CAM LABORATORY	L	T	P	C
		0	0	4	2

**COURSE OBJECTIVES:**

- To understand and apply basic CAD concepts including sketching, solid and surface modeling techniques.
- To learn feature manipulation and assembly modeling using constraints, interference checking, and exploded views.
- To develop skills in creating detailed 3D assembly models of common machine components using CAD software and practice manual drawing techniques.

<b>PART I</b>	<b>3D GEOMETRIC MODELLING</b>	<b>30</b>
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1. CAD Introduction

Sketch:

Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.

Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.

Feature manipulation: Copy, Edit, Pattern, Suppress, History operations.

Assembly: Constraints, Exploded Views, Interference check use of library component

Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting

2. Creation of 3D assembly model of following machine elements using 3D Modelling software

1. Flange Coupling

2. Plummer Block

3. Screw Jack

4. Lathe Tailstock

5. Universal Joint

6. Machine Vice

7. Stuffing box

8. Crosshead

\* Students may also be trained in manual drawing of some of the above components (specify the number – progressive arrangement of 3D)

<b>PART II</b>	<b>MANUAL PART PROGRAMMING</b>	<b>30</b>
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1. CNC Machining Centre

i) Linear Cutting.

ii) Circular cutting.

iii) Cutter Radius Compensation.

iv) Canned Cycle Operations.

2. CNC Turning Centre

i) Straight, Taper and Radial Turning.

ii) Thread Cutting.

iii) Rough and Finish Turning Cycle.

iv) Drilling and Tapping Cycle.

3. COMPUTER AIDED PART PROGRAMMING

i) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.

ii) Application of CAPP in Machining and Turning

<b>L:0</b>	<b>P:60</b>	<b>T:0</b>	<b>T: 60 PERIODS</b>
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**TEXT BOOKS**

1. Gopalakrishna K.R., "Machine Drawing", 17<sup>th</sup> Edition, Subhas Stores Books Corner, Bangalore, 2003.
2. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 51<sup>st</sup> Edition, Charator Publishers, 2022.

**REFERENCES**

1. K. L. Narayana, P. Kanniah, K. Venkata Reddy, Machine Drawing, 15 Edition, New Age International Publication
2. Goutam Pohit and Goutam Ghosh, "Machine Drawing with AutoCAD", 1st Edition, Pearson Education, 2004
3. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
4. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata McGrawHill, 2006
5. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Create and modify 2D sketches and 3D solid models using CAD tools like extrude, revolve, sweep, and loft.
- Build and edit complex surface models using extrusion, sweeping, trimming, and free-form tools.
- Apply feature operations such as copy, edit, pattern, suppress, and manage design history.
- Assemble multiple components using constraints, check for interferences, and create exploded views.
- Generate detailed engineering drawings with layouts, sectional views, and plotting for manufacturing.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.



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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR V SEMESTER**



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**Department of Mechanical Engineering**

**V Semester Syllabus**

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C	
<b>THEORY</b>								
1.	24UME501	Design of Machine Elements	PC	3	1	0	4	
2.	24UME502	Lean Manufacturing	PC	3	0	0	3	
3.	24UGE501	Human Values and Ethics	HSM	3	0	0	3	
4.		Professional Elective – I	PE	3	0	0	3	
5.		Open Elective – I	OE	3	0	0	3	
6.		Mandatory Course-I	Non credit					
<b>THEORY CUM PRACTICAL</b>								
7.	24UMEI501	Heat and Mass Transfer	PC	2	1	2	4	
<b>PRACTICAL</b>								
8.	24UME511	Metrology and Dynamics Laboratory	PC	0	0	4	2	
<b>Total Credits</b>				<b>17</b>	<b>2</b>	<b>6</b>	<b>22</b>	



24UME501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

**COURSE OBJECTIVES:**

- To understand the fundamental principles of machine design.
- To develop the skills to design essential mechanical components.
- To gain proficiency in the analysis and design of bearings, seals, and other miscellaneous machine elements.

<b>UNIT-I</b>	<b>FUNDAMENTAL CONCEPTS IN DESIGN</b>	12
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Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and ‘C’ frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.

<b>UNIT-II</b>	<b>DESIGN OF SHAFTS AND COUPLINGS</b>	12
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Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

<b>UNIT-III</b>	<b>DESIGN OF FASTENERS AND WELDED JOINTS</b>	12
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Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.

<b>UNIT-IV</b>	<b>DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS</b>	12
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Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs -rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines -Solid and Rimmed flywheels- connecting rods and crank shafts.

<b>UNIT-V</b>	<b>DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS</b>	12
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Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings Introduction to Seals and Gaskets.–Design of Seals and Gaskets.

<b>L:45</b>	<b>T:15</b>	<b>P:0</b>	<b>Total :60 Periods</b>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Bhandari V B, "Design of Machine Elements", 4<sup>th</sup> Edition , Tata McGraw-Hill Book Co, 2016</li> <li>2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10<sup>th</sup> Edition, Tata McGraw-Hill , 2015.</li> </ol>
<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1<sup>st</sup> Edition, Tata McGraw-Hill Book Co, 2004.</li> <li>2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements" 8<sup>th</sup> Edition, Printice Hall, 2004.</li> <li>3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design", 6<sup>th</sup> Edition, Wiley, 2017.</li> <li>4. Sundararamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.</li> <li>5. Design of Machine Elements   SI Edition   Eighth Edition   By Pearson by M. F. Spotts, Terry E. Shoup, et al., 2019</li> </ol>
<b>COURSE OUTCOMES:</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Explain the basic concepts of machine design and select appropriate materials based on mechanical properties.</li> <li>• Analyze different types of loads and stresses, and apply failure theories to ensure safe and efficient design.</li> <li>• Design shafts, couplings, fasteners, and welded joints for various mechanical applications.</li> <li>• Design energy-storing elements like springs and flywheels, along with engine components such as connecting rods and crankshafts.</li> <li>• Understand the working and design of bearings, seals, and gaskets used in machines.</li> </ul>



**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashpalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UME502	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the fundamental principles and elements of Lean Manufacturing.
- To learn and apply key Lean Manufacturing tools and methodologies
- To develop knowledge of quality management concepts related to Lean.

<b>UNIT-I</b>	<b>INTRODUCTION TO LEAN MANUFACTURING</b>	9
Mass production versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Types of wastes and activities.		

<b>UNIT-II</b>	<b>CELLULAR MANUFACTURING, JIT, TPM</b>	9
Cellular Manufacturing – Types of Layouts, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.		

<b>UNIT-III</b>	<b>SET UP TIME REDUCTION, TQM, 5S, VSM</b>	9
Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.		

<b>UNIT-IV</b>	<b>SIX SIGMA</b>	9
Six Sigma – Definition, statistical considerations, variability reduction, Design of experiments – Six Sigma implementation. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.		

<b>UNIT-V</b>	<b>QUALITY CONCEPTS FOR LEAN MANUFACTURING</b>	9
Quality concepts, Quality circle, Failure Mode and effects Analysis, Production Part Approval Process, Advanced Product Quality Planning, Zero defect approach, PDCA, Quality plan, Various case studies of implementation of lean manufacturing at industries.		

<b>L:45</b>	<b>T: 0</b>	<b>P: 0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Quality Planning and Analysis- JM Juran & FM Gryna, Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile South Asia

**REFERENCES**

1. Rother M. and Shook J, 1999 Learning to See: Value Stream Mapping to Add Value and Eliminate Muda ‘, Lean Enterprise Institute, Brookline, MA.
2. The Toyota Way: 14 Management Principles
3. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai
4. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain the basic principles and benefits of Lean Manufacturing and identify different types of waste.
- Describe and apply Cellular Manufacturing, JIT, and TPM concepts in manufacturing processes.
- Implement setup time reduction techniques, 5S, TQM, and value stream mapping for process improvement.
- Understand Six Sigma concepts and use statistical tools for reducing variability and improving quality.
- Apply quality management tools like FMEA, PDCA, and quality planning to achieve lean and zero-defect manufacturing.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UGE501	HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.

<b>UNIT-I</b>	<b>HUMAN VALUES</b>	<b>9</b>
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self Confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.		

<b>UNIT-II</b>	<b>ENGINEERING ETHICS</b>	<b>9</b>
Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.		

<b>UNIT-III</b>	<b>ENGINEERING AS SOCIAL EXPERIMENTATION</b>	<b>9</b>
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law. Framing the problem –Determining the facts – Codes of Ethics –Clarifying Concepts –Application issues –Common Ground –General Principles – Utilitarian thinking respect for persons-Case study		

<b>UNIT-IV</b>	<b>SAFETY, RESPONSIBILITIES AND RIGHTS</b>	<b>9</b>
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.		

<b>UNIT-V</b>	<b>GLOBAL ISSUES</b>	<b>9</b>
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility		

L:45	T: 00	P:00	Total :45 Periods
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**TEXT BOOK**

1. Mike W. Martin and Roland Schinzinger, Ethics in Engineeringl, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethicsl, Prentice Hall of India, New Delhi, 2004.

**REFERENCES**

1. Charles B. Fleddermann, —Engineering Ethicsl, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Engineering Ethics Concepts and Cases, Cengage Learning, 2009.
3. John R Boatright, Ethics and the Conduct of Businessl, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineersl, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, Business Ethics: Decision Making for Personal Integrity and Social Responsibilityl Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013..

**COURSE OUTCOMES**

**At the end of the course the students would be able to**

- Describe the human values with regard to the individual lifestyle for the society
- Explain the role of ethics to the engineering field
- Describe how engineering is applied in association with ethics based on engineering experimentation.
- Discuss the global issues of professional ethics in engineering.
- Explain the engineering ethics-based safety, responsibilities and rights



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEI501	HEAT AND MASS TRANSFER	L	T	P	C
		2	1	2	4

<b>Prerequisite</b>
Engineering Thermodynamics

<b>COURSE OBJECTIVES:</b>
<ul style="list-style-type: none"> <li>• To understand the core principles and mathematical models of heat conduction in steady and unsteady states.</li> <li>• To learn the fundamentals of convection, condensation, and heat exchangers with emphasis on analysis and heat-transfer enhancement methods.</li> <li>• To Gain basic knowledge of thermal radiation and mass transfer, including diffusion, convection, and their analogies with heat and momentum transfer.</li> </ul>

<b>UNIT-I</b>	<b>CONDUCTION</b>	12
General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction – plane and Composite Systems – Conduction with Internal Heat Generation –Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler’s charts – Methods of enhanced thermal conduction.		

<b>UNIT-II</b>	<b>CONVECTION</b>	12
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection. Case study- reducing heat transfer through surfaces.		

<b>UNIT-III</b>	<b>CONDENSATION AND HEAT EXCHANGERS</b>	12
Nusselt’s theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.		

<b>UNIT-IV</b>	<b>RADIATION</b>	12
Introduction to Thermal Radiation - Radiation laws and radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Radiation through gases.		

<b>UNIT-V</b>	<b>MASS TRANSFER</b>	12
Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state and Transient Diffusion -Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective mass transfer correlations.		

L:30	T:15	P:15	Total :60 Periods
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**LIST OF EXPERIMENTS:**

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils and water.
3. Determination of heat transfer coefficient of air under natural convection and forced convection.
4. Heat transfer from pin-fin under natural and forced convection.
5. Determination of heat flux under pool boiling and flow boiling in various regimes.
6. Determination of heat transfer coefficient in film-wise and drop-wise condensation

**TEXT BOOKS**

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009
2. Yunus A. Cengel, "Heat Transfer a Practical Approach" – Tata McGraw Hill, 5<sup>th</sup> Edition – 2013.

**REFERENCES**

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7<sup>th</sup> Edition, 2014.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand and solve problems related to heat conduction in different geometries and conditions.
- Explain the concepts of forced, free, and mixed convection and analyze heat transfer in various flows.
- Describe condensation processes and design basic heat exchangers using standard methods.
- Understand thermal radiation principles and calculate radiation heat transfer between surfaces.
- Explain mass transfer concepts including diffusion and convection, and apply relevant correlations in engineering problems.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME511	METROLOGY AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

**COURSE OBJECTIVES:**

- To provide hands-on experience in the calibration and use of linear, angular, and form measuring instruments for accurate dimensional inspection.
- To develop the ability to measure and analyze geometric features and machine elements.
- To understand and apply surface metrology and non-contact measurement techniques.

<b>UNIT-I</b>	<b>METROLOGY</b>	30
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**LIST OF EXPERIMENTS**

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.
3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.
4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.
6. Non-contact (Optical) measurement using Measuring microscope / Profile projector.
7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.

<b>UNIT-II</b>	<b>DYNAMICS LABORATORY</b>	30
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**LIST OF EXPERIMENTS**

1. Study of gear parameters.
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibrations of a single degree freedom spring-mass system.
6. Torsional Vibration (Undamped) of single rotor shaft system.
7. Dynamic analysis of cam mechanism.
8. Experiment on Watt Governor.
9. Experiment on Porter Governor. .
10. Experiment on motorized gyroscope.
11. Determination of critical speed of shafts.

L:0	T:0	P:60	Total :60 Periods
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**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Use and calibrate basic linear measuring instruments like vernier calipers, micrometers, and gauges.
- Measure angles accurately using tools like bevel protractors, sine bars, and autocollimators.
- Inspect screw threads and gear parameters using specialized instruments and techniques.
- Operate and program Coordinate Measuring Machines (CMM) for accurate 3D measurements.
- Perform surface and form measurements like flatness, roundness, and concentricity using appropriate instruments.



