Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya (SCSVMV)

(University U/S 3 of UGC Act 1956)
(Accredited with "A" Grade by NAAC)
Enathur, Kanchipuram - 631 561

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM AND SYLLABUS
(Regulation – 2025)

B.E. (Mechatronics Engineering)

Choice Based Credit System

(Students Admitted from AY-2025-26)

PROGRAM OUTCOMES [PO's]	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Mechanical engineering problems
PO 2	Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	Design/development of solutions: Design solutions for complex Mechanical engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, 5analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools that are relevant to Mechanical engineering, including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Mechanical engineering practice
PO 7	Environment and sustainability: Understand the impact of the Mechanical engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Mechanical engineering practice
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO 12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOME (PSO's) – Mechanical Engineering	
PSO 1	Apply modern engineering tools such as CAD/CAM, Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), and automation technologies to analyze and solve complex problems in mechanical and interdisciplinary engineering domains.
PSO 2	Demonstrate technical competencies and innovative problem-solving abilities to address real-world challenges in sectors like automotive, aerospace, energy, and manufacturing through internships, industry-driven projects, and collaborative engagements

PROGRAM SPECIFIC OUTCOME (PSO's) – Mechatronics Engineering	
PSO 1	Graduates will be able to apply the integrated knowledge of mechanical, electrical, electronics, and computer engineering to design, develop, and implement intelligent mechatronic systems and automation solutions for real-world applications.
PSO 2	Graduates will be capable of designing and deploying embedded systems, control algorithms, and real-time interfaces to address challenges in automation, robotics, and various industrial domains.

CREDIT ASSIGNMENT

1 Hour Lecture (L) per week	**1 Credit**
1 Hour Tutorial (T) per week	**1 Credit**
1 Hour Practical (P) per week	**0.5 Credit**
2 Hours Project Per week	**1 Credit**

PROCEDURE FOR AWARDING MARKS FOR CONTINUOUS ASSESSMENT

Internal Assessment Marks for Theory Courses

- ✓ First internal test : 15 marks
- ✓ Second internal test : 15 marks
- ✓ Assignment : 10 marks

TOTAL MARKS : 40 marks

Internal Assessment Marks for Laboratory Courses

- ✓ Weekly lab performance : 15 marks
- ✓ Model lab Exam : 15 marks
- ✓ Record : 10 marks

TOTAL MARKS : 40 marks

Internal Assessment for Laboratory Integrated Theory Course

- ✓ First Internal test : 10 marks
- ✓ Second Internal test : 10 marks
- ✓ Internal lab Exam / Project work : 15 marks
- ✓ Assignment : 05 marks

TOTAL MARKS : 40 marks

SEMESTER - I (First year)										
SL. No	**Course Category**	**Course Code**	**Course Type**	**Name of the Course**	**Hours per week**			**Credit**	**IA**	**EA**	**TM**
					L	**T**	**P**				
1.	HSMC			English	2	-	-	**2**	40	60	100
2.	BSC			Mathematics – I (Calculus and Differential Equations)	3	1	-	**4**	40	60	100
3.	BSC		L / T	Applied Physics for Engineers	3	-	2	**4**	40	60	100
4.	HSMC			Universal Human Values	3	-	-	**3**	40	60	100
5.	MC*			Environmental Science and Engineering*	2	-	-	**0**	100	-	100
6.	ESC		L / T	Design Thinking and Idea Lab	3	-	2	**4**	40	60	100
7.	HSMC			Soft Skills	2	-	-	**1**	100	-	100
8.	MC*			Industrial visit / Survey / Technical Seminar	-	-	-	**-**	**-**	**-**	**-**
9.	MC*			NSS / Technical Club / Green Cell / Archaeological Site Visit and Survey	-	-	-	**-**	-	-	-
* Not considered for GPA Calculations											
Total					**18**	**01**	**04**	**18**			

SEMESTER - II (First year)										
SL. No	**Course Category**	**Course Code**	**Course Type**	**Name of the Course**	**Hours per week**			**Credit**	**IA**	**EA**	**TM**
					L	**T**	**P**				
1.	BSC			Mathematics –II (Linear Algebra, Transform Calculus and Numerical Methods)	3	1	-	**4**	40	60	100
2.	BSC		L / T	Engineering Chemistry	3	-	2	**4**	40	60	100
3.	ESC			Basic Electrical & Electronics Engineering	2	1	-	**3**	40	60	100
4.	ESC			Programming for Problem Solving	3	-	-	**2**	40	60	100
5.	ESC		L / T	Engineering Graphics & Design (Theory & Practical)	2	-	2	**3**	40	60	100
6.	BSC			Basic Electrical & Electronics Engineering Lab	-	-	2	**2**	40	60	100
7.	ESC			Programming for Problem Solving Lab	1	-	2	**2**	40	60	100
Total					**14**	**02**	**08**	**20**			
Total Credits (First year)								**38**			

[**L**-Lecture, **T**-Theory, **P**-Practical, **C**-Credit, **IA**-Internal Assessment, **EA**-External Assessment, **TM**-Total Marks]

SEMESTER - III (Second year)										
SL. No	Course Category	Course Code	Course Type	Name of the Course	Hours per week			Credit	IA	EA	TM
					L	T	P				
1.	BSC		T	Mathematics III (Probability & Statistics)	3	1	-	**4**	40	60	100
2.	ESC		T	Engineering Mechanics[$]	3	-	-	**3**	40	60	100
3.	PCC		T	Materials Engineering[#]	3	-	-	**3**	40	60	100
4.	PCC		L / T	Electronic Devices[•]	3	-	2	**4**	40	60	100
5.	PCC		L / T	Digital Electronics[•]	3	-	2	**4**	100	-	100
6.	AEC		L	Programming Using Python lab[#]	1	-	2	**2**	40	60	100
7.	MC*		L	Skill Development Course – I*	-	-	-	**1***	100	-	100
Total					**16**	**01**	**06**	**20+1***			

SEMESTER - IV (Second year)										
SL. No	Course Category	Course Code	Course Type	Name of the Course	Hours per week			Credit	IA	EA	TM
					L	T	P				
1.	ESC		L / T	Solid and Fluid Mechanics	3	-	2	**4**	40	60	100
2.	PCC		L / T	Thermal Engineering	3	-	2	**4**	40	60	100
3.	PCC		L / T	Manufacturing Technology for Mechatronics	3	-	2	**4**	40	60	100
4.	PCC		T	Industrial Instrumentation	3	-	-	**3**	40	60	100
5.	PCC		T	Sensors and Actuators	3	-	-	**3**	100	-	100
6.	AEC		L	Programming Using MATLAB[#]	1	-	2	**2**	40	60	100
7.	MC*		T	Sanskrit and Indian Culture	1*	-	-	**1***	100	-	100
8.	MC*		L	Skill Development Course – II*	-	-	-	**1***	100	-	100
9.	MC*		-	Summer Training Internship	-	-	-	**1***	100	-	100
Total					**16**	**0**	**08**	**20+3***			

[$]Common to Mechanical, Mechatronics & Civil Engineering

[#]Common to Mechanical & Mechatronics Engineering

• Common to Mechatronics & Electronics Communication Engineering

* Not accountable for GPA calculation

Course Type: T – Theory, L – Laboratory Course, L / T – Laboratory Integrated Theory

SEMESTER - I

Course Code	Course Name	Semester	Credits	L T P C
	ENGLISH	1		2 0 0 2

COURSE OBJECTIVES

- Learn technical vocabulary and use it while speaking and writing in the professional arena.
- Help the students to understand the nuances of Grammar.
- To make learners acquire listening and help them to comprehend lectures and presentation.
- Develop strategies and skills to enhance students' ability to read and comprehend.
- Strengthen their proficiency in speaking and writing effectively which will help them comprehend lectures and talks in their areas of specialization.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT-I: Vocabulary Building — **9**

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT-II: Basic Writing Skills — **9**

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT-III: Identifying Common Errors in Writing — **9**

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT-IV: Nature and Style of sensible Writing — **9**

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

UNIT-V: Writing Practices — **9**

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

PRACTICE: ORAL COMMUNICATION

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Understand the nuances of grammar and vocabulary in speaking and writing.
2.	Listen and comprehend different spoken excerpts critically, infer and implied meanings.
3.	Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
4.	Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
5.	Write effectively and persuasively and by using different techniques of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
TEXT BOOK	
1.	Practical English Usage. Michael Swan. OUP. 1995
2.	Remedial English Grammar. F.T. Wood. Macmillan.2007
REFERENCES	
1.	On Writing Well. William Zinsser. Harper Resource Book. 2001
2.	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006
3.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011
4.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1														
CO2														
CO3														
CO4														
CO5														

Course Code	Course Name	Semester	Credits	L T P C
	Engineering Mathematics – I (Calculus, Ordinary Differential Equations, and Complex Variables)	**1**	**Credits**	**3 1 0 4**

COURSE OBJECTIVES

- To equip students with techniques to solve ordinary differential equations using analytical and numerical methods.
- To develop an understanding of partial differential equations and methods of finding their general and particular solutions.
- To introduce Fourier series and their applications in representing periodic functions.
- To familiarize students with Laplace transforms and their use in solving differential equations.
- To provide a foundation in Fourier transforms and their properties for analyzing signals and systems.

UNIT- I DIFFERENTIAL EQUATIONS **9**

Method of variation of parameters - Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation.- solving of Ordinary differential equations using Numerical methods: Taylor's series, Runge-Kutta method of fourth order for solving first order equations - Milne's predicator corrector methods.

UNIT-II PARTIAL DIFFERENTIAL EQUATIONS **9**

Formation of partial differential equations – Solution of a partial differential equation – Equations solvable by direct integration – Linear equations of first order – Non linear equations of the first order – Charpit's method - Homogeneous linear equations with constant coefficients – Rules for finding complementary functions – Rules for finding particular integral – Solution of homogeneous linear equation of any order.