**Head of the Department**  
Department of Mechanical Engineering  
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Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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## **REGULATION 2024**

# **B. E. MECHANICAL ENGINEERING**

## **SYLLABUS FOR VI SEMESTER**





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### Department of Mechanical Engineering

#### VI Semester Syllabus

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C	
<b>THEORY</b>								
1.	24UME601	Additive Manufacturing	PC	3	0	0	3	
2.	24UME602	Design of Transmission Systems	PC	3	0	0	3	
3.		Professional Elective – II	PE	3	0	0	3	
4.		Professional Elective – III	PE	3	0	0	3	
5.		Professional Elective – IV	PE	3	0	0	3	
6.		Open Elective – II	OE	3	0	0	3	
7.		Mandatory Course - II	Non Credit					
<b>PRACTICAL</b>								
8.	24UME611	Computer Aided Engineering Laboratory	PC	0	0	4	2	
9.	24UME612	Mini project	EE	0	0	4	2	
<b>Total Credits</b>				<b>18</b>	<b>0</b>	<b>8</b>	<b>22</b>	



24UME601	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the fundamentals, evolution, and classifications of Additive Manufacturing technologies.
- To explore the working principles, materials, processes, and applications of various AM techniques.
- To develop design competencies tailored to Additive Manufacturing.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	9
<p>Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.</p>		

<b>UNIT-II</b>	<b>VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION</b>	9
<p>Introduction and Principle of Vat Photo polymerization, Stereolithography (SLA)- Process steps and working mechanism, Digital Light Processing (DLP)- Working principle and comparison with SLA, Two-Photon Polymerization (2PP)- Basic concept and high-resolution micro-fabrication, Directed Energy Deposition (DED)- Laser Engineered Net Shaping (LENS), Electron Beam Additive Manufacturing (EBAM), Direct Metal Deposition (DMD)</p>		

<b>UNIT-III</b>	<b>POWDER BED FUSION AND MATERIAL EXTRUSION</b>	9
<p>Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.</p>		

<b>UNIT-IV</b>	<b>OTHER ADDITIVE MANUFACTURING PROCESSES</b>	9
<p>Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Overview on 4D Printing, Mechanism: Materials-Application and Limitation.</p>		

<b>UNIT-V</b>	<b>FILE FORMATS &amp; DESIGN FOR AM (DFAM)</b>	9
<p>AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation. Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - – Design rules for Extrusion based AM.</p>		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3<sup>rd</sup> edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. . Pham, D. T., & Dimov, S. S. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.

**REFERENCES**

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1<sup>st</sup> Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States 2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand the basics of Additive Manufacturing and its uses in different industries like automotive, aerospace, and healthcare.
- Learn how different AM methods work, such as Vat Polymerization, Directed Energy Deposition, Powder Bed Fusion, and FDM.
- Know about other AM processes like Binder Jetting, Material Jetting, Sheet Lamination, and 4D Printing, including their pros and cons.
- Understand the file formats used in AM and how to improve part quality using correct design steps like orientation and slicing.
- Use special design techniques like generative design, topology optimization, and lattice structures to create better AM parts.



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Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME602	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To equip students with fundamental knowledge and design skills for flexible transmission element.
- To enable students to analyze and design various gear systems.
- To develop the ability to design mechanical systems involving gearboxes, cams, clutches, and brakes.

<b>UNIT-I</b>	<b>DESIGN OF FLEXIBLE ELEMENTS</b>	9
Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.Introduction to modern transmission systems		

<b>UNIT-II</b>	<b>SPUR GEARS AND PARALLEL AXIS HELICAL GEARS</b>	9
Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.		

<b>UNIT-III</b>	<b>BEVEL AND WORM GEARS AND CROSS HELICAL GEARS</b>	9
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.		

<b>UNIT-IV</b>	<b>GEAR BOXES</b>	9
Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.		

<b>UNIT-V</b>	<b>CAMS AND CLUTCHES AND BRAKES</b>	9
Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Bhandari V, "Design of Machine Elements", 4<sup>th</sup> Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.

**REFERENCES**

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8<sup>th</sup> Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4<sup>th</sup> Edition, Wiley, 2005
4. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand and design basic flexible power transmission elements such as belts, ropes, chains, and modern transmission systems.
- Analyze and design spur and helical gears considering tooth forces, stresses, materials, and strength requirements.
- Apply gear design principles to bevel, worm, and cross-helical gears, including force analysis, efficiency, and size estimation.
- Design various types of gearboxes using step ratios, ray diagrams, and kinematic layouts for automotive and machine tool applications.
- Design cams, clutches, and brakes by evaluating geometry, forces, stresses, and performance requirements.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashpalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UME611	COMPUTER AIDED ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

**COURSE OBJECTIVES:**

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

**A. SIMULATION**

10

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

**B. ANALYSIS**

35

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

**L:0 T:00 P:45 Total :45 Periods**

**LIST OF EQUIPMENTS**

1. Computer Work Station	15
2. Color Desk Jet Printer	01
3. Multibody Dynamic Software Suitable for Mechanism simulation and analysis	15 licenses
4. C / MATLAB	05 licenses

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

1. Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB.
2. Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.
3. Calculate the natural frequency and mode shape analysis of 2D components and beams.

24UME612	MINI PROJECT	L	T	P	C
		0	0	4	2

**OBJECTIVES:**

The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

**GUIDELINE FOR REVIEW AND EVALUATION**

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ System / component (s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

L: 0	P:60	T: 0	T: 60 PERIODS
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**COURSE OUTCOMES:**

At the end of the course the students would be able to

- Design and fabricate the machine element or the mechanical product.
- Demonstrate the working model of the machine element or the mechanical product.



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 Department of Mechanical Engineering  
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 Tirupur-638 660. Tamil Nadu, India.

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Recognized by UGC & Accredited by NAAC and NBA (CSE and ECE)



## **REGULATION 2024**

# **B. E. MECHANICAL ENGINEERING**

## **SYLLABUS FOR PROFESSIONAL ELECTIVE I**



24UMEP501	ADVANCED CASTING AND WELDING PROCESSES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the composition, properties, and applications of ferrous and non-ferrous cast alloys.
- To learn the physical metallurgy involved in welding and how different materials behave during welding processes.
- To identify common casting and welding defects and understand methods of inspection and relevant standards.

<b>UNIT-I</b>	<b>FERROUS CAST ALLOYS</b>	10
<p>Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family &amp; microstructures-Alloying effects- Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions.</p>		

<b>UNIT-II</b>	<b>NON-FERROUS CAST ALLOYS</b>	9
<p>Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys-problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings</p>		

<b>UNIT-III</b>	<b>PHYSICAL METALLURGY OF WELDING</b>	8
<p>Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.</p>		

<b>UNIT-IV</b>	<b>WELDING OF ALLOY STEELS AND NON-FERROUS METALS</b>	9
<p>Basics of metal preparation for welding and selection of welding rods. Welding of cast irons, stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions</p>		

<b>UNIT-V</b>	<b>DEFECTS, WELDABILITY, INSPECTION AND STANDARDS</b>	9
<p>Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Methods used for inspection of casting and welding. Visual, magnetic particle, fluorescent particle, ultrasonic. Radiography, eddy current, holography methods of inspection. Introduction to International Standards and Codes</p>		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017.</li> <li>2. A.K.Chakrabarthi, 'Casting Technology and Cast Alloys, Prentice Hall, 2005.</li> </ol>
<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. ASM International. Handbook Committee, ASM Handbook: Casting. Volume 15, ASM International, 2008.</li> <li>2. Baldev Raj, Shankar V, Bhaduri A K, "Welding Technology for Engineers", Narosa Publications, 2009.</li> <li>3. Beeley P, "Foundry Technology" Butterworth-Heinemann, 2001.</li> <li>4. R.S. Parmar, 'Welding Engineering and Technology', Khanna Publishers, 2010</li> <li>5. John Campbell, "Casting", Butterworth-Heinemann, 2003.</li> </ol>
<b>COURSE OUTCOMES:</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Explain the composition, structure, and properties of various ferrous and non-ferrous cast alloys.</li> <li>• Describe the melting practices, heat treatment, and composition control of common casting alloys.</li> <li>• Understand the physical changes and microstructures that occur during welding of different metals.</li> <li>• Identify welding methods and challenges in joining alloy steels and non-ferrous metals.</li> <li>• Recognize common casting and welding defects and apply basic inspection and testing methods.</li> </ul>

  
**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMEP502	ENERGY STORAGE DEVICES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the need, types, and working principles of different energy storage systems.
- To explore various storage technologies for renewable energy, electric vehicles, and hybrid energy systems.
- To learn about advanced energy devices such as fuel cells, super capacitors, and energy management techniques.

<b>UNIT-I</b>	<b>INTRODUCTION TO ENERGY STORAGE</b>	9
Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison.		

<b>UNIT-II</b>	<b>ENERGY STORAGE SYSTEMS</b>	9
Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types - Charging and Discharging – Battery testing and performance		

<b>UNIT-III</b>	<b>MOBILE AND HYBRID ENERGY STORAGE SYSTEMS</b>	9
Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.		

<b>UNIT-IV</b>	<b>RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT</b>	9
Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management		

<b>UNIT-V</b>	<b>OTHER ENERGY DEVICES</b>	9
Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC,MCFC and Biofuel Cells – Biogas Storage.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2<sup>nd</sup> Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001

**REFERENCES**

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & amp; Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications", University Press(India), 2006
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain the need for energy storage and compare different energy storage methods.
- Describe the working and performance of mechanical, thermal, and electrochemical storage systems.
- Identify suitable energy storage systems for electric vehicles and hybrid applications.
- Understand energy storage in renewable systems and apply basic energy management techniques.
- Recognize the principles and types of advanced energy devices like fuel cells and super capacitors.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP503	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the working principles, components, and layout of different types of power plants including thermal, nuclear, and renewable.
- To learn about the operation, performance, and efficiency improvement methods for various power generation systems.
- To explore the economic, environmental, and technological issues related to power plant operation and energy production.

<b>UNIT-I</b>	<b>COAL BASED THERMAL POWER PLANTS</b>	9
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.		

<b>UNIT-II</b>	<b>DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS</b>	9
Components of Diesel and Gas Turbine powerplants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems. Improve the efficiency of a diesel power plant		

<b>UNIT-III</b>	<b>NUCLEAR POWER PLANTS</b>	9
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants		

<b>UNIT-IV</b>	<b>POWER FROM RENEWABLE ENERGY</b>	9
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.		

<b>UNIT-V</b>	<b>ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS</b>	9
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineering by R.K. Rajput, 2016

**REFERENCES**

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019.
5. Power Plant Engineering, as per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al., 2019.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Describe the layout, components, and working of coal-based thermal power plants.
- Explain the operation and efficiency improvement of diesel, gas turbine, and combined cycle power plants.
- Understand the types, functioning, and safety measures of nuclear power plants.
- Identify various renewable energy power systems and their basic principles.
- Analyze the economic, environmental, and operational aspects of different power plants.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP504	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the fundamentals, types, and applications of composite materials.
- To learn the processing, properties, and applications of PMC, MMC, and CMC.
- To explore advanced composites, aerospace applications, and material characterization.

<b>UNIT-I</b>	<b>INTRODUCTION TO COMPOSITES</b>	9
Fundamentals of composites Definition classification-based on Matrix-based on structure Advantages and applications of composites - Reinforcement whiskers-glass fiber-carbon fiber-Aramid fiber- ceramic fiber Properties and applications		

<b>UNIT-II</b>	<b>POLYMER MATRIX COMPOSITES</b>	9
Polymers- Polymer matrix materials - PMC processes- hand layup process- spray up process -resin transfer moulding- Pultrusion- Filament winding- Autoclave based methods – Injection- moulding-sheet moulding compound-properties and applications of PMC's		

<b>UNIT-III</b>	<b>METAL MATRIX COMPOSITES</b>	9
Metals -types of metal matrix composites - Metallic Matrices. Processing of MMC - Liquid state processes - solid state processes - In-situ processes. Properties and applications of MMC's		

<b>UNIT-IV</b>	<b>CERAMIC MATRIX COMPOSITES</b>	9
Ceramic matrix materials-properties-processing of CMCs-Sintering - Hot pressing - Infiltration-Lanxide process-In-situ chemical reaction techniques-sol-gel polymer pyrolysis -SHS - Cold isostatic pressing (CIPing) - Hot isostatic pressing (HIPing). Properties and Applications of CCMs.		

<b>UNIT-V</b>	<b>ADVANCES IN COMPOSITES</b>	9
Advantages of carbon matrix -limitations of carbon matrix carbon fibre -chemical vapour deposition of carbon on carbon fibre perform. Properties and applications of Carbon-carbon composites. Composites for aerospace applications. Characterization of composite materials - Mechanical Properties, Thermal Properties.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Chawla K.K, Composite materials, 2/e, Springer-Verlag, 1998.
2. Mathews F.L. and Rawlings R.D., Chapman and Hall, Composite Materials: Engineering and Science, 1/e, England, 1994.

**REFERENCES**

1. HK Shivanand, BV Babu Kiran, Composite Materials, ASIAN BOOKS 2011.
2. A.B. Strong, Fundamentals of Composite Manufacturing, SME, 1989.
3. S.C. Sharma, Composite materials, Narosa Publications, 2000.
4. Maureen Mitton, Hand Book of Bioplastics & Bio-composites for Engineering applications, John Wiley publications.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Identify and explain the fundamentals, classifications, reinforcements, and applications of composite materials.
- Understand the processing methods, properties, and applications of polymer matrix composites (PMC).
- Analyze the types, fabrication techniques, properties, and uses of metal matrix composites (MMC).
- Explain the processing, properties, and applications of ceramic matrix composites (CMC).
- Evaluate advanced composites, aerospace applications, and characterization of mechanical and thermal properties.

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP505</b>	<b>ELECTRICAL DRIVES AND ACTUATORS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the operation and characteristics of power semiconductor devices and their use in motor control.
- To learn the dynamics, selection, and control methods of various electric motors and drives.
- To explore the working principles and applications of DC, AC, stepper, and servo motors.

<b>UNIT-I</b>	<b>RELAY AND POWER SEMI-CONDUCTOR DEVICES</b>	<b>9</b>
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits		

<b>UNIT-II</b>	<b>DRIVE CHARACTERISTICS</b>	<b>9</b>
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.		

<b>UNIT-III</b>	<b>DC MOTORS AND DRIVES</b>	<b>9</b>
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications		

<b>UNIT-IV</b>	<b>AC MOTORS AND DRIVES</b>	<b>9</b>
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.		

<b>UNIT-V</b>	<b>STEPPER AND SERVO MOTOR</b>	<b>9</b>
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servomotor – Applications.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

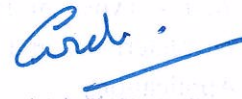
1. Bimbhra B.S., "Power Electronics", 5<sup>th</sup> Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2<sup>nd</sup> Edition, S.Chand & Co. Ltd., New Delhi, 2016.

**REFERENCES**

1. Gopal K. Dubey, "Fundamentals of Electrical Drives", 2<sup>nd</sup> Edition, Narosal Publishing House, New Delhi, 2001.
2. Theraja B.L. & Theraja A.K., "A Text Book of Electrical Technology", 2<sup>nd</sup> Edition, S. Chand & Co. Ltd., New Delhi, 2012.
3. Singh M.D. & Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Explain the types and characteristics of power semiconductor switching devices.
- Understand motor load dynamics and select suitable motors for different drive applications.
- Describe the working and control of DC motors, including PMDC and BLDC motors.
- Analyze the speed control methods for three-phase induction motors.
- Understand the construction, operation, and applications of stepper and servo motors.



**Head of the Department**  
Department of Mechanical Engineering  
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Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP506</b>	<b>COMPUTER NUMERICAL CONTROL TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the construction, working principles, and control systems of CNC machines.
- To learn CNC part programming methods and apply them to various machining operations.
- To explore the fundamentals of CAM, automation concepts, and economic aspects of CNC machine operation and maintenance.

<b>UNIT-I</b>	<b>CNC MACHINES</b>	<b>9</b>
NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feedback devices – Interchangeable tooling system – preset & qualified tools – ISO specification – Machining center – Turning center – CNC EDM – CNC wire cut EDM.		

<b>UNIT-II</b>	<b>CONSTRUCTIONAL FEATURES OF CNC MACHINES</b>	<b>9</b>
Machine structure - Slideways –Ball screws-Accessories-Spindle drives-Axes feed drives - Open and closed loop control - Types of positional control-Machine Tool control-Control of Spindle speed-Control of slide movement and velocity.		

<b>UNIT-III</b>	<b>CNC PROGRAMMING</b>	<b>9</b>
Manual part programming - Structure of CNC program, Coordinate system, G & M codes – steps involved – sample program in lathe & milling. – Computer-aided part programming – APT – CAM package – canned cycles – Programming.		

<b>UNIT-IV</b>	<b>ECONOMICS AND MAINTENANCE</b>	<b>9</b>
Factors influencing selection of CNC Machines-Cost of operation of CNC Machines-Cost of Operation of CNC Machines-Practical aspects of introduction of CNC-Maintenance features of CNC Machines-Preventive Maintenance.		

<b>UNIT-V</b>	<b>FUNDAMENTALS OF CAM</b>	<b>9</b>
Brief introduction to CAM – Manufacturing Planning, Manufacturing control – Concurrent Engineering – CIM concepts – Computerized elements of CIM system – Types of production Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.		

<b>L:45</b>	<b>T:00</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Nagpal G.R., "Machine Tool Engineering", Khanna Publishers, 2002.
2. Radhakrishnan P., "Computer Numerical Control Machines and Computer Aided Manufacturing", New Age International Publishers., United States, 2018, ISBN-13: 978-8122433975.

**REFERENCES**

1. Mike Mattson., "CNC Programming Principles and Applications", 2<sup>nd</sup> Edition, Delmar Cengage Learning, United States, 2010, ISBN: 9781418060992.
2. Smid P., "CNC Programming Handbook", 3<sup>rd</sup> Edition, Industrial Press Inc., United States, 2008, ISBN-13: 978-0831133474.
3. Rao P.N., "CAD/CAM Principles and Applications", 3<sup>rd</sup> Edition, Tata McGraw, Hill Publishing Company Limited, New Delhi, 2010, ISBN-13: 978-0070681934.
4. Smid P., "CNC Programming Handbook", 3<sup>rd</sup> Edition, Industrial Press Inc., United States, 2008, ISBN-13: 978-0831133474.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Explain the types, construction, and control systems of CNC machines.
- Understand the features of CNC machine components like slideways, ball screws, and drive systems.
- Write and interpret CNC part programs using G and M codes for lathe and milling operations.
- Analyze the cost, selection factors, and maintenance requirements of CNC machines.
- Describe the basics of CAM, CIM, automation levels, and modern production concepts like lean and JIT.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashpalayam,  
Tirupur-638 660. Tamil Nadu, India.

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## **REGULATION 2024**

# **B. E. MECHANICAL ENGINEERING**

## **SYLLABUS FOR PROFESSIONAL ELECTIVE II**



24UMEP601	NON-DESTRUCTIVE TESTING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the principles, advantages, and limitations of various non-destructive testing (NDT) methods.
- To learn the procedures, tools, and interpretation techniques used in visual, liquid penetrant, magnetic particle, eddy current, ultrasonic, thermography, and acoustic emission testing.
- To gain knowledge of radiographic testing techniques and ensure safe and effective evaluation of material defects.

<b>UNIT-I</b>	<b>INTRODUCTION TO NDT &amp; VISUAL TESTING</b>	9
<p>Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibrosopes – light sources and special lighting.</p>		

<b>UNIT-II</b>	<b>LIQUID PENETRANT &amp; MAGNETIC PARTICLE TESTING</b>	9
<p>Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods &amp; Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.</p>		

<b>UNIT-III</b>	<b>EDDY CURRENT TESTING &amp; THERMOGRAPHY</b>	9
<p>Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact &amp; Non-Contact inspection methods, Active &amp; Passive methods, Liquid Crystal – Concept, example, advantages &amp; limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.</p>		

<b>UNIT-IV</b>	<b>ULTRASONIC TESTING &amp; AET</b>	9
<p>Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages &amp; Limitations, Interpretation of Results, Applications.</p>		

<b>UNIT-V</b>	<b>RADIOGRAPHY TESTING</b>	9
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrimeters, safety in radiography.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1 Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3<sup>rd</sup> edition, 2002.</li> <li>2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw Hill Education, 2<sup>nd</sup> edition, 2011.</li> </ol>
<b>REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.</li> <li>2. Barry Hull and Vernon John, "Nondestructive Testing", Macmillan, 1989.</li> <li>3. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2012.</li> <li>4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.</li> <li>5. Paul E. Mix "Introduction to Non-Destructive Testing": "A Training Guide" Publisher: Wiley-Inter science</li> </ol>
<b>COURSE OUTCOMES:</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Understand the basic concepts and methods used in non-destructive testing (NDT).</li> <li>• Explain the principles and procedures of liquid penetrant and magnetic particle testing.</li> <li>• Describe eddy current testing and thermography methods with their applications.</li> <li>• Apply ultrasonic and acoustic emission testing techniques for flaw detection.</li> <li>• Understand radiographic testing methods and ensure safety during their application.</li> </ul>

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**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMEP602	MODERN ROBOTICS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To introduce definition, history of robotics and robot anatomy.
- To learn the simulation of robot kinematics
- To study the grasping and manipulation of robots.

<b>UNIT-I</b>	<b>INTRODUCTION TO ROBOTICS</b>	9
Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications		

<b>UNIT-II</b>	<b>ROBOT KINEMATICS</b>	9
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices Denvavit and Hartenberg (D-H) transformation.		

<b>UNIT-III</b>	<b>ROBOT DRIVE SYSTEMS AND END EFFECTORS</b>	9
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper		

<b>UNIT-IV</b>	<b>SENSORS IN ROBOTICS</b>	9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis.		

<b>UNIT-V</b>	<b>APPLICATIONS OF ROBOTS</b>	9
Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare. Demonstration using beginner level robots. Introduction to COBOTS.		

<b>L:30</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park, Cambridge University Press; 1<sup>st</sup> edition, 2017, ISBN-10 : 110715
2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education, 2019), ISBN-10 : 1641720751

**REFERENCES**

1. Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press, 2019, ISBN-10 : 1682856763
2. Advanced Technologies in Modern Robotic Applications, by Chenguang Yang , Hongbin Ma, Mengyin Fu, Springer; Softcover reprint of the original 1<sup>st</sup> ed. 2016 edition, 2018, ISBN10 : 981109263X
3. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition, 2006, ISBN-10 : 0816057451
4. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441
5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing, 2022, ISBN-10 : 1639873732

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Discuss the definition, history of robotics and robot anatomy.
- Develop the simulation of robot kinematics
- Describe the grasping and manipulation of robots.
- Explain about mobile robot and manipulation.
- Discuss the applications of industrial, service, domestic robots.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP603</b>	<b>SMART MOBILITY AND INTELLIGENT VEHICLES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
- To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
- To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task.

<b>UNIT-I</b>	<b>INTRODUCTION TO AUTOMATED, CONNECTED AND INTELLIGENT VEHICLES</b>	<b>9</b>
Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Power train Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles		

<b>UNIT-II</b>	<b>SENSOR TECHNOLOGY FOR SMART MOBILITY</b>	<b>9</b>
Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems		

<b>UNIT-III</b>	<b>CONNECTED AUTONOMOUS VEHICLE</b>	<b>9</b>
Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy		

<b>UNIT-IV</b>	<b>VEHICLE WIRELESS TECHNOLOGY &amp; NETWORKING</b>	<b>9</b>
Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks		

<b>UNIT-V</b>	<b>CONNECTED CAR &amp; AUTONOMOUS VEHICLE TECHNOLOGY</b>	<b>9</b>
Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019, Springer

**REFERENCES**

1. Tom Denton, "Automobile Electrical and Electronic systems, Routledge", Taylor & Francis Group, 5<sup>th</sup> Edition, 2018.
2. Rajesh Rajamani – Vehicle Dynamics and Control, Springer
3. Reza N. Jazar – Vehicle Dynamics: Theory and Application, Springer
4. Lingkaran Hai, Umit Ozguner & Daniel Fagnant – Autonomous Vehicles and Intelligent Transportation Systems, CRC Press
5. Mehmet C. Vuran, Azzedine Boukerche & Ekram Hossain – Vehicular Networks and Intelligent Transportation Systems, Wiley

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles
- Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing
- Familiar with the concept of fully autonomous vehicles
- Apply the basic concepts of wireless communications and wireless data networks
- Analyze the concept of the connected vehicle and its role in automated vehicles



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP604	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To study the fundamentals of compressible flow concepts and the use of gas tables.
- To learn the compressible flow behavior in constant area ducts.
- To study the development of shock waves and its effects.

<b>UNIT-I</b>	<b>BASIC CONCEPTS AND ISENTROPIC FLOWS</b>	10
Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.		

<b>UNIT-II</b>	<b>COMPRESSIBLE FLOW THROUGH DUCTS</b>	9
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Use of Gas tables.		

<b>UNIT-III</b>	<b>NORMAL AND OBLIQUE SHOCKS</b>	8
Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.		

<b>UNIT-IV</b>	<b>JET PROPULSION</b>	9
Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.		

<b>UNIT-V</b>	<b>SPACE PROPULSION</b>	9
Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Rocket performance calculations. Applications-space flights		

L:45	T: 0	P: 0	Total :45 Periods
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**TEXT BOOKS**

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M.Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

**REFERENCES**

1. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2<sup>nd</sup> edition, Wiley, 2011.
2. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2007.
3. Radhakrishnan, E., "Gas Dynamics", Prentice Hall of India, 2006.
4. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
5. Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1<sup>st</sup> Edition, 2008

**COURSE OUTCOMES:**

At the end of the course the students would be able to

- Understand the basic concepts of compressible flow, Mach number, flow regimes, stagnation properties, and isentropic relations.
- Analyze compressible flow in ducts such as Rayleigh (heat transfer) and Fanno (friction) flows using gas tables.
- Explain normal and oblique shocks, Rankine–Hugoniot relations, and Prandtl–Meyer expansion with changes in flow properties.
- Understand the working principles, cycle analysis, and performance of different jet propulsion systems such as ramjet, turbojet, turbofan, turboprop, and pulsejet engines.
- Explain rocket propulsion concepts, types of rocket engines, propellants, thrust and velocity calculations, staging, and space mission applications.



Head of the Department  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP605</b>	<b>COMPUTER INTEGRATED MANUFACTURING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the principles, components, and evolution of Computer Integrated Manufacturing (CIM) systems.
- To learn the concepts of automated manufacturing, group technology, flexible manufacturing systems (FMS), and process planning.
- To explore process control methods, data analysis, and automation technologies used in modern manufacturing environments.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>9</b>
Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM		

<b>UNIT-II</b>	<b>AUTOMATED MANUFACTURING SYSTEMS</b>	<b>9</b>
Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types & applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems– Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing.		

<b>UNIT-III</b>	<b>GROUP TECHNOLOGY AND FMS</b>	<b>9</b>
Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS – FMS applications, Benefits.		

<b>UNIT-IV</b>	<b>PROCESS PLANNING</b>	<b>9</b>
Process planning – Activities in process planning, Information required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning.		

Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

<b>UNIT-V</b>	<b>PROCESS CONTROL AND DATA ANALYSIS</b>	9
Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control – Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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<b>TEXT BOOKS</b>
<ol style="list-style-type: none"> <li>1. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.</li> <li>2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer</li> </ol>
<b>REFERENCES</b>
<ol style="list-style-type: none"> <li>1. Alavudeen and Venkateshwaran, Computer Integrated ManufacturingI, PHI Learning Pvt. Ltd., New Delhi, 2013.</li> <li>2. Gideon Halevi and Ronald D. Weill, Principles of Process PlanningI, Chapman Hall, 1995.</li> <li>3. James A. Retrg, Herry W. Kraebber, Computer Integrated ManufacturingI, Pearson Education, Asia,3<sup>rd</sup> Edition,2004.</li> <li>4. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3<sup>rd</sup> Edition, 2008.</li> <li>5. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.</li> </ol>
<b>COURSE OUTCOMES:</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Explain the concepts, components, and evolution of CIM systems.</li> <li>• Describe automated manufacturing systems, material handling, and smart factory technologies.</li> <li>• Apply group technology and explain the layout and operations of flexible manufacturing systems (FMS).</li> <li>• Understand manual and computer-aided process planning methods and tools.</li> <li>• Explain process control systems, data acquisition methods, and automated inspection techniques.</li> </ul>

  
**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMEP606	ELECTRIC VEHICLE TECHNOLOGIES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To provide a comprehensive understanding of rotating and static power converters, including their working principles, characteristics, and applications in electrical machines.
- To impart knowledge on control strategies for DC and AC motor drives, emphasizing advanced techniques such as vector control and four-quadrant operation.
- To introduce hybrid and electric vehicle architectures, powertrain components, energy storage systems, and battery management techniques for efficient EV operation.

<b>UNIT-I</b>	<b>ROTATING POWER CONVERTERS</b>	9
Magnetic circuits- DC machine and AC machine –Working principle of Generator and Motor- DC and AC - Voltage and torque equations – Characteristics and applications. Working principle of special machines like: Brushless DC motor, Switched reluctance motor and PMSM.		

<b>UNIT-II</b>	<b>STATIC POWER CONVERTERS</b>	9
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.		

<b>UNIT-III</b>	<b>CONTROL OF DC AND AC MOTOR DRIVES</b>	9
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter-based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives		

<b>UNIT-IV</b>	<b>HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS</b>	9
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.		

<b>UNIT-V</b>	<b>ENERGY STORAGE AND BATTERY MANAGEMENT</b>	9
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles. Battery specifications, Battery based energy storage and its analysis. Battery Management System: Functions of BMS, Block diagram of BMS. SoC Estimation methods, Thermal Management of Battery.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

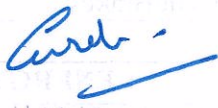
1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

**REFERENCES**

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7<sup>th</sup> Edition, 2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3<sup>rd</sup> Edition, Wiley-IEEE Press, 2013.
4. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10<sup>th</sup> Impression 2021.
5. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Analyze the working principles and characteristics of DC and AC machines, including special electrical machines like BLDC, PMSM, and SRM.
- Explain the functionality and applications of various power semiconductor devices and static power converters, such as rectifiers, inverters, and choppers.
- Implement speed control strategies for different motor drives, including vector control and V/f operation, for efficient motor performance.
- Compare different electric and hybrid vehicle architectures, evaluate powertrain components, and understand the role of gears, transmission, and braking systems.
- Assess energy storage requirements, battery technologies, and battery management systems, including SoC estimation and thermal management, for hybrid and electric vehicles.