UNIT-III FOURIER SERIES **9**

Introduction - Euler's Formulae - Conditions for a Fourier expansion - Functions having points of discontinuity - Change of interval - Odd and even function - Expansions of odd or even periodic functions - Half-range series - Typical wave-forms - Parseval's formula

UNIT-IV LAPLACE TRANSFORMS **9**

Definition, Properties of Laplace transforms: Linearity Property, First shifting property, Change of scale property – Transforms of derivatives - Transforms of integrals - Multiplication by t^n - Division by t - Evaluation of integrals by Laplace transform - Inverse transforms: Method of partial fractions – Other methods of finding inverse - Convolution theorem (without proof) Application to differential equations

UNIT-V FOURIER TRANSFORMS **9**

Fourier integral theorem (without proof) - Fourier Sine and Cosine integrals – Complex form of Fourier integral - Fourier transform – Fourier sine and Cosine transforms – Properties of Fourier Transforms: Linear property, Change of scale property, Shifting property -Parseval's identity for Fourier transforms (without proof)

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Solve ordinary differential equations using analytical methods and numerical techniques such as Taylor's series, Runge-Kutta, and Milne's methods.
2.	Formulate and solve partial differential equations using appropriate methods including Charpit's method.
3.	Represent periodic functions using Fourier series and apply them to solve engineering problems
4.	Apply Laplace transforms and their properties to solve differential equations and evaluate integrals
5.	Use Fourier transforms to analyze signals and solve problems involving integral transforms

TEXT BOOK	
1.	B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.
REFERENCES	
1.	Coddington, E. A, An Introduction to Ordinary Differential Equations. United Kingdom: Dover Publication. (2012)
2.	Simmons, G. F. Differential Equations: With Applications and Historical Notes. India: Tata McGraw-Hill. (2003)
3.	John, F. Partial Differential Equations. Germany: Springer New York(2013)
4.	Evans, L. C. Partial Differential Equations. United States: American Mathematical Society(2022)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PS02**
CO1														
CO2														
CO3														
CO4														
CO5														

Course Code	Course Name	Semester	Credits	L T P C
	APPLIED PHYSICS FOR ENGINEERS	1		3 0 2 4

COURSE OBJECTIVES

- Elastic properties of materials and their applications in beams, cantilevers and metallic ropes under torsion.
- Various acoustical effects in buildings and designing of auditorium for better acoustics.
- Einstein's theory on matter-radiation interaction, Laser principle and Properties, Nd:YAG and CO2 lasers, applications of lasers – IR thermography, light propagation in optical fiber, fiber parameters, types and applications, fiber losses
- Black body radiation, wave particle duality, De Broglie matter waves, physical significance of wave function, Schrodinger time wave equations.
- Dielectric materials, internal field, Superconductors, nanomaterial, methods of synthesis, shape memory alloys (SMA) and Biomaterials

UNIT- I PROPERTIES OF MATTER — **9**

Stress – Strain – Hooke's law – Elastic Behavior of Material – Young's modulus by cantilever depression – Non-uniform bending. Torsional Pendulum – Couple per unit twist of a wire-Time period-Application- Determination of Rigidity Modulus.

UNIT-II TECHNICAL ACOUSTICS — **9**

Acoustics of buildings – Reverberation- Weber Fechner law- Factors affecting acoustics of a building and remedies –Sabine's formula for reverberation time- Absorption coefficient. Ultrasonic waves - Properties - Generation – Piezoelectric method, Detection – Kundt's tube method, Applications – NDT.

UNIT-III LASER PHYSICS — **9**

Einstein's theory of matter - radiation interaction and A and B coefficients; Properties of laser- spontaneous and stimulated emission, amplification of light by population inversion, different types of lasers: solid-state laser(Nd:YAG), gas lasers (CO2), applications –IR Thermography.

UNIT-IV FIBRE OPTICS — **9**

Optical fibre- structure – core and cladding - principle [TIR] - types- material, mode, refractive index profile - Fibre losses -Expression for acceptance angle and numerical aperture. Application-optical fiber- Endoscope, Optical Fiber Communication.

UNIT-V ENGINEERING MATERIALS — **9**

Dielectric materials- Definition– Dielectric loss – Internal field – Claussius Mossotti relation. **Superconducting materials** -Introduction – Properties-Meissner effect – Type I & Type II superconductors – BCS theory. **Nanomaterial**- Introduction – Synthesis of nano materials – Top down and Bottom up approach- Ball milling- PVD method. **Smart materials**- Shape memory alloys-Biomaterials (properties and applications).

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	Determination of Rigidity Modulus & Moment of Inertia using Torsional Pendulum
2.	Determination of Young's Modulus.
3.	Determination of Wavelength of Laser light using transmission grating
4.	Determination of particle size using LASER
5.	Measurement of numerical aperture of an optical fiber.
6.	Determination of wavelength of light using Newton's Rings apparatus
7.	Determination of Velocity of sound waves in liquid using Ultrasonic interferometer
8.	Determination of wavelength of prominent colours of mercury spectrum using grating
9.	Determination of number of lines per meter of the grating using normal incidence method
10.	Determination of refractive index of the given prism using minimum deviation method

11.	Determination of emissivity of the surface of a black body
12.	Basic logic gates- Verification of truth tables
13.	NAND-Universal building block
14.	NOR-Universal building block
15.	Zener diode- I-V characteristics
16.	Study of LCR circuit
CO	**COURSE OUTCOMES**
At the end of the course, the student will gain adequate knowledge about	
1.	Young's modulus, bulk modulus and rigidity modulus of materials, cantilevers and metallic ropes under torsion
2.	Various acoustical problems in buildings and designing of auditorium for better acoustics
3.	Spontaneous and stimulated emissions, basic principles and properties of Laser, designing and working of Nd: YAG and CO2 lasers, applications, IR thermograph, optical fiber, fiber parameters, types and applications, fiber losses
4.	Black body radiation, wave particle duality, De Broglie matter waves, physical significance of wave function, Schrodinger time wave equations
5.	Dielectric materials, Superconductors, nanomaterials, Ball milling and PVD method of synthesis, shape memory alloys (SMA) and Biomaterials their nature and applications
TEXT BOOKS	
1.	V. Devanathan, "Quantum Mechanics", Narosa, 2011
2.	M.N. Avadhanulu, "Engineering Physics", S Chand & Co, 2007
3.	Charles Kittel , "Introduction to Solid state Physics", Wiley Student Edition, 2019
4.	D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", Wiley, 2001
5.	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", McGraw Hill, 2017
REFERENCES	
1.	K.Venkatramanan, R.Raja, M.Sundarrajan, "Applied Physics for Engineers", Scitech, 2014 [units I, III-V]
2.	Sathyaprakash, "Quantum Mechanics", Pragati Prakashan, 2016 [unit IV]

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1														
CO2														
CO3														
CO4														
CO5														

Course Code	Course Name	Semester	Credits	L T P C
	UNIVERSAL HUMAN VALUES	**1**		**3 0 0 3**

COURSE OBJECTIVES

- To help the students appreciate the complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
- To highlight Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
- This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Unit – I: Introduction to Value Education | **9**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations

Unit - II: Harmony in the Human Being | **9**

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

Unit III: Harmony in the Family and Society | **9**

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-toHuman Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order

Unit – IV : Harmony in the Nature/Existence : | **9**

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Unit - V: Implications of the Holistic Understanding – a Look at Professional Ethics | **9**

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

CO	COURSE OUTCOMES
At the end of the course the students will be able to	
1.	They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind
2.	They would have better critical ability.
3.	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society)
4.	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

TEXT BOOK	
1.	The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 97893-87034- 47-1
2.	The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

REFERENCES

References:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas.
5. Karamchand Gandhi [5]. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews.
7. Economy of Permanence - J C Kumarappa.
8. Bharat Mein Angreji Raj – Pandit Sunderlal.
9. Rediscovering India - by Dharampal.
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
11. India Wins Freedom - Maulana Abdul Kalam Azad.
12. Vivekananda - Romain Rolland (English).
13. Gandhi - Romain Rolland (English).
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991.
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, JeevanVidya EkParichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantra Shodh, Amravati.
20. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press.
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

- Value Education websites,
- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM

Course Code	Course Name	Semester	Credits	L T P C
	ENVIRONMENTAL SCIENCE AND ENGINEERING	**1**		**2 0 0 0**

COURSE OBJECTIVES

- To familiarize the students with basic concepts of environment
- To understand their role and responsibility of an individual in the environmental conservation.

UNIT-I: Introduction to environment and environmental studies	**9**

Introduction to environment – components – nature of environment - need of awareness –reason for environmental problems – anthropocentric and eco centric views.
Environmental studies - multidisciplinary nature – scope and aim – sustainable development- principles – RRR concept-Indian environmental movements – environmental calendar.

UNIT-II: Ecosystem and Biodiversity	**9**

Ecosystem – structure – functions – simplified ecosystem models (food chain and food webs and their types,energy flow) - forest – grassland – pond –ecosystems – ecological succession - ecological pyramids – Bio-geochemical cycles of water – oxygen-carbon-phosphorous and sulphur.
Biodiversity – definition – types – species – genetic and ecosystem diversities- values of biodiversity – threats to biodiversity – conservation of biodiversity – endemism – biodiversity hotspots – Indian biodiversity– endemic species of India – IUCN lists -red-green and blue data books.

UNIT-III: Natural resources	**9**

Natural resources – definition – types – forest resources – uses –deforestation- reasons - effects –water resources – dams – effects of dams - food resources – modern agriculture– ill effects -energy resources-types – hydel –nuclear – solar –wind and biomass energy - world scenario – Indian scenario.
Population and environment – reasons for over exploitation of resources – population – demography – population curves – population explosion – effects – consumerism – effects – urbanization – reasons and effects- role of an individual.

UNIT-IV: Environmental Pollution	**9**

Pollution – definition – types – air pollution – causes and effects – effects of CO_2 – CO – NOx –SOx – particulates – control of air pollution – water pollution – causes – effects – remedies – soil pollution – solid waste management – e waste – ill effects of e-waste – proper recycling- Noise pollution – reasons – effects – control – nuclear pollution – causes – effects and control –thermal pollution - causes – effects and remedies.
Legal provisions for protecting environment – article 48 A – 51 A (g) – Environment act 1986 – Air act 1981 – Water act 1974 – wild life protection act – Forest act 1980- problems in implementation–reasons.

Unit-V: Social issues and environmental ethics	**9**

Present environmental scenario – green house effect – climate change – The Kyoto Protocol – ozone layer depletion-The Montreal Protocol - acid rain – causes – effects - disparity among the nations – The Copenhagen UNFCCC summit – carbon currency- virtual water- genetically modified organisms, Disaster management.
Environmental ethics – introduction – people getting affected - resettlement and rehabilitation – issues involved –Sardhar Sarovar project – Tawa Matsya sang - Melting icebergs of Arctic.