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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## **REGULATION 2024**

# **B. E. MECHANICAL ENGINEERING**

## **SYLLABUS FOR PROFESSIONAL ELECTIVE III**



24UMEP607	MICRO AND NANO MACHINING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the fundamental techniques and processes used in micro fabrication and MEMS manufacturing.
- To learn about micro-machining, lithography, etching, and bonding techniques used in device miniaturization.
- To explore the production methods, properties, and applications of carbon nano tubes and nanotechnology in advanced systems.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	9
Micro fabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding, MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, High- Aspect- Ratio Micromachining.		

<b>UNIT-II</b>	<b>MICRO-MACHINING</b>	9
Material removal at micro-scale: size effect, chip thickness, Micro-Structure and Grain Size Effects; Tool geometry, Tool wear, and Tool Deflections, Tool Stiffness and Deflections under Dynamic Loading, Micro Turing and Micro Milling		

<b>UNIT-III</b>	<b>ETCHING</b>	9
Characterizing etching processes in bulk micromachining; micro-fabrication of MEMS and semiconductor devices; basics of micro-fabrication, integrated circuit fabrication; crystallography and its effects, silicon as substrate and structural material, stress and strain, crystal plane effects on etching, wet etching process, reaction phenomena, anisotropic etching, isotropic etch curves, masking for anisotropic etchants, etching control, fusion bonding of silicon on an insulator, deep reactive ion etching, fabrication of a cantilever probe, manufacture, microprocessors.		

<b>UNIT-IV</b>	<b>LITHOGRAPHY</b>	9
Principle of the soft lithography and applications; principle of micro contact printing and applications; characterizing the surface micromachining process, isolation layer, sacrificial layer, structural material, selective etching – properties, stress, stress measurement, friction; wafer bonding: anodic and fusion, bonding. Micro and nanotechnology: Applications for space micro propulsion, subsystems and devices for miniaturized spacecrafts micro propulsion: microbolomete, micro FEED, integrated cold-gas microthruster, microturbogas, pyrotechnic actuator and micro valve etc - propulsion systems: solid propellant, ADCS.		

<b>UNIT-V</b>	<b>CARBON NANO-TUBE PRODUCTION AND APPLICATION</b>	<b>9</b>
<p>Basis of nanotechnology, structure and properties of carbon nano tubes- production of carbon nano tube: chemical vapor deposition, arc discharge, laser ablation, mechanisms of growth, purification of carbon nano tube, applications: electrical transport of carbon nano tubes for FET, Computers, nano devices for biomedical, X-ray equipment, nano mechanic actuator and artificial muscles, fuel cells, membrane electrode assembly, mechanical and electrical reinforcement of bipolar plates, hydrogen storage.</p>		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Koc M and Ozel T, Micro-manufacturing: Design and Manufacturing of micro products, wiley.
2. Mahalik N P, Micro-manufacturing and nanotechnology, Springer

**REFERENCES:**

1. Jackson M J, Micro and nano-manufacturing, Springer.
2. Ramsden J, Micro & nano technologies, Elsevier.
3. Kahrizi M, Micromachining techniques for fabrication of micro, nano structures.
4. Gabor L H, Tibbals H F, Dutta J and Moore J, Introduction to Nan science and Nanotechnology, CRC.
5. Ahmed W and Jackson M J, Emerging nanotechnologies for manufacturing, Elsevier.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain various microfabrication techniques such as lithography, etching, and substrate bonding.
- Understand the principles of micro-machining and its effects on material removal at the micro-scale.
- Describe etching processes and challenges in MEMS and semiconductor device fabrication.
- Understand surface micromachining, soft lithography, and their applications in micro and space devices.
- Explain the production, properties, and applications of carbon nanotubes and nanotechnology.



**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashpalayam,  
 Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP608</b>	<b>PRODUCT LIFECYCLE MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the fundamentals, functions, and infrastructure of Product Lifecycle Management (PLM) and Product Data Management (PDM).
- To explore the features, modules, and industrial applications of PLM/PDM software tools.
- To learn the strategies, benefits, customization, and integration of PLM systems in real-world industries.

<b>UNIT-I</b>	<b>HISTORY, CONCEPTS AND TERMINOLOGY OF PLM</b>	<b>9</b>
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications		

<b>UNIT-II</b>	<b>PLM/PDM FUNCTIONS AND FEATURES</b>	<b>9</b>
User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.		

<b>UNIT-III</b>	<b>DETAILS OF MODULES IN A PDM/PLM SOFTWARE</b>	<b>9</b>
Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed		

<b>UNIT-IV</b>	<b>ROLE OF PLM IN INDUSTRIES</b>	<b>9</b>
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance- process compliance and process automation		

<b>UNIT-V</b>	<b>BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE</b>	<b>9</b>
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP, PLM modules		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition, 2016, ISBN-10 : 3662516330
2. Product Lifecycles and Product Management, Praeger Publishers Inc., 1989, ISBN-10 : 0899303196

**REFERENCES**

1. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007
2. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.
3. Antti Saaksvuori & Anselmi Immonen – Product Lifecycle Management, Springer
4. Gabriela Lindemann, Frank Riemer & Udo Lindemann – Product Lifecycle Management: Concept and Practice, Hanser Publishers
5. Dieter Uckelmann, Mark Harrison & Florian Michahelles – Architecting the Internet of Things (useful for PLM in Industry 4.0 context)

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain the concepts, need, and infrastructure of PLM and PDM systems.
- Describe the key functions and features of PLM/PDM software.
- Understand the structure and modules of popular PLM tools used in industries.
- Analyze the role of PLM in different industrial sectors through case studies.
- Explain how PLM software can be customized and integrated with other enterprise systems.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP609</b>	<b>RENEWABLE ENERGY TECHNOLOGIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the current energy scenario and the importance of renewable energy sources.
- To learn the working principles and applications of various renewable energy systems like solar, wind, and bio-energy.
- To explore the potential, technologies, and environmental aspects of ocean and geothermal energy sources.

<b>UNIT-I</b>	<b>ENERGY SCENARIO</b>	<b>9</b>
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans, Government schemes for RE		

<b>UNIT-II</b>	<b>SOLAR ENERGY</b>	<b>9</b>
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications		

<b>UNIT-III</b>	<b>WIND ENERGY</b>	<b>9</b>
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.		

<b>UNIT-IV</b>	<b>BIO-ENERGY</b>	<b>9</b>
Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration – Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.		

<b>UNIT-V</b>	<b>OCEAN AND GEOTHERMAL ENERGY</b>	<b>9</b>
Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, McGraw Hill; First edition, 2020, ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2<sup>nd</sup> edition, 2011, ISBN-10 : 8120344707

**REFERENCES**

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the current energy scenario and the role of renewable energy in various sectors.
- Explain the working and applications of solar thermal and solar photovoltaic systems.
- Describe wind energy systems, site selection, and environmental impacts.
- Understand bio-energy conversion methods and their practical applications.
- Explain the basic principles and applications of ocean and geothermal energy systems.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP610	TURBO MACHINES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To understand the basic working principles, classifications, and energy transfer in turbo machines.
- To study the construction, performance, and characteristics of centrifugal and axial flow compressors, fans, and blowers.
- To learn the velocity diagrams, stage work, and efficiency analysis of axial and radial flow turbines.

<b>UNIT-I</b>	<b>WORKING PRINCIPLES</b>	9
Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.		

<b>UNIT-II</b>	<b>CENTRIFUGAL FANS AND BLOWERS</b>	9
Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.		

<b>UNIT-III</b>	<b>CENTRIFUGAL COMPRESSOR</b>	9
Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.		

<b>UNIT-IV</b>	<b>AXIAL FLOW COMPRESSOR</b>	9
Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.		

<b>UNIT-V</b>	<b>AXIAL AND RADIAL FLOW TURBINES</b>	9
Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Ganesan, V., "Gas Turbines", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2011. .
2. Yahya, S.M., "Turbines, Compressor and Fans", 4<sup>th</sup> Edition, Tata McGraw Hill, 2011.

**REFERENCES**

1. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7<sup>th</sup> Edition, Butterworth-Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2<sup>nd</sup> Edition, 2008.
3. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996.
4. Saravanamutto, Rogers, Cohen, Straznicky., "Gas Turbine Theory" 6<sup>th</sup> Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the classification and energy transfer principles of turbo machines.
- Analyze the working and performance characteristics of centrifugal fans and blowers.
- Explain the components, velocity diagrams, and performance of centrifugal compressors.
- Describe axial flow compressors and evaluate their efficiency, losses, and flow behavior.
- Understand the operation, velocity diagrams, and performance of axial and radial flow turbines.

  
Head of the Department  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP611	DRONE TECHNOLOGIES	L	T	P	C
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**COURSE OBJECTIVES:**

- To understand the basics of drone concepts
- To learn and understand the fundamentals of design, fabrication and programming of drone
- To impart the knowledge of a flying and operation of drone

<b>UNIT-I</b>	<b>INTRODUCTION TO DRONE TECHNOLOGIES</b>	9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses. Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability		

<b>UNIT-II</b>	<b>DESIGN, FABRICATION AND PROGRAMMING</b>	9
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.		

<b>UNIT-III</b>	<b>FLYING AND OPERATION</b>	9
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications, Government		

<b>UNIT-IV</b>	<b>COMMERCIAL APPLICATIONS</b>	9
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing		

<b>UNIT-V</b>	<b>FUTURE DRONES AND SAFETY</b>	9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization. Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms		

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**TEXT BOOKS**

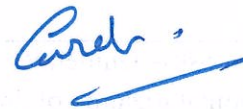
1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones", Maker Media, Inc, 2016

**REFERENCES**

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Završnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.
3. Ian Moir & Allan Seabridge – Design and Development of Aircraft Systems (includes UAV systems concepts)
4. Reg Austin – Unmanned Aircraft Systems: UAV Design, Development and Deployment
5. Kimon P. Valavanis & George J. Vachtsevanos – Handbook of Unmanned Aerial Vehicles

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Know about a various type of drone technology, drone fabrication and programming.
- Execute the suitable operating procedures for functioning a drone
- Select appropriate sensors and actuators for Drones
- Develop a drone mechanism for specific applications
- Create the programs for various drones



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP612</b>	<b>LOGISTICS AND SUPPLY CHAIN MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To introduce the fundamentals of logistics and supply chain management
- To equip students with the knowledge to design and analyze logistics systems and supply chain networks
- To develop the ability to evaluate and implement effective supply chain coordination mechanisms

<b>UNIT-I</b>	<b>INTRODUCTION TO LOGISTICS</b>	<b>9</b>
Introduction – Scope of logistics in business, Logistics and Supply Chain Management, Core and support activities of logistics; Logistical integration hierarchy; Integrated Logistics; Operating objectives; Barriers internal integration; Logistical performance cycles.		

<b>UNIT-II</b>	<b>LOGISTICS SYSTEM DESIGN</b>	<b>9</b>
Logistics reengineering, Logistical environmental assessment, Time based logistics, Anticipatory and Response based strategies, Alternative strategies, Logistical operational arrangements, Time based control techniques; Integration theory – Location structure, Transportation economies, Inventory economies, Formulating logistics strategy.		

<b>UNIT-III</b>	<b>SUPPLY CHAIN MANAGEMENT</b>	<b>9</b>
Introduction to Supply Chain Management- Supply chain – objectives – importance – decision phases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers – obstacles – framework – facilities – inventory – transportation – information – sourcing – pricing		

<b>UNIT-IV</b>	<b>SUPPLY CHAIN NETWORK DESIGN</b>	<b>9</b>
Designing the distribution network – role of distribution – factors influencing distribution – design options – e-business and its impact – distribution networks in practice – network design in the supply chain – role of network – factors affecting the network design decisions – modeling for supply chain		

<b>UNIT-V</b>	<b>SUPPLY CHAIN COORDINATION</b>	<b>9</b>
Lack of supply chain coordination and the Bullwhip effect – obstacle to coordination – managerial levels – building partnerships and trust – continuous replenishment and vendor-managed inventories – collaborative planning, forecasting and replenishment.		

<b>L:45</b>	<b>T: 0</b>	<b>P: 0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014
2. Sunil Chopra and Peter Meindl, Supply chain management – strategy, planning and operation, PHI, 4<sup>th</sup> Edition, 2010


**REFERENCES**

1. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.
2. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
3. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/ Supply Chain Management, I.K. International Publishing House Pvt. Ltd., 2016.
4. Sunil Chopra & Peter Meindl – Supply Chain Management: Strategy, Planning, and Operation, Pearson
5. Martin Christopher – Logistics & Supply Chain Management, Pearson

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the scope and significance of logistics and its integration with supply chain management.
- Analyze and design efficient logistics systems by applying concepts of time-based logistics, reengineering, and strategic operational arrangements.
- Evaluate supply chain management principles, including objectives, strategies, and drivers.
- Design and optimize supply chain networks.
- Identify challenges in supply chain coordination.

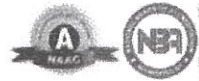
  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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## **REGULATION 2024**

# **B. E. MECHANICAL ENGINEERING**

## **SYLLABUS FOR PROFESSIONAL ELECTIVE IV**



<b>24UMEP613</b>	<b>MECHATRONICS AND IoT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To make students get acquainted with the sensors and the actuators, which are commonly used in mechatronics systems.
- To provide insight into the signal conditioning circuits, and also to develop competency in PLC programming and control
- To inculcate skills in the design and development of mechatronics and IoT based systems.

<b>UNIT-I</b>	<b>SENSORS AND ACTUATORS</b>	<b>9</b>
Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers, Optical Sensors. Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and– DC and AC Servo Motors		

<b>UNIT-II</b>	<b>SIGNAL CONDITIONING CIRCUITS AND PLC</b>	<b>9</b>
Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge Amplifier – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System –, Switching Loads by Power Semiconductor Devices Circuits – Thyristors – TRIAC PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.		

<b>UNIT-III</b>	<b>FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS</b>	<b>9</b>
The Internet of Things ( IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: Design of Embedded Systems, IIoT		

<b>UNIT-IV</b>	<b>CONTROLLERS</b>	<b>9</b>
Foundation topics: Programming Languages: C++ and Python - The Linux Operating System. Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System.– Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		

<b>UNIT-V</b>	<b>MECHATRONICS AND IoT CASE STUDIES</b>	<b>9</b>
Mechatronics systems: Drone actuation and Control -Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
2. Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

**REFERENCES**

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
2. David H., Gonzalo S., Patrick G., Rob B. and Jerome H., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018.
3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain Select suitable sensors and actuators to develop mechatronics systems.
- Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.
- Elucidate the fundamentals of Iot and Embedded Systems
- Explain Control I/O devices through Arduino and Raspberry Pi.
- Design and develop an apt mechatronics/IoT based system for the given real-time application.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP614	NON-TRADITIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To classify non-traditional machining processes and describe mechanical energy based nontraditional machining processes.
- To differentiate chemical and electro chemical energy-based processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

<b>UNIT-I</b>	<b>INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES</b>	9
Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Performance constraints and selection of NTM process; Abrasive jet machining, Water jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.		

<b>UNIT-II</b>	<b>CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES</b>	9
Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring, Problems for estimation of material removal rate in ECM		

<b>UNIT-III</b>	<b>THERMO-ELECTRIC ENERGY BASED PROCESSES</b>	9
Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining		

<b>UNIT-IV</b>	<b>NANO FINISHING PROCESSES</b>	9
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing, Recent trends in nano finishing.		

<b>UNIT-V</b>	<b>HYBRID NON-TRADITIONAL MACHINING PROCESSES</b>	9
Introduction - Hybrid non-traditional machining processes: Electro chemical and electro chemical discharge grinding, Vibration assisted EDM, ultrasonic assisted ECM and wire electrical discharge grinding; their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different nontraditional machining processes.		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**


1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

**REFERENCES:**

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3319-52008-7.
4. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN13: 978-3319259208.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
- Illustrate chemical and electro chemical energy based processes.
- Evaluate thermo-electric energy based processes.
- Interpret nano finishing processes.
- Analyze hybrid non-traditional machining processes and differentiate non- traditional machining processes.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP615</b>	<b>PROCESS PLANNING AND COST ESTIMATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the fundamentals and steps involved in process planning and selection of manufacturing resources.
- To learn methods of cost estimation for various manufacturing processes and components.
- To develop skills for calculating machining time and estimating production costs in different shop scenarios.

<b>UNIT-I</b>	<b>INTRODUCTION TO PROCESS PLANNING</b>	<b>9</b>
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection		

<b>UNIT-II</b>	<b>PROCESS PLANNING ACTIVITIES</b>	<b>9</b>
Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies		

<b>UNIT-III</b>	<b>INTRODUCTION TO COST ESTIMATION</b>	<b>9</b>
Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost –Straight Line method –Declining balance method – Service output Method, Activity Based Cost estimation		

<b>UNIT-IV</b>	<b>PRODUCTION COST ESTIMATION</b>	<b>9</b>
Cost Estimation for Different Types of Processes–Cost Estimation in Forging Shop, Cost Estimation in Welding Shop,Cost Estimation in Foundry.		

<b>UNIT-V</b>	<b>MACHINING TIME CALCULATION</b>	<b>9</b>
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring, Calculations of Machining time for CNC		

<b>L:45</b>	<b>T:00</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical estimating and Costing", Tata-McGraw Hill publishing co, 1995.

**REFERENCES**

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2<sup>nd</sup> Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9<sup>th</sup> Edition, John Wiley, 1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4<sup>th</sup> Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand the steps and methods used in process planning.
- Select suitable tools, jigs, fixtures, and quality methods for manufacturing processes.
- Explain cost estimation methods and calculate material, labor, and overhead costs.
- Estimate production costs for processes like forging, welding, and foundry.
- Calculate machining time for various operations including lathe, drilling, and CNC.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP616</b>	<b>REFRIGERATION AND AIR CONDITIONING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
- To study the vapour absorption and air refrigeration systems.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>9</b>
Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP		

<b>UNIT-II</b>	<b>VAPOUR COMPRESSION REFRIGERATION SYSTEM</b>	<b>9</b>
Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.		

<b>UNIT-III</b>	<b>OTHER REFRIGERATION SYSTEMS</b>	<b>9</b>
Working principles of vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic Vortex and Pulse tube refrigeration systems.		

<b>UNIT-IV</b>	<b>BIO-ENERGY</b>	<b>9</b>
Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.		

<b>UNIT-V</b>	<b>AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION</b>	<b>9</b>
Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators& Safety controls.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Arora, C.P., "Refrigeration and Air Conditioning", 3<sup>rd</sup> edition, McGraw Hill, New Delhi, 2010
2. Textbook of Refrigeration And Air-Conditioning (M.E.) by R.S. Khurmi, 2019

**REFERENCES**

1. ASHRAE Hand book, Fundamentals, 2010
2. Jones W.P., "Air conditioning engineering", 5<sup>th</sup> edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4<sup>th</sup> edition, Pearson Education Asia, 2009.
4. Stoecker, W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
5. A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput, 2013

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the basic principles of refrigeration and properties of refrigerants.
- Analyze vapor compression refrigeration systems using p-h and T-s diagrams.
- Explain alternative refrigeration systems and their working principles.
- Understand the psychrometric properties of moist air and air-conditioning processes.
- Estimate cooling loads and describe air-conditioning systems and their component



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEP617	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- Understand the basic concepts, mathematical modeling, and variational formulation used in Finite Element Method.
- Learn to develop and solve one-dimensional and two-dimensional finite element models for engineering problems.
- Gain knowledge of isoparametric elements, numerical integration, and the use of FEA software tools for practical applications.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	9
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.		

<b>UNIT-II</b>	<b>ONE-DIMENSIONAL PROBLEMS</b>	9
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer.		

<b>UNIT-III</b>	<b>TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS</b>	9
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.		

<b>UNIT-IV</b>	<b>TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS</b>	9
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations		

<b>UNIT-V</b>	<b>ISOPARAMETRIC FORMULATION</b>	9
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to FEA software modules.		

<b>L:45</b>	<b>T:00</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

**REFERENCES**

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3<sup>rd</sup> Edition, Prentice Hall College Div, 1990
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., "The Finite Element Method in Engineering", 3<sup>rd</sup> Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4<sup>th</sup> Edition, Wiley Student Edition, 2002.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the basic principles and mathematical modeling involved in FEM.
- Formulate and solve one-dimensional problems using finite element techniques.
- Apply FEM to two-dimensional scalar variable problems like heat transfer and torsion.
- Analyze two-dimensional vector problems in elasticity, including plane stress and strain.
- Use isoparametric elements and numerical integration, and get introduced to FEA software.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEP618</b>	<b>OPERATIONS RESEARCH</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To understand the fundamental concepts, models, and problem-solving techniques in Operations Research such as Linear Programming, transportation, assignment, and scheduling.
- To learn various analytical methods including inventory models, queuing theory, project management techniques (CPM & PERT), and replacement analysis for effective decision-making.
- To apply Operations Research tools and software to model, analyze, and solve real-world optimization and managerial problems.

<b>UNIT-I</b>	<b>INTRODUCTION TO OPERATIONS RESEARCH AND LINEAR PROGRAMMING</b>	<b>9</b>
<p>Operation Research: Definition – Models – Steps – Important topics – Scope - Tools. Linear Programming (LP): Introduction – Concept (Problem mix, Assumption, Properties) –Development (Problem formulation) – Problems in: Graphical method, Simplex methods, Big M method. Transportation problems: Introduction, Model, Types– Problems in: Initial Basic (feasible) solution: Northwest Corner Cell method; Least Cost Cell method; Vogel’s Approximation method and Optimal solution MODI (U-V) method.</p>		

<b>UNIT-II</b>	<b>TRANSPORTATION, ASSIGNMENT AND PRODUCTION SCHEDULING PROBLEMS</b>	<b>9</b>
<p>Assignment problems: Introduction, Types, Problems in Hungarian method. Production Scheduling problems: Introduction –Problems in Single Machine Scheduling: SPT; WSPT, EDD methods – Problems in Johnson’s Algorithm: n job 2 machines, n job 3 machines.</p>		

<b>UNIT-III</b>	<b>INVENTORY CONTROL MODELS &amp; SYSTEMS</b>	<b>9</b>
<p>Inventory Control: Introduction, Models – Problems in Purchase and Production(Manufacturing) models with and without shortages – Theory on types of inventory control systems: P&amp; Q, ABC, VED, FNS, XYZ, SDE and HML</p>		

<b>UNIT-IV</b>	<b>QUEUING THEORY</b>	<b>9</b>
<p>Queuing Theory: Introduction; Applications; Terminology, Poisson process and exponential distribution –Problems in Single Server and Multi Server Queuing Models –Case study on simulation using Monte Carlo technique.</p>		

<b>UNIT-V</b>	<b>PROJECT MANAGEMENT AND REPLACEMENT MODELS</b>	<b>9</b>
<p>Project Management: Introduction; Guidelines for Networking AOA Diagrams – Problems in Critical Path Method (CPM) &amp; Program Evaluation Review Technique (PERT) – Differences of CPM; PERT. Replacement Problems: Types – Problems in: Determination of Economic Life of an Asset – Problems in: Individual and Group Replacement Policies , Apply OR software</p>		

<b>L:45</b>	<b>T:00</b>	<b>P: 0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Pannervselvam R, "Operations Research", 2nd Edition, PHI, 2009.
2. Hamdy A. Taha, "Operations Research an Introduction", 10th Edition, PHI/Pearson Education, 2017.

**REFERENCES**

1. Ravindran, Phillips and Solberg, "Operations Research Principles and Practice", 2<sup>nd</sup> Edition, Wiley India, 2007.
2. Srinivasan G, "Operations Research Principles and Applications", 3<sup>rd</sup> Edition EEPHI, 2017.
3. Sharma J K, "Operations Research Theory and Applications", 5th Edition, Macmillan India, 2013.
4. Premkumar Gupta and D. S.Hira, "Problems in Operations Research", S.Chand, 2009.
5. Wayne L. Winston, "Operations Research Applications and Algorithms", 4th Edition, Cengage Learning, 2004.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Apply the basics of Operations Research to formulate and solve Linear Programming, transportation, and assignment problems.
- Use scheduling techniques to optimize job sequencing and production planning.
- Analyze and solve different inventory models and understand various inventory control systems.
- Evaluate queuing situations using queuing models and perform basic simulation using Monte Carlo methods.
- Apply CPM, PERT, and replacement models to plan projects and determine optimal replacement.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR MANDATORY COURSES I**



24UMC801	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
		3	0	0	0

### COURSE OBJECTIVES

- Introduce key concepts of gender, including sex vs. gender, patriarchy, and power structures.
- Explore feminist theories and their impact on gender roles and socialization.
- Analyze the history and influence of women's movements globally and in India.

<b>UNIT-I</b>	<b>CONCEPTS</b>	<b>9</b>
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.		

<b>UNIT-II</b>	<b>FEMINIST THEORY</b>	<b>9</b>
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides		

<b>UNIT-III</b>	<b>WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL</b>	<b>9</b>
Rise of Feminism in Europe and America. Women's Movement in India.		

<b>UNIT-IV</b>	<b>GENDER AND LANGUAG</b>	<b>9</b>
Linguistic Forms and Gender. Gender and narratives		

<b>UNIT-V</b>	<b>GENDER AND REPRESENTATION</b>	<b>9</b>
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total: 45 PERIODS</b>
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### TEXT BOOKS

- 1.Introducing Gender and Women's Studies by Linda Diane Richardson & Sandra Victoria Robinson Publisher: Bloomsbury Academic
- 2.Introduction to Women's & Gender Studies by Colleen Lutz Clemens (Open Publisher: PA-ADOPT / Open Education Network (Free e-textbook)

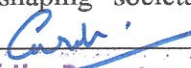
### REFERENCES

- 1.Woman, Culture, and Society – Michelle Zimbalist Rosaldo & Louise Lamphere (eds.)
- 2.Patriarchy – V. Geetha

### COURSE OUTCOMES

At the end of the course the students would be able to

- Understand fundamental gender concepts such as sex vs. gender, patriarchy, power, and socialization.
- Analyze feminist theories and their influence on gender roles, resistance, and social structures.
- Evaluate the impact of women's movements at global, national, and local levels.
- Examine the relationship between gender and language in narratives and communication.
- Critically assess gender representation in media and its role in shaping societal perceptions.

  
**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMC802	AUTOMOTIVE SAFETY	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To understand the safety aspects in the vehicle
- To understand the knowledge in sensors provided in the vehicle to avoid the crash and to detect the defects in the vehicle
- To know about the comfort and convenience system

<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>9</b>
Design of the body for safety, Energy equation, Engine location, Deceleration of vehicle inside passenger compartment, Deceleration on impact with stationary and movable obstacle, Concept of crumple zone, Safety sandwich construction.		

<b>UNIT-II</b>	<b>SAFETY CONCEPTS</b>	<b>9</b>
Active safety: Driving safety, Conditional safety, Perceptibility safety, Operating safety- Passive safety: Exterior safety, Interior safety, Deformation behaviour of vehicle body, Speed and acceleration characteristics of passenger compartment on impact.		

<b>UNIT-III</b>	<b>SAFETY AND AUTONOMOUS DRIVING</b>	<b>9</b>
Seat belt, Regulations, Automatic seat belt tightener system, Collapsible steering column, Tilttable steering wheel, Air bags, Electronic system for activating air bags, Bumper design for safety, Antiskid braking system, Regenerative Braking System, Cruise Control, Adaptive Cruise Control Devices.		

<b>UNIT-IV</b>	<b>COLLISION WARNING AND AVOIDANCE</b>	<b>9</b>
Collision warning system, Causes of rear end collision, Frontal object detection, rear vehicle object detection system, Object detection system with braking system interactions, Driver Fitness Detection - ADAS		

<b>UNIT-V</b>	<b>COMFORT AND CONVENIENCE SYSTEM</b>	<b>9</b>
Steering and mirror adjustment, Central locking system , Garage door opening system, Tyre pressure control system, Rain sensor system, Environment information system, Manual and Automated Wiper System, GPS.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.

**REFERENCES:**

1. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.
2. 2 Ronald.K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc., - 1999.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Identify various comfort and convenience systems used in vehicles.
- Describe modern safety and autonomous driving technologies, such as airbags, ABS, regenerative braking, cruise control, and adaptive cruise control.
- Understand the knowledge in sensors provided in the vehicle to avoid the crash and to detect the defects in the vehicle
- Explain the fundamentals of vehicle safety, including energy absorption, crash dynamics, crumple zones, and safety-oriented body design.



Head of the Department  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC803	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

**TOPICS:**

- Understanding the need and role of State and politics.
- Development of Nation-State, sovereignty, sovereignty in a globalized world. Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary,
- The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.
- Constitution making and the Constitution of India. Goals, objective and philosophy.
- Why a federal system? National integration and nation-building.
- Challenges of nation-building – State against democracy (Kothari) New social movements.
- The changing nature of Indian Political System, the future scenario. What can we do?