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Understand the individual responsibility towards environment
2.	Create Eco-centrism approach towards sustainable society
3.	Enable the learners to understand, think and evolve strategies for management and conservation of environment for sustaining life on earth.
4.	Develop a new solution towards various environmental problems
5.	Understand the current environmental trends of India and the world and about environmental legislation
TEXT BOOK	
1.	Anubha Kaushik and C.P. Kaushik, "Prospects of Environmental Science", New Age International publishers, 2013
REFERENCES	
1.	Environmental Studies, N. Nandini, N. Sunitha and Sucharita Tandon, Sapna Book House, 2007
2.	Text book of Environmental Science, Ragavan Nambiar, Scitech Publications, 2009
3.	Text book of Environmental Chemistry and Pollution Control, S.S.Dara, S.Chand and Co., 2002
4.	Environmental Chemistry, Colin Baird, W.H.Freeman and company, New York,1999
5.	Environmental Chemistry, Gary W. VanLoon and Stephen J.Duffy, Oxford University Press, 2000
6.	New Trends in Green Chemistry, V.K. Ahluwalia and M. Kidwai, Anamaya Publishers, 2006

Course Title	DESIGN THINKING AND IDEA LAB	Semester	Credits	L T P C
Course Code		1		3 0 2 4

OBJECTIVES

- To understand various learning process, understanding the problems and enhancement techniques on innovative engineering products.
- To understand the importance of the design thinking tools.
- To learn about the problem-solving techniques and gain the knowledge about Empathy methods.
- To develop skills in ideation, product design tools and prototyping.
- To develop skills in testing, innovations, and collaboration on novel products.

UNIT - I BASICS OF LEARNING, UNDERSTANDING AND ENHANCEMENT TECHINIQUES **9**

Principles and Dimensions of Learning Process – Learning Styles - Human Centered Design – Assessing and Interpreting – Learning Retention process – Memory Enhancement Techniques – Emotions and Psychology – Importance of Peer Learning.

UNIT - II DESIGN THINKING TOOLS & TECHNIQUES **9**

Design Thinking process – Need of Design Thinking – Objectives of Design Thinking – Design Thinking Frameworks – Design Thinking Mindsets – Design Thinking Tools – Empathize, Define, Ideate, Prototype and Test.

UNIT - III EMPATHY **9**

Role of Empathy – Methods and tools of Empathy – Defining the problem – Analysis and Synthesis – Empathy Mapping & its types – Double diamond design thinking -Ethical reasoning.

UNIT - IV IDEATION, PROTOTYPING & TESTING **9**

Ideation methods – Brainstorming techniques - Prototype – Need of Prototype – Types of Prototype – Rapid Prototyping – Testing: Purpose of testing – Types of testing - Designing for business growth

UNIT - V ETHICS & SUSTAINABILITY **9**

Values of morals – Five ways of ethical thinking – Ethical issues – Sources of ethics – Universal principle of Ethics – Ethical design test – Sustainability and sustainable futures – Pillers of sustainability – Sustainable design – Desing thinking for 2030 agenda.

CASE STUDIES (Practical only)

Real life case studies – Karnataka health promotion trust – Shriram life insurance corporation – Government of Odisha – Kotak Mahindra Bank - Design Thinking for Patient waiting in Hospitals - Design Thinking for Higher Education – Design Thinking for developing the application / Technology – Design Thinking for Patient waiting in Hospitals - Design Thinking for Seat confirmation in Train/Flight transport - Design Thinking for reducing effect of Global warming.

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	To study the working principles and operation of normal lathe machine.
2.	To study the, working and operation of different welding equipment's.
3.	To study the working principles and operation of wood lathe machine.
4.	To study the machining of 3D geometry on soft material such as soft wood or modelling wax.
5.	To study the 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	To study the 3D 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm

	thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver
7.	Scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
8.	Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
9.	Embedded programming using Arduino and/or Raspberry Pi.
10.	Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.
❖ Discussion and Implementations of a Mini Project ❖ Documentation of the Mini Project (Report & Video)	
CO	**COURSE OUTCOMES**
Upon completion of this course, Students should be able to	
1.	Classify the various learning principles and styles, memory technologies, and assess the emotional experience when examining emotional expressions in engineering education in order to create novel products.
2.	Discover the importance of brainstorming and how to apply design thinking tools to produce new products through innovative thinking.
3.	Propose the suitable problem-solving techniques through different Empathy tools and methods on defining problem statement on new products.
4.	Generate new ideation techniques applied on new product design and evaluate prototype effectiveness on different suitable developed prototype models.
5.	Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.
TEXT BOOKS	
1.	Balaguruswamy, E., "Design Thinking", Mc Graw Hill, First Edition, January 2024.
2.	Idris Mootee, Design thinking for strategic innovation, Wiley publications, 2013.
3.	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.
4.	Michael Lewrick, Patrick Link, and Larry Leifer, The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems, 2018, John Wiley & Sons.
REFERENCES	
1.	Tom Kelley, The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm, Currency/Doubleday, 2001
2.	Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd, 2009
3.	Ulrich & Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004.
4.	Kevin Otto, Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson publications, 2001.
5.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
6.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
7.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.

SEMESTER - II

Course Code	Course Name	Semester	Credits	L T P C
	ENGINEERING MATHEMATICS - II	2		3 1 0 4

COURSE OBJECTIVES

- To understand matrix theory, including eigenvalues, eigenvectors, and quadratic forms, for solving engineering problems
- To apply numerical methods for solving algebraic and transcendental equations using both direct and iterative techniques
- To learn interpolation, numerical differentiation, and integration methods for approximating functions and values.
- To evaluate multiple integrals and use Beta and Gamma functions in engineering applications.
- To apply vector calculus concepts and theorems to solve problems in physics and engineering fields

UNIT- I MATRICES — **9**

Eigen Value and Eigen Vectors – Properties of Eigen Values – Cayley-Hamilton Theorem – Reduction to Diagonal Form – Reduction of Quadratic Form to Canonical Form – Nature of Quadratic Forms.

UNIT-II NUMERICAL SOLUTIONS TO ALGEBRAIC EQUATIONS — **9**

Introduction – Solution of Algebraic and Transcendental Equations – Bisection Method, Method of False Position, Newton's Method – Solution of Linear Simultaneous Equations – Direct Methods of Solution – Gauss Elimination, Gauss-Jordan Method – Indirect Methods of Solution – Jacobi's Method, Gauss-Seidel Method.

UNIT-III INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION — **9**

Finite Differences – Newton's Interpolation Formula – Interpolation with Unequal Intervals – Lagrange's Formula – Divided Differences – Newton's Divided Difference Formula. Numerical Differentiation – Formulae for Derivatives – Numerical Integration – Newton-Cote's Quadrature Formula – Trapezoidal Rule – Simpson's 1/3rd Rule – Simpson's 3/8th Rule.

UNIT-IV MULTIPLE INTEGRALS AND BETA-GAMMA FUNCTIONS — **9**

Double Integrals – Change of Order of Integration – Double Integrals in Polar Coordinates – Area enclosed by Plane Curves – Triple Integrals – Volume of Solids – Beta Function – Gamma Function – Relation between Beta Function and Gamma Function

UNIT-V VECTOR CALCULUS — **9**

Scalar and Vector Point Functions-Vector Operator del. – Del applied to Scalar Point Functions-Gradient – Del applied to Vector Point Functions-Divergence and Curl – Del applied twice to Point Functions – Del applied to Product of Point Functions – Integration of Vectors – Line Integrals-Circulation-Work – Surface Integral-Flux – Green's Theorem in the Plane – Stoke's Theorem – Volume Integral – Divergence Theorem – Irrotational and Solenoidal Fields.(statement only for theorems).

CO	COURSE OUTCOMES
After successful completion of this course, students will be able to	
1.	Solve problems involving eigenvalues, eigenvectors, and reduce matrices and quadratic forms to canonical forms.
2.	Apply numerical methods to find approximate solutions of algebraic and transcendental equations.
3.	Use interpolation techniques and numerical integration/differentiation for estimating values from data.
4.	Evaluate double and triple integrals, and apply Beta and Gamma functions in engineering contexts.
5.	Compute gradient, divergence, and curl, and apply vector integral theorems in physical applications.

TEXT BOOK

1. B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

REFERENCE

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PS02**
CO1														
CO2														
CO3														
CO4														
CO5														

ourse Code	Course Name	Semester	Credits	L T P C
	ENGINEERING CHEMISTRY	2		3 0 2 4

COURSE OBJECTIVES

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UNIT- I MOLECULAR ENGINEERING AND NANOTECHNOLOGY	9

Review of chemical bonding - MO theory – formation of H2,He2,O2,N2,CO and HF – hybridization definition- CH4,C2H4 and C2H2 - Supramolecular chemistry definition – types of molecular assemblies - molecular machines (concepts only) – Nanomaterials-differences between bulk and nanophases - synthesis (top-down and bottom-up) - Applications: sensors, energy devices, coatings

UNIT-II ENGINEERING MATERIALS – POLYMERS, CERAMICS & COMPOSITES	9

Polymers – introduction – types - advanced functional polymers -conducting polymers - biodegradable plastics – PLA and cellulose derivatives - Engineering ceramics – properties – types – oxide (Alumina and zirconia) non-oxide (SiC) and composite ceramics (metal cements) - applications - Composite materials: classification and uses.

UNIT-III ELECTROCHEMISTRY AND CORROSION CONTROL	9

Electrodes – types of electrodes – SEP – Nernst equation -Electrochemical cells, EMF, Nernst equation for cells -Batteries- Ni-Cd and Li-ion batteries - supercapacitors – introduction only - fuel cells introduction and types - Corrosion: types of corrosion - mechanisms, protection strategies.

UNIT-IV WATER TREATMENT TECHNOLOGY	9

Water as universal solvent – hardness-types - units of hardness -estimation of hardness - disadvantages of hard water – scale and sludges – water softening methods - ion exchange method, RO methods - Wastewater treatment: primary to tertiary methods - water pollutants types- heavy metals, microplastics and pesticide residues – effects. Domestic water treatment.