L:45	T: 00	P: 00	Total : 45 Periods
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**SUGGESTED READING:**

- Sunil Khilnani, *The Idea of India*. Penguin India Ltd., New Delhi.
- Madhav Khosla, *The Indian Constitution*, Oxford University Press. New Delhi, 2012
- .Brij Kishore Sharma, *Introduction to the Indian Constitution*, PHI, New Delhi, latest edition.
- Sumantra Bose, *Transforming India: Challenges to the World's Largest Democracy*, Picador India, 2013.
- Atul Kohli, *Democracy and Discontent: India's Growing Crisis of Governability*, Cambridge University Press, Cambridge, U. K., 1991.
- M. P. Singh and Rekha Saxena, *Indian Politics: Contemporary Issues and Concerns*, PHI, New Delhi, 2008, latest edition.
- Rajni Kothari, *Rethinking Democracy*, Orient Longman, New Delhi, 2005

### **COURSE OUTCOMES**

**At the end of the course the students would be able to**

- It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashpalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC804	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management.
- To acquaint with the skills for planning and organizing disaster response

<b>UNIT-I</b>	<b>HAZRADS, VULNERABILITY AND DISASTER RISKS</b>	<b>9</b>
<p>Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals</p>		

<b>UNIT-II</b>	<b>DISASTER RISK REDUCTION (DRR)</b>	<b>9</b>
<p>Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.</p>		

<b>UNIT-III</b>	<b>DISASTER MANAGEMENT</b>	<b>9</b>
<p>Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMADDMA-NRDF- Civic Volunteers)</p>		

<b>UNIT-IV</b>	<b>TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT</b>	<b>9</b>
<p>Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management</p>		

<b>UNIT-V</b>	<b>DISASTER MANAGEMENT: CASE STUDIES</b>	<b>9</b>
<p>Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill</p>		

<b>L:45</b>	<b>T: 00</b>	<b>P: 00</b>	<b>Total : 45 Periods</b>
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## REFERENCES

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

## COURSE OUTCOMES

### At the end of the course the students would be able to

- Describe disaster risk reduction (DRR) strategies, including the disaster cycle, preparedness, mitigation, community-based DRR, roles of institutions, and the importance of indigenous knowledge
- Analyse real-world disaster case studies and demonstrate understanding of impacts, assessment methods, and practical disaster management activities through fieldwork and mock drills.
- Use tools and technologies for disaster management, such as early warning systems, GIS, IT-based assessment tools, and standard procedures for disaster response
- Enhance awareness of institutional processes for Disaster response in the country.
- Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC805	FILM APPRECIATION	L	T	P	C
		3	0	0	0

**Theme - A: The Component of Films**

- A-1: The material and equipment
- A-2: The story, screenplay and script
- A-3: The actors, crew members, and the director
- A-4: The process of film making... structure of a film

**Theme - B: Evolution of Film Language**

- B-1: Film language, form, movement etc.
- B-2: Early cinema... silent film (Particularly French)
- B-3: The emergence of feature films: Birth of a Nation
- B-4: Talkies

**Theme - C: Film Theories and Criticism/Appreciation**

- C-1: Realist theory; Auteursists
- C-2: Psychoanalytic, Ideological, Feminists
- C-3: How to read films?
- C-4: Film Criticism / Appreciation

**Theme – D: Development of Films**

- D-1: Representative Soviet films
- D-2: Representative Japanese films
- D-3: Representative Italian films
- D-4: Representative Hollywood film and the studio system

**Theme - E: Indian Films**

- E-1: The early era
- E-2: The important films made by the directors
- E-3: The regional films
- E-4: The documentaries in India

**READING:** A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these

L:45	T: 00	P: 00	Total : 45 Periods
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**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMC806	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience

**UNIT-I INTRODUCTION TO ELEMENTS OF LITERATURE**

Relevance of literature a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect.

**UNIT-II ELEMENTS OF FICTION**

a) Fiction, fact and literary truth. b) Fictional modes and patterns. c) Plot character and perspective.

**UNIT-III ELEMENTS OF POETRY**

Elements of poetry a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend

**UNIT-IV ELEMENTS OF DRAMA**

a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.

L45	T:0	P: 0	Total :45 Periods
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**TEXT BOOKS**

- An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
- An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
- The Experience of Poetry, Graham Mode, Open college of Arts with Open Univ Press, 1991.
- The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
- The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

  
 Head of the Department  
 Department of Mechanical Engineering  
 Jai Shriram Engineering College  
 Dharapuram Road, Avinashpalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMC807	INCLUSIVE WORK CULTURE	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To develop a comprehensive understanding of diversity, equity, and inclusion (DEI) principles and their importance in building a positive and productive work environment.
- To equip learners with the knowledge and tools to recognize, challenge, and mitigate unconscious biases and discriminatory practices in organizational settings.
- To enable learners to design and implement inclusive policies, leadership strategies, and measurable frameworks that promote sustainable inclusion and cultural competence in the workplace.

<b>UNIT-I</b>	<b>INTRODUCTION TO DIVERSITY AND INCLUSION</b>	9
Definition and Dimensions of Diversity: Gender, Race, Age, Disability, LGBTQ+, etc. - Inclusion vs. Integration - Business Case for Diversity and Inclusion - Historical Context of Workplace Inequality - Legal and Ethical Frameworks.		

<b>UNIT-II</b>	<b>UNCONSCIOUS BIAS AND INCLUSIVE LEADERSHIP</b>	9
Understanding Implicit and Unconscious Bias - Types of Workplace Bias (Affinity, Confirmation, Gender, etc.) - Role of Inclusive Leadership - Empathy and Emotional Intelligence in Leadership - Strategies to Recognize and Reduce Bias.		

<b>UNIT-III</b>	<b>BUILDING AN INCLUSIVE ORGANIZATIONAL CULTURE</b>	9
Inclusive Hiring Practices - Accessibility and Accommodation - Inclusive Language and Communication - Employee Resource Groups (ERGs) and Affinity Networks - Culture Audits and Climate Surveys		

<b>UNIT-IV</b>	<b>CONFLICT RESOLUTION AND INCLUSIVE PRACTICES</b>	9
Cultural Sensitivity and Awareness - Conflict Resolution Frameworks - Mediation and Inclusive Decision-Making - Allyship and Advocacy - Dealing with Microaggressions and Harassment.		

<b>UNIT-V</b>	<b>MEASURING AND SUSTAINING INCLUSION</b>	9
Inclusion Metrics and KPIs (e.g., diversity ratios, engagement surveys) - Benchmarking Best Practices - Continuous Improvement and Change Management - D&I Strategy Implementation - Future Trends: AI, Remote Work, and Global Inclusion.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. "Inclusive Leadership: The Definitive Guide to Developing and Executing an Impactful Diversity and Inclusion Strategy" by Charlotte Sweeney & Fleur Bothwick
2. "Everyday Bias: Identifying and Navigating Unconscious Judgments in Our Daily Lives" by Howard J. Ross

**REFERENCES**

1. "The Inclusion Nudges Guidebook" by Tinna C. Nielsen & Lisa Kepinski
2. "Blindspot: Hidden Biases of Good People" by Mahzarin R. Banaji & Anthony G. Greenwald
3. "Diversity, Inc.: The Failed Promise of a Billion-Dollar Business" by Pamela Newkirk

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain the key concepts and dimensions of diversity and inclusion, and articulate their significance in modern organizational contexts.
- Identify and analyze the impact of unconscious biases on workplace behavior and decision-making.
- Evaluate and design inclusive policies and practices related to recruitment, communication, leadership, and workplace accessibility.
- Demonstrate the ability to resolve conflicts and promote allyship, cultural sensitivity, and inclusive communication in diverse teams.
- Apply tools and metrics to assess inclusion levels and develop strategic initiatives to foster a sustainable inclusive work culture.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashpalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC808	QUALITY SYSTEMS	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

The objective of this course is to provide students with a comprehensive understanding of quality systems, standards, methodologies, and their applications in various industries. The course will focus on principles of quality management, quality control techniques, and continuous improvement practices.

<b>UNIT-I</b>	<b>INTRODUCTION TO QUALITY SYSTEMS</b>	6
Definition of Quality and its Importance, History and Evolution of Quality Management, Key Contributors: Deming, Juran, Crosby, Ishikawa, Quality vs. Productivity vs. Cost		

<b>UNIT-II</b>	<b>QUALITY MANAGEMENT SYSTEMS</b>	6
Introduction to Quality Management Systems (QMS), ISO 9001: Structure, Principles, and Requirements, Other Standards: ISO 14001 (Environmental), ISO 45001 (Occupational Health & Safety), ISO 27001 (Information Security), Certification Process and Compliance		

<b>UNIT-III</b>	<b>STATISTICAL QUALITY CONTROL (SQC)</b>	6
Basics of Statistics in Quality, Control Charts for Variables & Attributes, Process Capability Analysis, Six Sigma: Concept & Implementation		

<b>UNIT-IV</b>	<b>QUALITY IMPROVEMENT TOOLS &amp; TECHNIQUES</b>	6
Seven Basic Quality Tools (Histogram, Pareto Chart, Fishbone Diagram, etc.), Failure Mode and Effects Analysis (FMEA), Total Quality Management (TQM) Principles, Lean Management and Continuous Improvement (Kaizen)		


<b>UNIT-V</b>	<b>AUDITING &amp; QUALITY ASSURANCE</b>	6
Types of Audits: Internal, External, and Third-Party Audits, Quality Assurance vs. Quality Control, Documentation in Quality Systems, Role of Leadership in Quality Management		

L:45	T:0	P:0	Total :45 Periods
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<b>TEXT BOOKS</b>
1."Juran's Quality Handbook: The Complete Guide to Performance Excellence" – Joseph M. Juran & Joseph A. DeFeo
2. Dale H. Besterfield – <i>Total Quality Management</i>

<b>REFERENCES</b>
1. Joseph Juran – <i>Juran's Quality Handbook</i>
2. Philip B. Crosby – <i>Quality is Free</i>
3. ISO Standards Documentation
4. Six Sigma and Lean Manufacturing Guides

<b>COURSE OUTCOMES:</b>
<b>At the end of the course the students would be able to</b>
<ul style="list-style-type: none"> <li>• Understand key concepts of quality management systems (QMS).</li> <li>• Learn various international quality standards and certifications.</li> <li>• Implement quality control tools and techniques.</li> <li>• Apply quality improvement methodologies in real-world scenarios.</li> <li>• Analyze case studies of successful quality management practices.</li> </ul>

  
 Head of the Department  
 Department of Mechanical Engineering  
 Jai Shriram Engineering College  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMC809	INDUSTRIAL PRACTICES AND REQUIREMENTS	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To understand the methods and procedures of mechanical manual handling.
- To know the hazards involved in material handling.
- To familiarize with usage of personal protective equipment.

<b>UNIT-I</b>	<b>MATERIAL HANDLING</b>	9
Overview of material handling – Manual material handling and mechanical material handling Material handling methods- standards- ergonomic issues- musculoskeletal disorder		

<b>UNIT-II</b>	<b>MECHANICAL MATERIAL HANDLING</b>	9
Mechanical material handling Selection, operation, inspection and testing of ropes, slings, chains ,hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builders hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, scaffolding, hoisting cranes.		

<b>UNIT-III</b>	<b>OVERVIEW OF INDUSTRIAL REQUIREMENTS</b>	9
Concepts of personal protective equipment -Need for Personal Protective Equipment-general Principles sources of help-requirements-p -procurement procedures - user involvement.		

<b>UNIT-IV</b>	<b>NON RESPIRATORY PERSONAL PROTECTIVE EQUIPMENT</b>	9
Head protection-helmet, hoods, bump caps, soft caps, Hair net and caps-Eye and Face protection-spectacles, goggles ,types of goggles and face shields-Hearing Protection – ear muff, ear plugs and combination- Body Protection: coats, aprons, full suits, proximity suits, high visibility clothing, personal flotation devices, puncture resistant and cut resistant clothing- Fall Protection: safety belt, safety harness, lanyard, grabbing device, lifeline, fall arrestor, climbing safety system and safety net-emergency showers- eye wash fountains- eye and face wash fountain- Hand, finger and arm protection: gloves and its types, pads, finger guard, sleeves, creams and lotions-Foot and Leg protection: safety shoes- instep guard, steel insole, rubber boots, non- sparking shoes, non conductive shoes and slip resistant shoes – maintenance procedures - limitations - relevant Indian standards - Personal Training.		

<b>UNIT-V</b>	<b>RESPIRATORY PERSONAL PROTECTIVE EQUIPMENTS</b>	9
Respiratory Protection, selection of the respiratory protective equipment, quality of breathing air, respiratory fit testing, SCBA, Hose mask, Air-line respirator, air-supplied suits and hoods, air-purifying respirators, canister mask, filter respirator and others- maintenance procedures- limitations Pre Employment – Fitness test - health surveillance relevant Indian standards – Personal Training		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Michael G Kay, "Material Handling Equipment", McGraw-Hill, 2nd Edition, 2013.
2. "Industrial Safety", National Institute of Industrial Research, New Delhi, 2003

**REFERENCES**

1. Raymond A Kulwiec, "Materials Handling Handbook", Wiley, 2<sup>nd</sup> Edition, 1985
2. John V Grimaldi and Rollin H Simonds, "Safety Management", All India Traveller Book Seller, 5th Edition, New Delhi, 2001.
3. Roger L Brauer, "Safety and Health for Engineers", Wiley, Third Edition, 2016.
4. David E Mulcahy, "Materials Handling Handbook" McGraw-Hill, 1999.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand the techniques of material handling
- Identifies issues in manual material handling and guides in material handling practices.
- Understand the significance of PPE.
- Choose and recommending suitable respiratory and non-respiratory PPE for workers.
- Inspect and train workers on respiratory and non-respiratory PPE for workers..

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR MANDATORY COURSES II**



24UMC901	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	L	T	P	C
		3	0	0	0

### COURSE OBJECTIVES

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life

UNIT-I	HEALTH AND ITS IMPORTANCE	9
<p><b>Health: Definition - Importance of maintaining health</b> - More importance on prevention than treatment</p> <p>Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health- Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health.</p> <p><b>Present health status</b> - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.</p> <p><b>Types of diseases and disorders</b> - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.</p> <p><b>Causes of the above diseases / disorders - Importance of prevention of illness</b> - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time</p> <p><b>Simple lifestyle modifications to maintain health</b> - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken</p>		

UNIT-II	DIET	9
<p><b>Role of diet in maintaining health</b> - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.</p> <p><b>Balanced Diet and its 7 Components</b> - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.</p> <p><b>Food additives and their merits &amp; demerits</b> - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions</p> <p><b>Definition of BMI and maintaining it with diet</b></p> <p>Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM</p> <p><b>Common cooking mistakes</b></p> <p>Different cooking methods, merits and demerits of each method</p>		

UNIT-III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	9
<p><b>AYUSH systems and their role in maintaining health</b> - preventive aspect of AYUSH - AYUSH as a soft therapy.</p> <p><b>Secrets of traditional healthy living</b> - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.</p> <p><b>Principles of Siddha &amp; Ayurveda systems</b> - Macrocosm and Microcosm theory - Panchcheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri Dosha Theory) - Udal Thathukkal</p> <p><b>Prevention of illness with our traditional system of medicine</b></p> <p>Primary Prevention - To decrease the number of new cases of a disorder or illness - Health Promotion /education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.</p>		

UNIT-IV	MENTAL AWARENESS	9
<p><b>Emotional health</b> - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.</p> <p><b>Stress management</b> - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.</p> <p><b>Sleep</b> - Sleep and its importance for mental wellness - Sleep and digestion.</p> <p><b>Immunity</b> - Types and importance - Ways to develop immunity</p>		

UNIT-V	YOGA	9
<p><b>Definition and importance of yoga</b> - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life</p>		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners\_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

**REFERENCES**

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/>
2. Simple lifestyle modifications to maintain health  
<https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20c>ook.
3. Read more: <https://www.legit.ng/1163909-classes-food-examples-functions.html>
4. <https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926>
5. Benefits of healthy eating <https://www.cdc.gov/nutrition/resources-publications/benefits-of-healthy-eating.html>
6. Food additives <https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives>
7. BMI <https://www.hsph.harvard.edu/nutritionsource/healthy-weight/>  
<https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations>
8. Yoga <https://www.healthifyme.com/blog/types-of-yoga/>  
<https://yogamedicine.com/guide-types-yoga-styles/>  
Ayurveda : <https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda>
9. Siddha : [http://www.tkdil.res.in/tkdil/langdefault/Siddha/Sid\\_Siddha\\_Concepts.asp](http://www.tkdil.res.in/tkdil/langdefault/Siddha/Sid_Siddha_Concepts.asp)
10. CAM : <https://www.hindawi.com/journals/ecam/2013/376327/>
11. Preventive herbs : <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/>

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health
- Provide safety education and training.

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMC902</b>	<b>HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>

**COURSE OBJECTIVES:**

- To understand the historical development of science and technology in India, from ancient to modern periods.
- To explore major scientific contributions, innovations, and technological advancements made in fields such as mathematics, astronomy, medicine, engineering, and metallurgy.
- To appreciate the role of Indian scientists, institutions, and traditional knowledge systems in shaping modern science and their impact on national progress.

<b>UNIT-I</b>	<b>CONCEPTS AND PERSPECTIVES</b>	<b>9</b>
Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.		

<b>UNIT-II</b>	<b>HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA</b>	<b>6</b>
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		

<b>UNIT-III</b>	<b>SCIENCE AND TECHNOLOGY IN ANCIENT &amp; MEDIEVAL INDIA</b>	<b>12</b>
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.  Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest		

<b>UNIT-IV</b>	<b>SCIENCE AND TECHNOLOGY IN COLONIAL INDIA</b>	<b>9</b>
Science and the Empire Indian response to Western Science Growth of techno-scientific institutions		

<b>UNIT-V</b>	<b>SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA</b>	<b>9</b>
Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology		

<b>L:45</b>	<b>T: 00</b>	<b>P:00</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. A Concise History of Science in India by D. Chattopadhyaya, D.M. Bose, S.N. Sen  
Publisher: Indian National Science Academy (INSA)
2. Science and Technology in India by V. Rajaram Publisher: Spectrum Publications

**REFERENCES**

1. India's Ancient Past by : R.S. Sharma Publisher: Oxford University Press
2. A History of Science, Technology and Culture in India (Vol. 1-4) by A. Rahman & Others  
Publisher: CSIR / Oxford University Press
3. Indian Science and Technology in the Eighteenth Century by Dharampal Publisher: Other India Press (OIP)

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Explain the evolution of science and technology in India from ancient to modern times.
- Identify major scientific achievements and technological innovations in areas such as mathematics, astronomy, medicine, engineering, and metallurgy.
- Describe the contributions of prominent Indian scientists and institutions to the growth of modern science and technology.
- Recognize the significance of traditional knowledge systems and indigenous practices in India's scientific heritage.
- Analyze the impact of science and technology on India's socio-economic development and its role in shaping contemporary society,



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC903	POLITICAL AND ECONOMIC THOUGHT FOR HUMAN SOCIETY	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to full fill them.
- In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.
- To learn ancient and Indian political thoughts and Indian economy

<b>UNIT-I</b>	<b>HUMAN CONSIDARATIONS</b>	<b>9</b>
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal system		

<b>UNIT-II</b>	<b>CAPITALISM</b>	<b>9</b>
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. Fascism and totalitarianism. World war I and II. Cold war.		

<b>UNIT-III</b>	<b>COMMUNISM</b>	<b>9</b>
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models. Welfare state. Relation with human desires. Empowered human beings, satisfaction.		

<b>UNIT-IV</b>	<b>THOUGHTS</b>	<b>9</b>
Introduction Sources and significance of Ancient and Indian Political Thought - Social and Political Institutions in Vedic and Epic periods – State – Law – Justice – Dharma – Caste System – Varnasharma Dharma- Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives.		

<b>UNIT-V</b>	<b>NATURE TECHNOLOGY AND SOCIETY</b>	<b>9</b>
Relationship with nature. Essential elements of indian civilization. Technology as driver of society, Role of education in shaping of society. Future directions.		

<b>L:45</b>	<b>T: 00</b>	<b>P:00</b>	<b>Total :45 Periods</b>
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<b>TEXT BOOKS</b>
<p>1. J.C. Jojhari, Political Thought: Ancient &amp; Medieval, Vol. I, Metropolitan Book Co, Pvt. Ltd., New Delhi, 2012.</p> <p>2. Letkar A.S., State and Government in Ancient India; Motilal Banarasi Das, New Delhi.</p>
<b>REFERENCES</b>
<p>1. Sharam, P. Ancient Indian Political Institution, Meenakshi Prakasan, Meerut.</p> <p>2. Varma, V.P., Ancient and Medieval Indian Political Thought, Lakshmi Narayan Agarwal, Agra, 2001.</p> <p>3. Thalaimadhiyavan, NabigalNayagam Valkai Varalaru, KizhakkuPathippagam, Chennai, 2014.</p>
<b>COURSE OUTCOMES</b>
<p><b>At the end of the course the students would be able to</b></p> <ul style="list-style-type: none"> <li>• Understanding of how societies are shaped by philosophy, political and economic system,</li> <li>• Students gained knowledge about how they relate to fulfilling human goals &amp; desires with some case studies of how different attempts have been made in the past and how they have fared.</li> <li>• Student gained knowledge about the capitalism and communism in India and world.</li> <li>• Students will understand the political and ancient thoughts.</li> <li>• Students gained knowledge about nature, technology and society.</li> </ul>



**Head of the Department**  
 Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
 Dharapuram Road, Avinashipalayam,  
 Tirupur-638 660. Tamil Nadu, India.

24UMC904	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To study the fundamental concept and principles of industrial safety
- To study the basics of hazardous waste management and safety audit.
- To study the occupational health hazard and safety education.

<b>UNIT-I</b>	<b>CONCEPTS AND TECHNIQUES</b>	9
History of Safety movement –Evolution of modern safety concept- general concepts of management –line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety – Behavior based safety.		

<b>UNIT-II</b>	<b>HAZARDOUS WASTE MANAGEMENT</b>	9
Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes incineration and vitrification - hazards due to bio-process-dilution standards and restrictions – recycling and reuse. Environmental impact assessment (EIA)-scope, guidelines, activities and methodologies.		

<b>UNIT-III</b>	<b>SAFETY AUDIT</b>	9
Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor-IS 14489: 1998 Code of practice on occupational Safety and health audit.		

<b>UNIT-IV</b>	<b>OCCUPATIONAL HEALTH, PHYSIOLOGY AND TOXICOLOGY</b>	10
Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations – occupational related diseases, levels of prevention of diseases, notifiable occupational diseases. Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.		

<b>UNIT-V</b>	<b>SAFETY EDUCATION AND TRAINING</b>	8
Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training DGFASLI, NSC, ASSE, HSE, OSHA-NEBOSH – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge safety incentive scheme, safety campaign.SSR		

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

**REFERENCES**

1. Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
2. Garg, HP, Maintenance Engineering, S. Chand Publishing.
3. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
4. R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
5. W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Explain the fundamental concept and principles of industrial safety
- Apply the methods of hazardous waste management.
- Perform safety audit in industries.
- Explain the occupational health hazards
- Provide safety education and training.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMC905</b>	<b>QUANTITATIVE AND VERBAL PROFICIENCY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>

**COURSE OBJECTIVES:**

- To strengthen foundational and advanced quantitative skills, enabling students to solve mathematical problems with speed, accuracy, and logical reasoning.
- To enhance verbal ability through structured vocabulary development, grammar proficiency, and critical reading strategies.
- To equip students with effective test-taking techniques and analytical thinking skills for academic, competitive, and professional assessments.

<b>UNIT-I</b>	<b>FOUNDATIONS OF QUANTITATIVE APTITUDE</b>	<b>9</b>
Number Systems and Properties - LCM and HCF - Simplification and Approximation - Percentages - Profit, Loss, and Discount - Ratio and Proportion - Averages and Mixtures.		

<b>UNIT-II</b>	<b>ADVANCED QUANTITATIVE TECHNIQUES</b>	<b>9</b>
Time, Speed, and Distance - Time and Work - Simple and Compound Interest - Data Interpretation (Bar Graphs, Line Graphs, Pie Charts, Tables) - Permutations and Combinations - Probability - Algebraic Expressions and Linear Equations.		

<b>UNIT-III</b>	<b>VERBAL REASONING AND CRITICAL THINKING</b>	<b>9</b>
Analogies - Logical Deduction - Syllogisms - Blood Relations - Direction Sense - Coding-Decoding - Series Completion - Puzzles and Seating Arrangement		

<b>UNIT-IV</b>	<b>VERBAL PROFICIENCY AND COMMUNICATION</b>	<b>9</b>
Vocabulary Building: Synonyms, Antonyms, Word Roots - Sentence Correction and Error Spotting - Fill in the Blanks - Reading Comprehension - Sentence Completion and Para-jumbles - Idioms and Phrases - Active/Passive Voice, Direct/Indirect Speech.		

<b>UNIT-V</b>	<b>APPLICATION AND TEST STRATEGIES</b>	<b>9</b>
Test-taking Strategies for Competitive Exams (CAT, GRE, GMAT, etc.) - Time Management Techniques - Mock Test Practice (Quant + Verbal) - Review and Feedback Sessions - Analytical Writing Basics (Essay, Summary)		

<b>L:45</b>	<b>T:00</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal
2. "Fast Track Objective Arithmetic" by Rajesh Verma

**REFERENCES**

1. "Word Power Made Easy" by Norman Lewis
2. "A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal
3. "Barron's GRE – Graduate Record Examination" by Sharon Weiner Green & Ira K. Wolf

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Apply arithmetic, algebraic, and data interpretation techniques to solve real-world and academic quantitative problems.
- Demonstrate proficiency in verbal reasoning, including analogies, syllogisms, and logical deduction.
- Use grammar rules and vocabulary effectively to comprehend and construct error-free sentences and passages.
- Analyze and interpret written content with improved reading speed, accuracy, and critical thinking.
- Implement efficient time management and test strategies to perform confidently in competitive exams and interviews.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC906	INDUSTRIAL HYDRAULIC CIRCUITS	L	T	P	C
		3	0	0	0

**COURSE OBJECTIVES:**

- To provide the knowledge on the working principles of fluid power systems.
- To study the fluids and components used in modern industrial fluid power system.
- To develop the design, construction and operation of fluid power circuits.

<b>UNIT-I</b>	<b>INTRODUCTION TO HYDRAULICS AND HYDRAULIC SYSTEMS</b>	9
Basic Concepts-Hydraulic Fluids- Hydraulic Systems- Hydraulic Power Supply- Hydraulic Symbols- Advantages of Hydraulics		

<b>UNIT-II</b>	<b>HYDRAULIC PUMPS AND ACTUATORS</b>	9
Hydraulic Pumps- Pump Characteristics- Hydraulic Cylinders- Linear Actuators- Selection of Pumps and Cylinders		

<b>UNIT-III</b>	<b>HYDRAULIC VALVES AND CONTROLS</b>	9
Control Valves- Relief Valves- Pressure Control- Flow Control- Pilot Control		

<b>UNIT-IV</b>	<b>HYDRAULIC CIRCUIT DESIGN AND ANALYSIS</b>	9
Basic Circuit Design- Combination Circuits- Flow and Pressure Control in Circuits- Application of Electro-hydraulic Systems- Hydraulic Circuit Troubleshooting		

<b>UNIT-V</b>	<b>ADVANCED HYDRAULIC SYSTEMS AND APPLICATIONS</b>	9
Hydraulic Power Packs- Mobile Hydraulic Systems- Hydraulic Systems in Automation- Energy Efficiency and Environmental Considerations- Maintenance and Safety		

L:45	T:00	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

**REFERENCES**

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance", TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Explain the basic concepts of hydraulics, types of hydraulic fluids, hydraulic power supply, and advantages of hydraulic systems.
- Describe the working and characteristics of hydraulic pumps and actuators, and select suitable pumps and cylinders for various applications
- Design and develop hydraulic circuits and systems.
- Describe advanced hydraulic systems and applications, including power packs, mobile hydraulics, automation systems, energy efficiency, maintenance, and safety practices.
- Identify various troubles shooting methods in fluid power systems.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMC907	<b>ELECTRICAL SAFETY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>

**COURSE OBJECTIVES**

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety.
- To understand the causes of accidents due to electrical hazards.
- To know the various protection systems in Industries from electrical hazards.

<b>UNIT-I</b>	<b>CONCEPTS AND STATUTORY REQUIREMENTS</b>	<b>9</b>
Review of Electrical concept - electrostatics, electro magnetism, stored energy - working principles of major electrical equipment - Indian electricity act and rules - statutory requirements from electrical inspectorate- international standards on electrical safety.		

<b>UNIT-II</b>	<b>ELECTRICAL HAZARDS</b>	<b>9</b>
Primary and secondary hazards - Energy leakage - clearances and insulation - current surges - electrical causes of fire and explosion - national electrical safety code ANSI- Lightning hazards.		