UNIT-V INTRODUCTION TO GREEN CHEMISTRY	9

Introduction to Green Chemistry – definition, scope, and significance - Twelve Principles of Green Chemistry – Atom Economy – definition, calculation, and applications, Carbon Footprint and Water Footprint – concepts and relevance in chemical industries -LCA – introduction- imporatnace- Green Synthetic Methodologies – use of green solvents, supercritical fluids, and ionic liquids - Solvent- Free Reactions – techniques and advantages - Microwave-Assisted and Sonochemical Reactions – principles, mechanisms, and applications.

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	Kinetics of Green synthesis of silver nanoparticles-Colorimetry
2.	Determination of hardness of water (EDTA method)
3.	Estimation of DO of water samples
4.	Estimation of COD of water samples
5.	Verification of Nernst equation for an electrode
6.	Electrochemical cell construction and EMF measurement
7.	Corrosion studies of metals
8.	Prediction of Feasibility of cells.
9.	Bioplastic preparation and testing.
10.	Ion exchange water purification
11.	Green synthesis of b*is*-naphthol
12.	Air particulate analysis using filter method

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	
2.	
3.	
4.	
5.	
TEXT BOOK	
1.	Jain & Jain, Engineering Chemistry, Dhanpat Rai Publishing, Latest Edition.
REFERENCES	
1.	P.C. Jain & Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing
2.	Shashi Chawla, *A Textbook of Engineering Chemistry*, Dhanpat Rai & Co
3.	S.S. Dara & S.S. Umare, *Engineering Chemistry*, S. Chand & Company
4.	R. Mukhopadhyay, *Advanced Engineering Chemistry*, New Age International
5.	Anastas & Warner, *Green Chemistry: Theory and Practice*, Oxford University Press

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PS02**
CO1														
CO2														
CO3														
CO4														
CO5														

Course Code	Course Name	Semester	Credits	L T P C
	BASIC ELECTRICAL ENGINEERING	2		2 1 0 3

COURSE OBJECTIVES

- To understand and analyze basic electric and magnetic circuits.
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations.

UNIT-I DC CIRCUITS — **9**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation-Superposition, Thevenin and Norton Theorems.

UNIT-II AC CIRCUITS — **9**

Representation of sinusoidal waveforms, peak and rms values, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series), series resonance -Three-phase balanced circuit-voltage and current relationship in star and delta connections.

UNIT-III ELECTRICAL MACHINES (STATIC) — **9**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, transformer losses, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT-IV ELECTRICAL MACHINES (ROTATING) — **9**

Construction and working principle – DC motor, Three-phase induction motor and Single- phase induction motor - torque –slip characteristics (three phase)-starting and speed control of three phase induction motor – Construction and working principle of DC generator and Three phase alternator.

UNIT-V POWER CONVERTER AND ELECTRICAL INSTALLATIONS — **9**

DC-DC buck and boost converters – Single phase voltage source inverters – Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Cables - Earthing - Types of Batteries - Power factor improvement.

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Explain the basic electrical quantities and laws
2.	Explain the construction, types and applications of electrical machines
3.	Study the working principles of power converters
4.	Show the tariff or a given load and energy consumption
5.	Introduce the components of low voltage electrical installations and its applications

TEXT BOOK

1.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2.	D. C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2009.

REFERENCES

1.	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2.	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3.	V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

Course Code	Course Name	Semester	Credits	L T P C
	PROGRAMMING FOR PROBLEM SOLVING	2		3 0 0 2

COURSE OBJECTIVES

- The course is designed to provide complete knowledge of C and basic of C++.
- To provide students an exposure to gain the knowledge
- To ensure that students begin to learn the concepts of basic programming
- To design a creative solution for real world problems.
- To develop awareness of learning the basic concepts and creating algorithms.

UNIT - I COMPUTER BASICS	**9**
Introduction to components of computer system - Generation of programming languages - Types of Computers - Organization of Computers - Types of memory , Number systems - Idea of Algorithm -Pseudo code - Flow Chart with examples.	
UNIT - II DATA TYPE & CONTROL STRUCTURES	**9**
Introduction to C - Character set, Constants, Variables, Data Types – Operators –Arithmetic expressions and precedence – Decision Making statement - Looping statements.	
UNIT - III ARRAY, STORAGE CLASS, FUNCTIONS	**9**
Arrays and its types - Basic searching–Linear and Binary, Basic sorting, Storage class, Functions–Parameter passing in functions - call by value - call by reference – Passing array to functions-Recursive function.	
UNIT - IV STRUCTURE, UNION, STRINGS AND POINTER	**9**
Structure, array of structures, Union, array of union, String operations. Dynamic Memory Allocation, Introduction to Pointer, basic programs for Pointer arithmetic.	
UNIT - V FILE HANDLING, ,PREPROCESSORAND COMMAND LINE ARGUMENTS	**9**
Introduction to File –Reading File content to display in console, writing console content to file, read the content from file to the writing to another file, overwriting and appending file, random access file handing, Preprocessor directives, basics programs for Command line arguments.	

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Makes students gain a broad perspective about the uses of computers in the engineering industry.
2.	Develops a basic understanding of computers, the concept of algorithm and algorithmic thinking.
3.	Develops the ability to analyze a problem, develop an algorithm to solve it.
4.	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
5.	Introduces the features of data structures in this C Programming language.

TEXT BOOK	
1.	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2.	Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, Third edition, 2006
3.	Robert Lafore, "Object-Oriented Programming in C++" Pearson Education India, Fourth Edition
REFERENCES	
1.	Let Us 'C' - Yashawant Kanetkar, (Unit-II to V), BPB publications, 10th Edition, 2010
2.	Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2008
WEB SOURCE REFERENCES	
3.	https://www.it.iitb.ac.in/lakshya/workshopContent.html?workshopid=FHf3Ht5njLv Vww7Tz3f8xg
4.	https://nptel.ac.in/courses/106104074

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1														
CO2														
CO3														
CO4														
CO5														

Course Code	Course Name	Semester	Credits	L T P C
	ENGINEERING GRAPHICS & DESIGN (Theory & Practical)	**2**		**2 0 2 3**

OBJECTIVES

- To introduce and develop the students towards the graphical skills for effective communication of concepts, ideas and design of engineering products.
- To make the students aware of existing national and international standards practiced in technical drawings, drafting and presentations.
- To introduce drafting software and its uses in design and detailing by using AutoCAD.

UNIT – I Introduction to Engineering Drawing **5**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT – II Orthographic Projections **5**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

UNIT – III Projections of Regular Solids **5**

Inclined to HP & VP - Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc

UNIT – IV Sections and Sectional Views of Right Angular Solids **5**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT – V Isometric Projections **5**

: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

UNIT – VI **5**

Overview of Computer Graphics-theory of CAD software-Drawing Area, Dialog boxes and windows- Different methods of zoom as used in CAD-Isometric Views of lines, Planes, Simple and compound Solids-Customisation & CAD Drawing-ISO and ANSI standards for coordinate dimensioning and tolerancing; dimensions to objects-various ways of drawing circles, Annotations, layering & other functions-Setting up and use of Layers, layers to create drawings-color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling-Introduction to Building Information Modelling (BIM)

LIST OF EXPERIMENTS

- Introduction to engineering design (CAD)
- Introduction to Auto CAD
- Introduction to BIM

1.	Drafting and modelling with co-ordinate systems
2.	Creation of a simple machined component
3.	Creation of title block
4.	Creation of orthographic views of a cone, cylinder and hexagon
5.	Creation of sectional views of a cone, cylinder and hexagon
6.	Creation of orthographic views
7.	Creation of isometric view of a V-block.
8.	Conversion of 3D to 2D drawings

9.	Creation of 3D solid machine component
10.	Creation of 3D solid V block
11.	Building plan of a simple office
12.	Building plan of a simple home
13.	Creation of simple steel truss

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Draw orthographic projections of lines, planes and solids
2.	Draw projections of solids including cylinder, prism and pyramid.
3.	Draw section of solids including cylinder, prisms and pyramids.
4.	Draw the development of surfaces including cylinder, pyramid and prism
5.	Draw projection of lines, planes, solids, orthographic projection, Isometric projection, and section of solids including cylinder, cone, prism, pyramid and building drawing using Auto CAD.
TEXT BOOK	
1.	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
2.	Shah, M.B. & Rana B.C. (2010), Engineering Drawing and Computer Graphics, Pearson Education.
REFERENCES	
1.	Agrawal B. & Agrawal C. M. (2017), Engineering Graphics, TMH Publishers.
2.	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
3.	AUTO CAD User Manual.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓	✓	✓								✓	✓
CO2	✓	✓	✓	✓	✓								✓	✓
CO3	✓	✓	✓	✓	✓								✓	✓
CO4	✓	✓	✓	✓	✓								✓	✓
CO5	✓	✓	✓	✓	✓								✓	✓

Course Code	Course Name	Semester	Credits	L T P C
	BASIC ELECTRICAL ENGINEERING LAB	2		0 0 2 2

COURSE OBJECTIVES

- To study the working of AC and DC drives.
- To measure the basic electrical parameters.
- To experimentally verify the networks theorems.
- To study the basic power conversion circuits.
- To study the working of basic electrical measuring instruments.

LIST OF EXPERIMENTS

1.	Study of Electric Motors (AC & DC Motors).
2.	Load Test on Single Phase Induction Motor.
3.	Load Test on Three Phase Induction Motor.
4.	Load Test on Single Phase Transformer.
5.	Load Test on Three Phase Alternator.
6.	Speed Control of DC Motor.
7.	Speed Control of Three Phase Induction Motor (Pole Changing Method).
8.	Study of Multi meter, CRO and LCR Meter.
9.	Measurement of Voltage, Current and Power.
10.	Verification of Kirchoff's Law.
11.	Verification of Thevenin's Theorem.
12.	B-H Curve of a Magnetic Material.
13.	Rectifier Circuit Analysis (AC – DC).
14.	Inverter Circuit Analysis (DC – AC).
15.	Chopper Circuit Analysis (DC – DC).
16.	Series and Parallel RLC Circuit Analysis.

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Study the various electrical parameters and the measuring instruments.
2.	Study the working of AC and DC drives.
3.	Design and experiment the various network theorems.
4.	Measure the power and power factor in AC circuit.
5.	Understand the three phases balanced and unbalanced supply.

TEXT BOOK

1.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2.	D. C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2009.

REFERENCES

1.	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2.	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3.	V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1														
CO2														
CO3														
CO4														
CO5														

Course Code	Course Name	Semester	Credits	L T P C
	PROGRAMMING FOR PROBLEM SOLVING LAB	**2**		**0 0 2 2**

COURSE OBJECTIVES

- The course aims to provide exposure to problem-solving through programming.
- To ensure that students begin to understand the fundamentals of Computer programming.
- To be able to effectively choose programming components to solve computing problems in real-world.
- To be able to formulate problems and implement in Computer programming.
- Learning the basic programming constructs them easily switch over to any other language in future.

LIST OF EXPERIMENTS

1.	Basic programs in data types.
2.	Problems in Decision making statements. a. Find the Biggest among 3 numbers. b. Find Even or odd. c. Arithmetic operations using Switch - Case Statements
3.	Problems in looping statements. a. Find the Sum of digits using (i) For loop (ii) While loop b. Generate the Fibonacci series c. Check whether the number is prime or not
4.	Matrix Manipulation-Addition, Subtraction and Multiplication
5.	String operations-string copy, string reverse, string concatenate
6.	Swapping of numbers using call by value, call by reference
7.	Find factorial using recursive functions
8.	Display the student information & marks using Structure & Unions
9.	Evaluate Expressions using library Function using C++ a. πr^2 b. (A+B+(2C/3A)+A2+2B) c. $\sqrt{S(S-A)\ (S-B)\ (S-C)}$ d. LOG $(x^3+y^3+z^3)$
10.	Numerical Methods-Quadratic Equation using C++
11.	Class and object
12.	To implement Constructor and Destructor
13.	To implement Inheritance.

CO	COURSE OUTCOMES	PO
Upon completion of this course, Students should be able to		
1.	Know the basic concepts in problem solving	**PO1, PO5**
2.	Demonstrate the algorithm and flow chart for the given problem	**PO2, PO4**
3.	Design and develop the program to evaluate simple expressions and logical operations.	**PO3**
4.	Write creative solutions using C &C++language	**PO3, PO4**
5.	Design and develop solutions to real world problems.	**PO5**

TEXT BOOK	
1.	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2.	Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, Third edition, 2006
3.	Robert Lafore, "Object-Oriented Programming in C++" Pearson Education India, Fourth Edition
REFERENCES	
1.	Let Us 'C' - Yashawant Kanetkar, (Unit-II to V), BPB publications, 10th Edition, 2010
2.	Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2008
3.	Venugopal.K and Kavichithra.C, "Computer Programming", New Age International Publishers, First Edition, 2007
4.	Kernighan B.W and Ritchie,D.M , The C programming language: second edition, Pearson education,2006

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1														
CO2														
CO3														
CO4														
CO5														

SEMESTER - III

Course Code	Course Name	Semester	Credits	L T P C
	MATHEMATICS – III (Probability and Statistics)	**3**		**3 1 0 4**

COURSE OBJECTIVES

- The objective of this course is to familiarize the students with statistical and probability techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

UNIT - I BASIC PROBABILITY **9**

Probability spaces, conditional probability, Independent random variables, sums of independent random variables, Bayes' Theorem,Discrete and Continuous one dimensional random variables - Expectations, Moments, Variance of a sum, Moment generating function, Tchebyshev's Inequality.

UNIT - II PROBABILITY DISTRIBUTIONS **9**

Discrete Distributions – Binomial, Poisson and Negative Binomial distributions, Continuous Distributions - Normal, Exponential and Gamma distributions.

UNIT - III BASIC STATISTICS **9**

Measures of Central tendency: Averages, mean, median, mode, Measures of dispersion – Range, Mean deviation, Quartile deviation and Standard deviation, Moments, skewness and Kurtosis, Correlation and regression – Rank correlation.

UNIT - IV APPLIED STATISTICS **9**

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

UNIT V SMALL SAMPLES **9**

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

CO	COURSE OUTCOMES
1.	Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
2.	How to derive the probability function of transformations of random variables and use these techniques to generate data from various distributions.
3.	How to calculate and apply measures of location and measures of dispersion in grouped and ungrouped data cases.
4.	Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.
5.	How to translate real-world problems into probability models. Also how to collect data, analyze and deduce information from a real time survey without any unwilling bias.

TEXT BOOKS	
1.	T. Veerarajan, "Probability, Statistics and Random Processes", Fourth edition, Tata McGraw-Hill, New Delhi, 2015.
2.	S.P. Gupta, "Statistical Methods, 46th Revised Edition, Sultan chand and sons", New Delhi, 2023.
3.	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2010.
4.	B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, 2024.
5.	S. Ross, "A First Course in Probability", 10th Ed., Pearson Education India, 2019.
6.	W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed.Wiley, 1968
7.	N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", 14th Edition, Laxmi Publications, Reprint, 2023.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	
CO2	√	√											√	
CO3	√	√		√			√				√		√	
CO4	√	√		√			√				√		√	
CO5	√	√		√			√				√		√	

Course Code	Course Name	Semester	Credits	L T P C
	ENGINEERING MECHANICS	3		3 0 0 3

COURSE OBJECTIVES

- To familiarize the basics laws of physics, vector operations and forces.
- To understand the principles of beams, supports and equilibrium of rigid bodies.
- To know the area and mass property calculations of various sections and solids.
- To study and analyse the dynamics of particles by various methods.
- To understand the applications of friction and rigid body dynamics.

UNIT-I STATICS OF PARTICLES **9**

Introduction – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces, Principle of transmissibility, Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Single equivalent force.

UNIT-II EQUILIBRIUM OF RIGID BODIES **9**

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 – Examples

UNIT-III PROPERTIES OF SURFACES AND SOLIDS **9**

Determination of Area and Volume – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moment of inertia.

UNIT-IV DYNAMICS OF PARTICLES **9**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse- Momentum principle – Impact of elastic bodies.

UNIT-V FRICTION AND RIGID BODY DYNAMICS **9**

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction-Ladder friction- Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of bodies.

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Get familiarized with the basic laws of physics, vector operations and forces.
2.	Understand the principles of beams, supports and equilibrium of rigid bodies.
3.	Calculate the area and mass properties of various sections and solids.
4.	Know about dynamics of particles and their analysis by various methods.
5.	Know about the applications of friction and rigid body dynamics.

TEXT BOOKS

1.	Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2007), 3rd Edition.
2.	Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, Tata McGraw-Hill International Edition, 2017, 11th edition

REFERENCES	
1.	Hibbeler, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2017).
2.	Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
3.	Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd.,(2008).
4.	Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).
5.	K.L. Kumar, "Engineering Mechanics" Tata McGraw-hill, 2017, 4th Edition
6.	S.S. Bhavikatti, " Engineering Mechanics", New Age International Publishers, 2006
7.	R. S. Khurmi, " Engineering Mechanics", S. Chand Publishers, 2018.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√	√		√								√	√
CO2	√	√	√		√								√	√
CO3	√	√	√		√								√	√
CO4	√	√	√		√								√	√
CO5	√	√	√		√								√	√

Course Code	Course Name	Semester	Credits	L T P C
	MATERIALS ENGINEERING	**3**	**3**	**3 0 0 3**

COURSE OBJECTIVES

- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams.
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

UNIT-I CRYSTAL STRUCTURE **9**

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

UNIT-II MECHANICAL PROPERTY MEASUREMENT **9**

Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, Introduction to nondestructive testing (NDT).

UNIT-III ALLOYS, SOLID SOLUTIONS AND PHASE DIAGRAMS **9**

Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-carbon phase diagram and microstructure aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV HEAT TREATMENT OF STEEL **9**

Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V METALS AND ALLOYS **9**

Introduction to Nano Materials Alloying of steel, properties of stainless steel and tool steels, maraging steels-cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminum and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys.

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Identify crystal structures for various materials and understand the defects in such structures.
2.	Understand how to tailor material properties of ferrous and non-ferrous alloys and how to quantify mechanical integrity and failure in materials
3.	Understand the micro structural aspects and phases of Fe-C systems.
4.	Understand the various heat treatment process.
5.	properties and applications of ferrous and non ferrous metals.

TEXT BOOKS

1.	W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2.	Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3.	V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 2004, 5th Edition.
4.	U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

REFERENCES	
1.	W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2.	Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3.	V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 2004, 5th Edition.
4.	U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√	√					√			√	√	√	√
CO2	√	√	√	√			√		√	√	√	√	√	√
CO3	√					√					√	√	√	√
CO4	√		√		√	√	√	√	√	√	√	√	√	√
CO5	√						√			√	√	√	√	√

Course Code	Course Name	Semester	Credits	L T P C
	ELECTRONIC DEVICES	3		3 0 2 4

COURSE OBJECTIVES

The course should enable the students:

- To know about semiconductor materials and their types.
- To design and construct diode circuits.
- To learn fundamentals of transistor and its variants.
- To study frequency response of amplifiers under small signal conditions.
- To understand construction and characteristics of JFET and MOSFET.