<b>UNIT-III</b>	<b>PROTECTION SYSTEMS</b>	<b>9</b>
Fuse, circuit breakers and types - protection against over voltage and under voltage - safe limits of amperage – safe distance from lines - overload and short circuit protection - earth fault protection - system grounding – equipment grounding - earth leakage circuit breaker (ELCB).		

<b>UNIT-IV</b>	<b>SELECTION, INSTALLATION, OPERATION AND MAINTENANCE</b>	<b>9</b>
Role of environment in selection - protection and interlock - discharge rod and earthing devices - safety in the use of portable tools - preventive maintenance.		

<b>UNIT-V</b>	<b>HAZARDOUS AREAS</b>	<b>9</b>
Hazardous area classification and classification of electrical equipment for hazardous areas (IS, API and OSHA standards)- classification of equipment/enclosure for hazardous locations.		

<b>L: 45</b>	<b>T: 00</b>	<b>P: 00</b>	<b>Total: 45 Periods</b>
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**TEXT BOOKS**

1. John Cadick, Mary Capelli Schellpfeffer, Dennis Neitzel, Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
2. Fordham Cooper, W., "Electrical Safety Engineering, Butterworth and Company", London, Third Edition, 2013.

**REFERENCES**

1. "Indian Electricity Act and Rules", Government of India.
2. "Power Engineers", Handbook of TNEB, Chennai, 2010.
3. "Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
4. Rao.S, Jain R.K & Saluja H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", 2nd Edition, Khanna Publishers, 1997.
5. Peter E. Sutherland., "Principles of Electrical Safety" IEEE Press Series on Power Engineering, John Wiley and Sons, New Jersey, March 2018.

**COURSE OUTCOMES**

**At the end of the course the students would be able to**

- Analyze the basic concepts in electrical circuit and hazards involved in it.
- Analyze the electrical hazards in the workplace and its impacts.
- Examine the operation of various protection systems from electrical hazards.
- Analyze the various safety procedures involved in the industries.
- Explore the different hazardous zones in Industries and their safety measures.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.



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**JAI SHRIRAM ENGINEERING COLLEGE, TIRUPPUR – 638 660**

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**REGULATION 2024**

**B. E. MECHANICAL ENGINEERING**

**SYLLABUS FOR OPEN ELECTIVE**



24UMEO01	FUNDAMENTALS OF ROBOTICS	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To impart fundamental knowledge about robotic systems.
- To develop analytical and problem-solving skills in robot kinematics and drive systems.
- To introduce sensor technologies, robot programming, and practical applications.

<b>UNIT-I</b>	<b>FUNDAMENTALS OF ROBOT</b>	9
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Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications

<b>UNIT-II</b>	<b>ROBOT KINEMATICS</b>	9
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Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices

<b>UNIT-III</b>	<b>ROBOT DRIVE SYSTEMS AND END EFFECTORS</b>	9
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Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

<b>UNIT-IV</b>	<b>SENSORS IN ROBOTICS</b>	9
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Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis.

<b>UNIT-V</b>	<b>PROGRAMMING AND APPLICATIONS OF ROBOT</b>	9
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Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields, Introduction to Autonomous robots and COBOTS.

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.
2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.

**REFERENCES**

1. Fu K.S. Gonzalez R.C. and Lee C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.
2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2<sup>nd</sup> Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010..

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the fundamental principles and components of robotic systems.
- Analyze and apply kinematic concepts and drive systems in robotics.
- Demonstrate the ability to integrate sensors, vision systems, and programming techniques.
- Interpret the features of robots and technology involved in the control.
- Demonstrate the image processing and image analysis techniques by machine vision system.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEO02	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To provide foundational understanding of nano materials and their unique properties.
- To familiarize students with various synthesis and characterization techniques.
- To explore the diverse applications of nano materials across fields.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	<b>8</b>
General definition and size effects—important nano structured materials and nano particles—importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.		

<b>UNIT-II</b>	<b>SYNTHESIS OF NANOMATERIALS</b>	<b>8</b>
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.		

<b>UNIT-III</b>	<b>NANO COMPOSITES</b>	<b>10</b>
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications.		

<b>UNIT-IV</b>	<b>NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES</b>	<b>10</b>
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites		

<b>UNIT-V</b>	<b>APPLICATIONS OF NANO MATERIALS</b>	<b>9</b>
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, “ Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas Press
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design”, 10<sup>th</sup> Edition, Tata McGraw-Hill , 2015.

**REFERENCES**

1. R.H.J. Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd.,Cambridge, 2006.
2. G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications” Imperial College Press, 2004.
3. C. N. R. Rao, A. Muller, A. K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag GmbH & Co
4. Ivor Brodie and Julius J.Murray, 'The physics of Micro/Nano – Fabrication', Springer International Edition, 2010
5. William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3<sup>rd</sup> Edition, CRC Taylor and Francis group 2012.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Explain the fundamental concepts and size-dependent properties of nanomaterials.
- Describe various synthesis techniques for nanomaterials.
- Classify and analyze nanocomposites.
- Distinguish between different types of nanostructures.
- Identify and evaluate the diverse applications of nanomaterials.

  
Head of the Department  
Department of Mechanical Engineering  
Jai Shriram Engineering College  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEO03	REVERSE ENGINEERING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To introduce the fundamentals and phases of reverse engineering.
- To enable students to analyze material characteristics and manufacturing processes.
- To equip students with skills in data processing, 3D scanning, and modeling.

<b>UNIT-I</b>	<b>INTRODUCTION &amp; GEOMETRIC FORM</b>	9
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Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping

<b>UNIT-II</b>	<b>MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION</b>	9
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Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

<b>UNIT-III</b>	<b>DATA PROCESSING</b>	9
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Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility

<b>UNIT-IV</b>	<b>3D SCANNING AND MODELLING</b>	9
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Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling

<b>UNIT-V</b>	<b>INDUSTRIAL APPLICATIONS</b>	9
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Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights – Trade Secret – Third-Party Materials.

L:45	T:0	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1<sup>st</sup> Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

**REFERENCES**

1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, "Reverse Engineering", McGraw-Hill, 1994.
4. Linda Wills, "Reverse Engineering", Kluwer Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, "Reverse Engineering: An Industrial Perspective", Springer Verlag London Limited 2008

**COURSE OUTCOMES****At the end of the course the students would be able to**

- Understand and explain the fundamental concepts, phases, and applications of reverse engineering including geometric form reconstruction and prototyping.
- Analyze material characteristics and identify manufacturing processes through mechanical testing, microstructure analysis, and failure analysis techniques.
- Apply statistical and reliability methods to process engineering data and evaluate performance metrics for system compatibility.
- Demonstrate the ability to operate 3D scanning equipment and use modelling software for accurate digital reconstruction of physical components.
- Evaluate industrial applications of reverse engineering across sectors such as automotive, aerospace, and medical, including understanding legal considerations like patents and copyrights.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEO04	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To introduce the fundamentals of plant engineering and layout design.
- To develop knowledge of work study and production management techniques.
- To familiarize students with quality control and materials management practices.

<b>UNIT-I</b>	<b>PLANT ENGINEERING</b>	9
Plant -Selection of site of industry - Plant layout- Principles of a good layout - Types - Process - Product and Fixed position - Techniques to improve Layout - Principles of Material handling equipment - Plant maintenance- Importance- Break down maintenance - Preventive maintenance and Scheduled maintenance, Predictive maintenance, Condition based maintenance.		

<b>UNIT-II</b>	<b>WORK STUDY &amp; METHOD STUDY</b>	9
Work Study- Productivity - Standard of living - Method of improving Productivity - Objectives; Importance of good working conditions. Method Study – Definition, Objectives - Selection of a job for method study - Basic procedure for conduct of Method study - Tools used - Operation process chart - Flow process chart - Two handed process chart - Man Machine chart - String diagram and flow diagram.		

<b>UNIT-III</b>	<b>PRODUCTION PLANNING AND CONTROL</b>	9
Introduction - Major functions of Production Planning and Control - Pre planning - Methods of forecasting - Routing and Scheduling - Dispatching and Controlling - Concept of Critical Path Method (CPM) - Types of Production- Mass Production, Batch Production and Job Order Production Characteristics - Economic Batch Quantity (EBQ) - Principles of Product and Process Planning - Make or Buy decision - Numerical problems.		

<b>UNIT-IV</b>	<b>QUALITY CONTROL</b>	9
Definition – Objectives - Types of Inspection - First piece, Floor and Centralized Inspection - Advantages and Disadvantages - Statistical Quality Control - Types of Measurements - Method of Variables - Method of Attributes - Uses of X, R, p and c charts - Operating Characteristics curve (O.C curve) - Sampling Inspection - Single and Double Sampling plan - Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure - Benefits of ISO to the organization.		

<b>UNIT-V</b>	<b>MATERIALS MANAGEMENT</b>	9
Materials Management - Objectives of good stock control system - ABC analysis of Inventory - Procurement and Consumption cycle - Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems - Supply Chain Management.		

L:45	T:00	P:0	Total :45 Periods
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**TEXT BOOKS**

1. Khanna O. P., and Sarup A., "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353
2. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002

**REFERENCES**

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002
2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003
3. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 2002
4. Seetharama L.Narasimhan, Dennis W.McLeavey, Peter J.Billington, "Production Planning and Inventory Control" , PHI, 2002
5. Eugene L. Grant and Richard S. Leaven Worth, "Statistical Quality Control", McGraw-Hill Education, Seventh Edition, 2000

**COURSE OUTCOMES:**

**At the end of the course the students would be able to**

- Understand the concepts of plant engineering
- Understand the purpose of method study and its method
- Determine the lot size and EOQ using the inventory systems
- Control the quality of processes using control charts for variables in manufacturing industries
- Learn how to classify the inventories for a better control

  
**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

<b>24UMEO05</b>	<b>INTRODUCTION TO ADDITIVE MANUFACTURING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

- To provide a comprehensive understanding of additive manufacturing (AM) technologies.
- To equip students with skills in 3D modeling, CAD software, and data processing for AM.
- To explore material-specific AM processes and their industrial applications.

<b>UNIT-I</b>	<b>FUNDAMENTALS OF ADDITIVE MANUFACTURING</b>	<b>9</b>
Introduction to manufacturing - Traditional vs. Additive Manufacturing - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping, Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. Applications: Building Printing - Bio Printing - Food Printing, Electronics Printing. Business Opportunities and Future Directions		

<b>UNIT-II</b>	<b>3D MODELLING &amp; SOFTWARE FOR ADDITIVE MANUFACTURING</b>	<b>9</b>
Introduction to CAD software (Fusion 360, SolidWorks, Tinker Cad) - Part Consolidation –Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation - Optimization Algorithms for 3D Printing - AI & Machine Learning Applications in AM - Generative Design & Topology Optimization.		

<b>UNIT-III</b>	<b>VAT POLYMERIZATION AND Fused DEPOSITION MODELLING</b>	<b>9</b>
Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom-up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.		

<b>UNIT-IV</b>	<b>POWDER BED FUSION</b>	<b>9</b>
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications.		

<b>UNIT-V</b>	<b>APPLICATIONS OF AM IN VARIOUS DOMAINS</b>	<b>9</b>
Electronics & IoT Applications - 3D-Printed PCBs, Antennas, Sensors, Flexible & Wearable Electronics. AI & Data Science in AM - Predictive Maintenance of 3D Printers, Data-Driven Optimization of Printing Parameters. Biomedical & Industrial Applications - Prosthetics, Implants, and Bioprinting, Aerospace & Automotive Applications		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies", 3rd edition Springer Cham, Switzerland. (2021).
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015.

**REFERENCES**

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Understand the fundamental principles of Additive Manufacturing, its evolution, and applications in construction, healthcare, food, and electronics.
- Apply knowledge of 3D modeling, slicing, and design optimization techniques to prepare CAD models for AM processes.
- Analyze and compare different AM processes such as Vat Polymerization, Fused Deposition Modeling, and Powder Bed Fusion, including their materials, advantages, and limitations.
- Evaluate the role of AI, machine learning, and optimization algorithms in improving AM processes and predicting printing outcomes.
- Demonstrate the ability to explore emerging applications of AM in electronics, IoT, biomedical, aerospace, and automotive industries and identify business opportunities in the field.



**Head of the Department**  
Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
Dharapuram Road, Avinashipalayam,  
Tirupur-638 660. Tamil Nadu, India.

24UMEO06	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

**COURSE OBJECTIVES:**

- To provide foundational knowledge of the global, national, and regional energy scenario.
- To enable students to analyze and implement energy conservation techniques.
- To equip students with practical skills for conducting energy audits.

<b>UNIT-I</b>	<b>INTRODUCTION</b>	9
Energy scenario of Tamil Nadu, India and World - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers and energy auditors.		

<b>UNIT-II</b>	<b>ELECTRICAL SUPPLY SYSTEMS</b>	9
Electricity Tariff structures – Typical Billing - Demand Side Management – High Tension and Low Tension supply - Power Factor – Energy conservation in Transformers – Harmonics, Energy conservation measures.		

<b>UNIT-III</b>	<b>ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES</b>	9
Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.		

<b>UNIT-IV</b>	<b>ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES</b>	9
Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems		

<b>UNIT-V</b>	<b>ENERGY AUDIT</b>	9
Definition, need and objectives; Types of energy audit; Basic components of energy audit; preparing for audit, Energy audit instruments, Data collection, safety considerations. Methodologies of conducting energy audit; Preliminary questionnaire, Review of previous records, Walk through audit, Energy flow diagram (Shankey diagram).		

<b>L:45</b>	<b>T:0</b>	<b>P:0</b>	<b>Total :45 Periods</b>
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**TEXT BOOKS**

1. Guide book for National Certification Examination for “Energy Managers and Energy Auditors” (4 Volumes). Available at <http://www.em-ea.org/gbook1.asp>. Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, administers this website.
2. K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers &Dist, 2007.

**REFERENCES**

1. Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press, 2006.
2. Albert Thumann and Paul Mehta D, “Handbook of Energy Engineering”, 7th Edition, The Fairmont Press, 2013.
3. Murphy.W.R. and McKay.G, “Energy Management”, Butterworth, London 1982.
4. Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Pergamon Press, 1981.
5. Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.

**COURSE OUTCOMES:****At the end of the course the students would be able to**

- Discuss Quantify the energy demand and energy supply scenario of nation and appreciate the need for energy auditing for becoming environmentally benign
- Analyze factors behind energy billing and apply the concept of demand side management for lowering energy costs
- Compute the stoichiometric air requirement for any given fuel and quantify the energy losses associated with thermal utilities of industries
- Diagnose the causes for under performance of various electrical utilities and suggest remedies for improving their efficiency
- Apply energy audit in industries for identifying and reducing energy wastage.



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Department of Mechanical Engineering  
**Jai Shriram Engineering College**  
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