UNIT-I SEMICONDUCTOR MATERIALS **9**

Elemental & compound semiconductor materials , Bonding forces and Energy bands in intrinsic and extrinsic silicon, Charge carrier in semiconductors , carrier concentration, Junction properties, Equilibrium condition, biased junction, Steady state condition, breakdown mechanism (Rectifying Diodes, Zener Diodes), Metal Semiconductor Junction. Special diodes: Tunnel diodes, Varactor diodes, Schottky diode, Photo diodes, Photo detector, LED, Solar cell

UNIT-II DIODE CIRCUITS **9**

Ideal and Practical diode, Clipper, Clamper. Power Supply: Rectifiers-Half wave, Full wave, Bridge rectifier, filter circuits, Voltage regulation using shunt & series regulator circuits, Voltage regulation using IC 723

UNIT-III FUNDAMENTALS OF BJT **9**

Construction, basic operation, current components and equations, CB, CE and CC configuration, input and output characteristics, Early effect, Region of operations: active, cut-off and saturation region. BJT as an amplifier and switch - Photo transistor, Uni-junction Transistor (UJT) and Thyristors: UJT: Principle of operation, characteristics, UJT relaxation oscillator

UNIT-IV SMALL SIGNAL ANALYSIS **9**

Small signal Amplifier, Amplifier Bandwidth, Hybrid model, analysis of transistor amplifier using h-parameter, Multistage Amplifier: Cascading amplifier, Boot-strapping Technique, Darlington
amplifier and Cascode amplifier, Coupling methods in multistage amplifier, Low and high frequency response, Hybrid π model, Current Mirror circuits

UNIT-V FET CONSTRUCTION **9**

JFET Construction, n-channel and p-channel, transfer and drain characteristics, parameters, Equivalent model and voltage gain, analysis of FET in CG, CS and CD configuration. Enhancement and Depletion MOSFET drain and transfer Characteristics.
Integrated Circuit Fabrication Process: oxidation, diffusion, ion implantation, photolithography, etching, Chemical vapor deposition, sputtering, twin-tub CMOS process

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	Study of LabVIEW / Multisim / PSPICE / ELVIS
2.	CRO Operation and its Measurements.
3.	P-N Junction Diode Characteristics (Forward bias & Reverse bias)
4.	Zener Diode Characteristics a. Part A: V-I Characteristics b. Part B: Zener Diode act as a Voltage Regulator
5.	BJT Characteristics (CE Configuration) a. Part A: Input Characteristics b. Part B: Output Characteristics

6.	FET Characteristics (CS Configuration) a. Part A: Drain (Output) Characteristics b. Part B: Transfer Characteristics
7.	LED and PHOTO DIODE Characteristics
8.	SCR Characteristics
9.	UJT Characteristics
10.	Clipper and Clamper Circuits
11.	Design and Simulate basic Common Source / Common Gate / Common Drain Amplifier
12.	BJT- CE Amplifier
13.	FET- CS Amplifier

CO	COURSE OUTCOMES
On completion of the course, the student will be able to	
1.	Characterize the types of semiconductors.
2.	Design and construct circuits using various diodes.
3.	Design and construct circuits using BJT.
4.	Design and construct transistor amplifiers using h-parameters.
5.	Understand the characteristics of JFET and MOSFET.

TEXT BOOK	
1.	Donald .A. Neamen, "Electronic Circuit Analysis and Design" , 3 rd Edition, Tata Mc Graw Hill, 2019.
REFERENCES	
1.	Salivahanan, Kumar &Vallavaraj, "Electronic Devices and Circuits", 5 th Edition, Tata Mc Graw Hill, 2022.
2.	Theodore F. Bogart, Jeffrey S. Beasley, "Guillermo Rico Electronic Devices & Circuits", 6 th Edition,PHI, 2014.
3.	Millman & Halkias, "Electronic Devices and Circuits", 4 th Edition, Tata Mc Graw Hill, 2015.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓									✓			
CO2	✓	✓	✓	✓							✓	✓		✓
CO3	✓	✓		✓							✓	✓		✓
CO4	✓	✓	✓	✓							✓	✓	✓	✓
CO5	✓	✓									✓			✓

Course Code	Course Name	Semester	Credits	L T P C
	DIGITAL ELECTRONICS	3		3 0 2 4

COURSE OBJECTIVES

Course Objectives:

The course should enable the students -

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions.
- To introduce the methods for simplifying Boolean expressions.
- To outline the formal procedures for the analysis and design of combinational circuits and Sequential circuits.
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits.

UNIT-I MINIMIZATION TECHNIQUES AND LOGIC GATES **9**

Minimization Techniques: Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions –– Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions –Quine- McCluskey method of minimization.

Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND –NOR implementations – Multilevel gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates.

UNIT-II COMBINATIONAL CIRCUITS **9**

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer - decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator

UNIT-III SEQUENTIAL CIRCUITS **9**

Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation – Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment -Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators

UNIT-IV MEMORY DEVICES **9**

Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell – Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL.

UNIT-V SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Synchronous Sequential Circuits**:** General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits**:** Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG

LIST OF EXPERIMENTS FOR LABORATORY COURSE	
1.	Study of Multisim and LT spice.
2.	Study of Gates & Flip-flops.
3.	Half Adder and Full Adder.
4.	Encoders and Decoders.
5.	Multiplexer and De-multiplexer.
6.	Magnitude Comparator (2-Bit) and Code Converter.
7.	Synchronous Counters.
8.	Ripple Counter and Mod–N Counter.
9.	Shift Register–SISO/SIPO/PIPO/PISO
10.	Design of Memory Devices
11.	Design of Hazard Free Switching circuits.
12.	Design of Mealy and Moore Circuits

CO	COURSE OUTCOMES
On completion of the course, the student will be able to	
1.	Explain the basic theorems and properties of Boolean algebra .
2.	Utilize K- Map for gate level minimization of the given Boolean function.
3.	Construct combinational logic circuits for the given requirement and determine their performance.
4.	Illustrate the Classifications of memories and programmable logic devices.
5.	Design synchronous and asynchronous sequential circuits using VERILOG.

TEXT BOOK	
1.	M. Morris Mano, "Digital Design", 6e, Prentice Hall of India Pvt. Ltd.,2018/PearsonEducation (Singapore) Pvt. Ltd., New Delhi.

REFERENCES	
1.	John F.Wakerly, "Digital Design", Fifth Edition, Pearson/PHI, 2021.
2.	John Yarb rough, "Digital Logic Applications and Design", Thomson Learning, 2016.
3.	Charles H.Roth. "Fundamentals of Logic Design", 7th Edition, Thomson Learning, 2015.
4.	Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 8th Edition, TMH, 2015.
5.	Thomas L. Floyd, "Digital Fundamentals", 13th Edition, Pearson Education Inc, 2024.
6.	Donald D.Givone, "Digital Principles and Design", TMH, 2003.
7.	A.Ananda Kumar, Fundamentals of digital circuits, 4 th edition, PHI learning private Limited, 2016.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓	✓							✓	✓		✓
CO2	✓	✓	✓	✓	✓						✓	✓		✓
CO3	✓	✓	✓	✓	✓						✓	✓		✓
CO4	✓	✓	✓	✓	✓							✓		✓
CO5	✓	✓	✓	✓	✓							✓		✓

Course Code	Course Name	Semester	Credits	L T P C
	PROGRAMMING USING PYTHON LAB	**3**		**1 0 2 2**

COURSE OBJECTIVES

- Learn the syntax and semantics of the Python programming language
- Illustrate the process of structuring the data using lists, tuples and dictionaries.
- Demonstrate the use of file operations and searching pattern
- Interpret the concepts of Object-Oriented Programming as used in Python
- Appraise the need for working with various documents like Excel, PDF, Word and others file formats.

LIST OF EXPERIMENTS

1.	**Calculation of Test Average:** Write a python program to find the best of two test average marks out of three test's marks accepted from the user.
2.	**Palindrome Check & Digit Occurrence Count:** Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.
3.	**Fibonacci sequence:** Defined as a function F as Fn = Fn-1 + Fn-2. Write a Python program which accepts a value for N (where N >0) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed.
4.	**Binary to Decimal & Octal to Hexadecimal Conversion:** Develop a python program to convert binary to decimal, octal to hexadecimal using functions.
5.	**Sentence Statistics:** Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.
6.	**String Similarity:** Write a Python program to find the string similarity between two given strings.
7.	**Insertion Sort & Merge Sort on lists:** Write a python program to implement insertion sort and merge sort using lists.
8.	**Check Phone Number:** Write a function called isphonenumber () to recognize a pattern 415-555-4242 without using regular expression and also write the code to recognize the same pattern using regular expression.
9.	**Search Phone Number & Email:** Develop a python program that could search the text in a file for phone numbers (+919900889977) and email addresses (sample@gmail.com)
10.	**File Operations:** Write a python program to accept a file name from the user and perform the following operations 1. Display the first N line of the file 2. Find the frequency of occurrence of the word accepted from the user in the file
11.	**Zip operation on a folder:** Develop a program to backing up a given Folder (Folder in a current working directory) into a ZIP File by using relevant modules and suitable methods.
12.	**Inheritance:** By using the concept of inheritance write a python program to find the area of triangle, circle and rectangle.
13.	**Employee Details:** Write a python program by creating a class called Employee to store the details of Name, Employee_ID, Department and Salary, and implement a method to update salary of employees belonging to a given department.
14.	**Polymorphism and Inheritance:** Write a python program to find the whether the given input is palindrome or not (for both string and integer) using the concept of polymorphism and inheritance.
15.	**Spreadsheet Operations:** Demonstrate python program to read the data from the spreadsheet and write the data in to the spreadsheet
16.	**Merge selected pages from Multiple PDFs to a new PDF:** Write a python program to combine select pages from many PDFs
17.	**Fetch weather data from the JSON:** Write a python program to fetch current weather data from the JSON file

CO	COURSE OUTCOMES
At the end of the course the student will be able to:	
1.	Understand Python syntax and semantics and be fluent in the use of Python flow control and Functions
2.	Develop, run and manipulate Python programs using Core data structures like Lists, Dictionaries, and use of Strings Handling methods.
3.	Develop, run and manipulate Python programs using File Operations and searching pattern using regular expressions.
4.	Interpret the concepts of object oriented programming using Python.
5.	Determine the need for scraping websites and working with CSV, JSON and other file formats.
REFERENCES	
1.	https://moodle.sit.ac.in/blog/python-programming-laboratory-21csl46/

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√	√		√							√	√	
CO2	√	√	√		√							√	√	
CO3	√	√	√		√							√	√	
CO4	√	√	√		√							√	√	
CO5	√	√	√		√							√	√	

SEMESTER - IV

Course Code	Course Name	Semester	Credits	L T P C
	SOLID AND FLUID MECHANICS	4		3 0 2 4

COURSE OBJECTIVES

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

- To provide knowledge about stress distribution and strains in regular and composite structures subjected to axial loads
- To give input on shear force, bending moment diagrams and evaluate the bending stress in different beams under transverse loading
- To provide awareness on stresses on shafts and helical springs based on theory of torsion.
- To provide fundamental knowledge of fluids and its properties
- To apply the basic knowledge of fluid mechanics to real-world problems.

UNIT - I STRESS, STRAIN AND DEFORMATION OF SOLIDS **9**

Concept of stress - strain, Hooke's law, Tension, compression and shear, stress - strain diagram, Poisson's relation, volumetric strain, Elastic constants and their relation. Stress in simple and composite bars subjected to axial loading and temperature.

UNIT - II TRANSVERSE LOADING ON BEAMS, SHEAR FORCE AND BENDING MOMENT **9**

Types of Beams, Transverse loading on beams shear force and Bending moment in beams- cantilever, simply supported, overhanging beam subjected to concentrated load and UDL - maximum bending moment and point of contra flexure. Theory of simple bending and assumption.

UNIT - III TORSION **9**

Theory of torsion and assumption - Torsion of circular shafts, solid & hollow - strain energy in torsion. Power transmission, strength and stiffness of shafts.

UNIT - IV FLUID STATICS AND DYNAMICS **9**

Fluid - Properties of fluids, Pascal's Law, Hydrostatic Law, Pressure and its variation in astatic Fluid, Measurement of static fluid pressure: Manometers, hydrostatic pressure concept and distribution on plane surfaces. Continuity equation, Euler equations, Bernoulli's equations, Momentum equation - applications.

UNIT- V FLUID KINEMATICS, FLUID FLOW AND FLUID MACHINERY **9**

Fluid Kinematics, Types of flow, Velocity field and acceleration.
Fluid flow, Flow through pipes, Darcy-Weisbach equation, Friction factor, Major and Minor losses.
Turbines and pumps - classification and working principle.(Qualitative approach only).

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	Tensile test on MS rod and twisted bar (Electronic UTM)
2.	Comparison of hardness value of steel, copper and aluminium using Rockwell and Brinell hardness measuring machines
3.	Estimation of notch toughness of steel using impact testing machine
4.	Estimation of spring constant under tension and compression
5.	Tension test on MS wire (Tensile Testing Machine)
6.	Torsion test on mild steel rod.
7.	Deflection Test on Steel and Wooden Beam
8.	Experimental Study of Bernoulli's Theorem
9.	Calibration of orifice meter, nozzle & Venturi Meter
10.	Flow through pipes and losses in pipes
11.	Flow through Notches

12.	Buoyancy experiment – Meta centric height
13.	Performance Characteristics of Centrifugal pump
14.	Performance Characteristics of Jet pump
15.	Performance Characteristics of Gear pump
16.	Performance Characteristics of Francis pump
CO	**COURSE OUTCOMES**
Upon completion of this course, Students should be able to	
1.	Find the stress distribution and strains in regular and composite structures subjected to axial loads
2.	Assess the shear force, bending moment and bending stresses in beams under transverse loading
3.	Apply torsion equation in design of circular shafts and helical springs
4.	Applying the fundamental laws of fluid statics and derive the fluid flow equations.
5.	Derive the equation for flow through pipes. Select a suitable pump and turbine for a given application and evaluate the operating characteristics of hydraulic pumps and turbines.
TEXT BOOKS	
1.	Ramamrutham S. and Narayanan .R. Strength of material, Dhanpat Rai Pvt. Ltd., New Delhi, 2001
2.	Bansal.R.K.StrengthofMaterial,LakshmipublicationsPvt.Ltd.,NewDelhi,1996
3.	Kumar .K.L., Engineering Fluid Mechanics, Eurasla publishers Home Ltd., New Delhi, 1995
4.	Bansal .R.K Fluid Mechanics and Hydraulic Machines Laxmi publications (P) Ltd., New Delhi, 1995
REFERENCES	
1.	Popov.E.P., Mechanics of Materials, Prentice Hall, 1982
2.	Timoshenko .S.P and Gere M.J., Mechanics of Materials, C.B.S. publishers,
3.	Ferdinand P. Beer and Russell Johnston. E Mechanics of Materials SI metric Edition McGraw Hill, 1992
4.	Srinath L.N. Advanced Mechanics of Solids Tata McGraw Hill Ltd., New Delhi
5.	Ramamrutham.S. Fluid Mechanics and Hydraulics Dhanpat Rai and Sons, Delhi.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓			✓	✓	✓					✓	
CO2	✓	✓	✓			✓	✓	✓					✓	
CO3	✓	✓	✓			✓	✓	✓					✓	
CO4	✓	✓	✓			✓	✓	✓					✓	
CO5	✓	✓	✓			✓		✓		✓			✓	

Course Code	Course Name	Semester	Credits	L T P C
	THERMAL ENGINEERING	4		3 0 2 4

COURSE OBJECTIVES

The course should enable the students to:

- To learn and apply the basic concepts & laws of thermodynamics
- To analyse the different gas power cycles & to understand the various systems of I.C. Engines
- To apply the concept of thermodynamics to steam Nozzle & steam turbines
- To analyze the performance of reciprocating air compressors
- To apply the concepts of thermodynamics to refrigeration & Air conditioning

UNIT- I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS **9**

Systems and control volume, properties of a system, state and equilibrium, quasi-static equilibrium, processes and cycles, forms of energy, pressure, work and heat transfer, temperature and the Zeroth law of thermodynamics.

First law of thermodynamics - application to closed and open systems – Statements of second law and its corollaries – Carnot theorem - Carnot cycle & Reversed Carnot cycle - Clausius inequality. Concept of entropy.

UNIT–II GAS POWER CYCLES AND I.C. ENGINES **9**

Air Standard Cycles - Otto, Diesel, Dual & Brayton cycle (Basic)- –Performance Calculations.

I.C. Engines Classification – Components and their function - Working Principle of four stroke and two stroke engines, Valve timing & port timing diagram. Simple Carburettor, Diesel pump and injector system - Ignition System, Lubrication and Cooling systems.

UNIT-III STEAM NOZZLES AND STEAM TURBINES **9**

Steam Nozzles – One-dimensional steady flow of steam through a convergent and divergent nozzle – Metastable flow.

Impulse and Reaction turbine Principles - Compounding – Types – Performance - Speed regulations – Governors.

UNIT- IV AIR COMPRESSORS **9**

Reciprocating Air Compressors – Classifications - Working principle – work done - Effect of clearance volume - Single and multi-stage compressors, Volumetric efficiency – calculation of power requirement – Rotary compressors (Working Principle).

UNIT V REFRIGERATION AND AIR CONDITIONING **9**

Refrigeration cycles- Reversed Carnot – Bell Coleman cycle - Vapour compression system –Super heating/Sub cooling - Vapour absorption refrigeration system- Properties of refrigerants. – Simple Problems on VCR system Principles of air-conditioning - Types of air-conditioning system and its working principles - Concept of GSHF – RSHF – ESHF.

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	Performance test on single stage reciprocating Air Compressor.
2.	Performance test on constant speed centrifugal air blower
3.	Valve timing diagram on four stroke petrol engine
4.	Port timing diagram on two stroke petrol engine
5.	Load test on single cylinder diesel engine with mechanical loading
6.	Performance test on high-speed diesel engine with alternator loading
7.	Testing of fuels and lubricants using saybolt and redwood apparatus
8.	Flash and fire point of fuels and lubricating oil

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Apply the first law of thermodynamics for simple open and closed systems and second law of thermodynamics.
2.	Explain the functioning & features of I.C. Engines & analyse & solve the problems of air standard cycles.
3.	Analyse the problems of steam nozzles and steam turbines.
4.	Analyse the performance behaviour of single & multi stage reciprocating air compressors.
5.	Understand the different Refrigeration & A/C systems and solve the problems of VCR system.
TEXT BOOKS	
1.	Nag. P. K., "Engineering Thermodynamics", 6th edition, Tata McGraw-Hill, New Delhi, 2017.
2.	Kothandaraman.C.P.,Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons, 2016.
3.	Rajput. R. K., "Thermal Engineering" S. Chand Publishers, 2017.
REFERENCES	
1.	Arora.C.P, "Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 2017
2.	Ganesan V," Internal Combustion Engines",3rd Edition, Tata McGraw-Hill 2017
3.	Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi,2003
4.	Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
5.	P. L. Ballaney, Thermal Engineering, Khanna Publishers, 2007, 24th Edition.
6.	Dr. K.S. Yadav, "Applied Thermodynamics", Vayu Education of India, 2012, 1st Edition.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓			✓						✓	✓	
CO2	✓	✓	✓									✓	✓	
CO3	✓	✓	✓	✓			✓					✓	✓	
CO4	✓	✓	✓	✓			✓					✓	✓	
CO5	✓	✓	✓	✓			✓					✓	✓	

Course Code	Course Name	Semester	Credits	L T P C
	MANUFACTURING TECHNOLOGY FOR MECHATRONICS	4		3 0 2 4

COURSE OBJECTIVES

The course should enable the students to:

- Concept of casting Technology
- Study the various ways of working of metals
- Concept of Machining with lathes and automats
- Various Surface finishing and Gear manufacturing processes
- Study of Milling machine, Shaper, Planer and Slotting processes

UNIT - I CASTING AND WELDING 9

Introduction to casting, Patterns, Types, Pattern materials, Allowances - Moulding - types- Moulding sand, Cores &Core making. Special Casting Process- Shell Investment, Die casting, Centrifugal Casting. Special welding- Laser, Electron Beam, Ultrasonic, Friction welding.

UNIT - II MECHANICAL WORKING OF METALS 9

Hot and Cold Working: Rolling, Forging, Wire Drawing, Extrusion- types- Forward and backward extrusion. Sheet Metal Operations: Blanking, Piercing, Punching, Trimming, Stretch forming, Bending- Embossing and coining, Types of dies: Progressive, compound and combination dies.

UNIT - III THEORY OF METAL CUTTING 9

Orthogonal and oblique cutting- Classification of cutting tools: single, multipoint - Mechanics of orthogonal cutting - Shear angle and its significance - Chip formation-Cutting tool materials- Tool wear and tool life - Machinability - Cutting Fluids- Simple problems.

UNIT - IV GEAR MANUFACTURING AND SURFACE FINISHING PROCESS 9

Gear manufacturing processes: Gear Machining: Forming. Gear generating process- Gear shaping, Gear hobbing. Grinding process, various types of grinding machine, Grinding Wheel- types - dressing and truing. Fine Finishing- Lapping, Buffing, Honing, and Super finishing.

UNIT - V MACHINE TOOLS 9

Milling Machine - specification, Types, Types of cutters, operations, Indexing methods- simple problems. Shaping, Planning and Slotting Machine- description, Operations, Work and tool holding Devices.

LIST OF EXPERIMENTS FOR LABORATORY COURSE

1.	Study of lathe – types – accessories – capabilities and process – specification
2.	Lathe operation – plain & step turning, taper turning, grooving and under cutting, knurling, thread cutting (single, multistart and internal), eccentric turning
3.	Machining of plane and inclined surfaces, grooving, dovetail cutting using shaping machine.
4.	Cutting of spur, helical, bevel gear and milling of polygon surface using milling machine.
5.	Making of helical gear using gear Hobbing machine.
6.	Cutting of keyway (internal & external) using slotting machine
7.	Exercises involving cylindrical grinder
8.	Exercises involving surface grinder

CO	COURSE OUTCOMES
At the end of the course the student should be able to	
1.	Learn the process of metal casting.
2.	Understand different sheet metal operations.
3.	Explain the concept of different metal forming operations.
4.	Discuss the mechanism of metal cutting and different forces acting on the tools.
5.	Explain the different gear manufacturing processes and gear finishing operations.
6.	Understand the different advance manufacturing processes and their applications.
TEXT BOOKS	
1.	Sharma, P.C., A textbook of Production Technology - Vol I and II, S. Chand & Company Ltd., New Delhi, 1996.
2.	Rao, P.N., Manufacturing Technology, Vol I & II, Tata McGraw Hill Publishing Co., New Delhi, 1998.
REFERENCE BOOKS	
1.	Chapman W. A. J., Workshop Technology Vol. I and II, Arnold Publisher, New Delhi, 1998
2.	HajraChoudhary, S. K. and HajraChoudhary, A. K., Elements of Manufacturing Technology, Vol II, Media Publishers, Bombay, 1988
3.	Jain. R. K., Production Technology, Khanna Publishers, New Delhi, 1988
4.	Kalpakjian, Manufacturing and Technology, Addison Wesley Longman Pvt., Singapore, 2000
5.	Kalpakjian, Manufacturing Engineering and Technology, Addison Wesley Longman Pvt., Singapore, 2000

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	
CO4	✓	✓	✓	✓	✓						✓	✓	✓	
CO5	✓	✓	✓	✓	✓						✓	✓	✓	
CO6	✓	✓	✓	✓	✓	✓					✓	✓	✓	

Course Code	Course Name	Semester	Credits	L T P C
	INDUSTRIAL INSTRUMENTATION	4		3 0 0 3

COURSE OBJECTIVES

The course will enable the students to:

- Have an idea about the temperature standards, calibration, thermocouples; signal conditioning used in RTD's and pyrometer techniques.
- Learn about Tachometer, Load cells, Torque meter and various densitometers.
- Have an adequate knowledge about pressure transducers.
- Understand about various types of flow meters and their installation.
- Have sound knowledge about various types of viscometers, level measurements, humidity and moisture measurements adopted in industrial environment

UNIT - I MEASUREMENT OF TEMPERATURE 9

Temperature scales, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistor, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT - II MEASUREMENT OF PRESSURE 9

Manometers – different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, thermocouple gauge, ionization gauge, Differential pressure transmitter - electrical & pneumatic types.

UNIT - III MEASUREMENT OF FLOW, LEVEL 9

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Positive displacement meter, turbine flowmeter, electromagnetic flow meter, ultrasonic flow meter, open channel flow measurement, solid flow measurement. Sight glass, float gauge, displacer, torque tube, bubbler tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type,capacitance type, ultrasonic level gauging.

UNIT - IV MEASUREMENTOFSPEED,FORCE,TORQUE, ACCELERATION 9

Measurement of speed- Revolution counter, Drag cup tachometer, AC and DC tachogenerators, photo electric pickup. Measurement of force - Load cell, pneumatic load cell, hydraulic load cell. Measurement of Torque using strain gauges and magneto elastic principle, Measurement of acceleration - Elementary accelerometers, seismic accelerometers, practical accelerometers, calibration.

UNIT - V MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY 9

Hydrometer – continuous weight measurement, liquid densitometer – float principle, air pressure balanced method, using gamma rays – gas density measurements – gas specific gravity measurements – Viscosity terms, saybolt viscometer, rotometer type viscometer, and Industrial consistency meters. Humidity terms – dry & wet bulb psychrometers – hot wire electrode type hygrometer, electrolytic hygrometer, Dew point hygrometer.

CO	COURSE OUTCOMES
At the end of the course, the students should be able to	
1.	Understand the various techniques used for the measurement of industrial parameters.
2.	Explain the design and working of various instruments.
3.	Understand the installation techniques of various systems.
4.	Understand the concept of various transducers used in industries.
5.	Work with signal conditioning circuit of various measuring equipments.

TEXT BOOKS	
1.	D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill, 3rd Edition, New Delhi, Reprint 2017.
2.	S. K. Singh, "Industrial Instrumentation & Control" 3rd Edition, Tata McGraw Hill, Reprint 2009.
3.	K.Krishnaswamy&S.Vijayachitra, "Industrial Instrumentation" New age International, Reprint 2019.
REFERENCES	
1.	Ernest O. Doeblin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 7th Edition,2019.
2.	R.K.Jain,"Mechanical&IndustrialMeasurements",KhannaPublishers,11thEdition,2004.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	
CO2	✓	✓	✓	✓									✓	
CO3	✓		✓		✓	✓	✓						✓	
CO4	✓			✓						✓			✓	
CO5							✓	✓	✓	✓	✓	✓	✓	

Course Code	Course Name	Semester	Credits	L T P C
	SENSORS AND ACTUATORS	4		3 0 0 3

COURSE OBJECTIVES

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

- Acquire knowledge about the principles and analysis of sensors.
- Emphasis on characteristics and response of micro sensors.
- Acquire adequate knowledge of different transducers and Actuators.
- Learn about the Micro sensors and Micro actuators.

Selection of sensor materials for fabrication for different applications

UNIT - I SENSORS **9**

Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy,impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details,characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

UNIT- II INDUCTIVE & CAPACITIVE TRANSDUCER **9**

Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn.

Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications:- capacitormicrophone, capacitive pressure sensor, proximity sensor.

UNIT - III ACTUATORS **9**

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator

UNIT - IV MICRO SENSORS AND MICRO ACTUATORS **9**

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles

UNIT - V SENSOR MATERIALS AND PROCESSING TECHNIQUES **9**

Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process

CO	COURSE OUTCOMES
The students should be able to	
1.	Analyze the basics and design the resistive sensors.
2.	Identify the materials and designing of inductive and Capacitive Sensors.
3.	Analyze various types of Actuators.
4.	Design Micro sensors and Micro Actuators for various applications.
5.	Implement fabrication process and technologies and compare various Micro machining processes.

TEXT BOOKS	
1.	Patranabis.D, ”Sensors and Transducers”, Second Edition, PHI Learning Private Limited, 2004.
2.	SergejFatikow and Ulrich Rembold, “Microsystem Technology and Microbotics”, First edition, Springer –VerlagNEwyork, Inc, 1997.
3.	Jacob Fraden, “Handbook of Modern Sensors: Physics, Designs and Application” Fifth edition, Springer, 2016.
REFERENCES	
1.	Robert H.Bishop,“The Mechatronics HandBook”, Second edition, CRC Press, 2008.
2.	Thomas.G.Bekwithand Lewis Buck.N, “Mechanical Measurements”, Oxfordand IBH publishing Co. Pvt. Ltd., 2010.
3.	Massood Tabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, First edition, Kluwer academic publishers, Springer, 1997.
4.	Manfred Kohl, ”Shape Memory Actuators”, first edition, Springer, 2004.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓	✓										✓	
CO2	✓		✓			✓	✓	✓	✓	✓			✓	
CO3	✓		✓			✓	✓	✓	✓	✓			✓	
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO5	✓	✓	✓					✓	✓		✓		✓	

Course Code	Course Name	Semester	Credits	L T P C
	PROGRAMMING USING MATLAB	**4**		**1 0 2 2**

COURSE OBJECTIVES

- Gaining a solid foundation in MATLAB programming and its applications in Solid Mechanics
- Gaining a solid foundation in MATLAB programming and its applications in Heat Transfer
- Gaining a solid foundation in MATLAB programming and its applications in Control Systems
- Gaining a solid foundation in MATLAB programming and its applications in Vehicle Dynamics
- Gaining a solid foundation in MATLAB programming and its applications in Automatic Transmission Simulation

LIST OF EXPERIMENTS

1.	To understand variables, arrays, matrices, and their operations
2.	To Learning about scripts, functions, loops, conditional statements, and control flow
3.	To solve linear and nonlinear equations using MATLAB
4.	To solving linear systems, Gaussian elimination, eigenvalues, and eigenvectors.
5.	Applying statistical methods for data analysis, including descriptive statistics, regression analysis, and hypothesis testing.
6.	Creating various types of plots (2D and 3D) to visualize data and results.
7.	Using MATLAB for simulation and modeling of mechanical systems and processes
8.	Modelling and simulating the behaviour of structures using MATLAB
9.	Analyzing heat transfer phenomena and solving heat transfer equations using MATLAB
10.	Designing and simulating control systems using MATLAB and Simulink
11.	Modelling and analyzing the dynamics of vehicles using MATLAB
12.	Coding and evaluating the performance of an automatic transmission in MATLAB

CO	COURSE OUTCOMES
Upon completion of this course, Students should be able to	
1.	Being able to implement various programming concepts in Solid Mechanics using MATLAB.
2.	Being able to implement various programming concepts in Heat Transfer using MATLAB.
3.	Being able to implement various programming concepts in Control Systems using MATLAB.
4.	Being able to implement various programming concepts in Vehicle Dynamics using MATLAB.
5.	Being able to implement various programming concepts in Automatic Transmission Simulation using MATLAB.

TEXT BOOKS

1.	S. J. Chapman, "MATLAB Programming for Engineers", 7 th edition, Cengage Learning, 2024.
2.	D. J. Higham and N. J. Higham, "MATLAB Guide", third edition, SIAM, 2017.
3.	A. Gilat, "MATLAB: An introduction with Applications", 6th Edition, John Wiley and Sons, 2024
4.	D. Houcque. Applications of MATLAB: Ordinary Differential Equations. Internal communication, Northwestern University, pages 1–12, 2005.

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√	√		√							√	√	
CO2	√	√	√		√							√	√	
CO3	√	√	√		√							√	√	
CO4	√	√	√		√							√	√	
CO5	√	√	√		√							√	√	